Biosolids Energy and Emissions Plan

Executive Summary

The Encina Wastewater Authority (EWA) has undertaken a Biosolids Energy and Emissions (BEE) Plan that will be used to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan. The BEE Plan has several goals:

- Provide a comprehensive analysis of all project elements including biosolids treatment, biogas use, energy generation, and waste heat
- Address capacity limitations in the solids handling process at the Encina Water Pollution Control Facility (EWPCF)
- Assess which alternative is likely to be the most cost-effective and sustainable solution for EWA
- Move EWPCF toward lower energy costs, rate stability, and greater overall sustainability
- Reduce greenhouse gas emissions

As part of the BEE Plan, the Brown and Caldwell (BC) team performed an extensive technology and alternatives analysis which is documented in a series of eight technical memoranda. Major decisions were made, including technology selection and narrowing of alternatives, in a series of workshops with EWA staff. Table ES-1 includes a list of these ten technical memoranda.

	Table ES-1. Summary of BEE Technical Memoranda					
TM 1	Baseline Energy Profiles and Projections					
TM 2	Technology Evaluations for Biosolids Handling					
TM 3	Technology Evaluations for Alternative Power Production					
TM 4	Technology Evaluations for Biogas Production					
TM 5	Technology Evaluations for Waste Heat					
TM 6	Air Emissions					
TM 7	Alternatives Development, Evaluation, and Selection					
TM 8	IM 8 Grant Incentive Programs Summary					
TM 9	High Strength Waste Feasibility Study					
TM 9.1	Encina Renewable Natural-gas Injection Feasibility Study					

BEE Process

The process began with an evaluation and selection of technologies for solids processing and energy generation. The technologies selected are presented in Table ES-2. These technologies were subjected to a fatal flaw screening process and evaluated for the following fatal flaw criteria:

• There must be at least one full-scale installation of the technology at a wastewater treatment plant (WWTP) in North America



- There must be at least one successful installation of the technology at a facility of similar size to EWPCF to ensure compatibility
- The technology must be accommodated within EWPCF's limited available footprint
- The technology must be capable of being integrated into the existing treatment infra-structure

If a given technology failed any of the fatal flaw criteria, it did not proceed to the next round of evaluation.

	Table ES-2. Evaluation and Selection of Technologies forSolids Processing and Energy and Heath Utilization							
	Solids Processi	ng Technologies	Energy and Heat Utilization					
Thickening	Stabilization	Dewatering	Post Digestion	Digestion Biogas Energy Treatment Generation		Waste Heat Utilization		
Primary clarifier	Mesophilic anaerobic digestion	Centrifuge	Direct drum drying	Biogas upgrading	Internal combustion engines	Small-scale steam turbines		
Dissolved air floatation	Mesophilic high- solids digestion	Belt filter press	Indirect drying	Gas conditioning	Microturbines	Thermophilic digestion or thermal hydrolysis process		
Rotary drum	Staged mesophilic anaerobic digestion	Screw press	Solar drying	Exhaust treatment	Direct use of biogas in drying	Adsorption and absorption chillers		
	Acid-gas phase digestion	Rotary press	Gasification	WAS pretreatment	Fuel cells	Organic Rankine cycle		
	Thermophilic anaerobic digestion	Volute press	Pyrolysis	Increased co- digestion	Energy storage (batteries)	Gasification of biosolids		
	Temperature- phased anaerobic digestion	Bucher press	Incineration		Large-scale photovoltaics			
	Thermal hydrolysis process		Deep-well injection		Small-scale photovoltaics			
	Enzymatic hydrolysis		Dehydration		Wind turbines			
	Thermo-chemical hydrolysis				Direct sale to adjacent power plant			
	Lystek				Net energy metering			

Technologies in blue were considered in the end-to-end alternatives.

Following the fatal flaw evaluation, technologies were scored and ranked for a series of criteria developed with EWA. While some criteria overlap, unique criteria were developed for the solids and energy related technologies. Technologies were ranked on a scale of 1 to 5, with scoring performed in a workshop setting. Those with an aggregate score of under 3 were eliminated from further analysis. Those technologies that were used in the formation of end-to-end alternatives are



presented in bold in Table ES-3; alternatives that are not presented in bold were eliminated from further consideration.

Table ES-3. End to End Technology Screening and Ranking						
Criterion	Description	Scoring Description	Weight			
Proven Technology Performance	Proven and reliable technology with same configuration intended at Encina. Long successful operating track record.	Low score indicates no successful large-scale operating installations in North America or Europe, no successful demonstration scale installations in North America or Europe, and unknown safety or reliability record.				
		High score indicates more than one successful operating installation in North America or Europe, more than one operating installation at a WWTP of at least 40 mgd in North America or Europe, track record duration > 5 years, and vendors in western USA.	20%			
Minimize Life-Cycle Costs	Qualitative metric of program cost. Capital and O&M costs based on existing EWA data or similar experience at other WWTPs. Potential revenues from sales.	Low score indicates high capital cost to build onsite facilities, high O&M costs, and low energy recovery efficiency. High score indicates low capital cost to build onsite facilities, low O&M costs, and potential revenue.	10%			
Energy/Resource Recovery	Recovery of renewable energy.	Low score indicates high energy requirement for onsite technology, technology does not recover, and low efficiency recovery of renewable energy. High score indicates a higher electrical efficiency.	25%			
O&M Impacts	Impacts to existing plant O&M staff levels. Complexity of new technology O&M and control systems.	Low score indicates more O&M time required, complex mechanical and control systems required compared with existing plant facilities, potential equipment downtime, and newer hazards. High score indicates reduction in O&M staff time	10%			
	Reliability of new technology (potential downtime). Minimal impacts to plant safety.	required, new technology is simple to operate and maintain, reliable with minimal downtime, and no new hazards.				
F	Impacts to carbon footprint and air	Low score indicates high carbon footprint for technology, and new permitting for environmental regulatory requirements.	4 5 0/			
Environmental Impacts	permitting.	High score indicates low carbon footprint for technology, reduced pollutant emissions, no additional permitting for environmental regulatory requirements.	15%			
Community & Stakeholder	Minimize nuisance impacts such as dust, odors, vectors, aesthetics, noise and traffic.	Low score indicates nuisance factors for on-site technology are difficult to mitigate.	10%			
Impacts	Assess impacts to partner agency issues/values as well as local planning codes and requirements.	High score indicates nuisance factors can be mitigated at plant site.	10%			
Project Site Compatibility	Assess compatibility of technology with available plant footprint.	Low score indicates lack of site space for new facilities, requires abandonment of existing facilities, and difficult integration with existing plant.	10%			
	Incorporation into existing treatment process.	High score indicates available footprint for new facilities and maintains space for future facilities, ease of integration with existing processes and facilities.	10 /0			



The BC team then worked with EWA to create over 48 end-to-end alternatives, which evaluated the solids process from thickening to final disposition, as well as assessing biogas treatment and beneficial use. Figure ES-1 shows how the technologies that passed the evaluation scoring criteria were combined to create end-to-end alternatives.

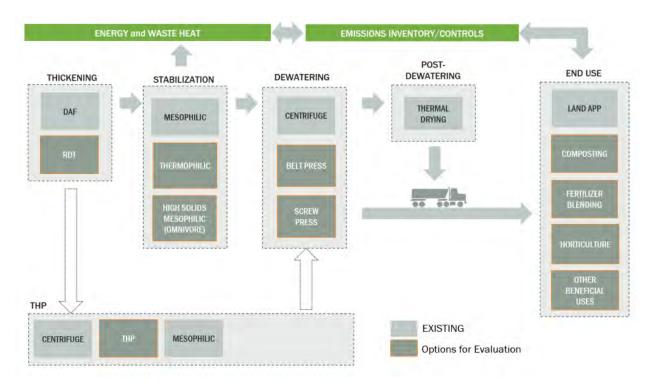


Figure ES-1. Technologies that passed evaluation scoring criteria combined to create end-to-end alternatives

Alternatives were developed for beneficial use of digester gas alongside solids handling improvements. The digester gas utilization alternatives included engine-based cogeneration systems, microturbine-based cogeneration systems, and gas separation to produce renewable natural gas (RNG) for pipeline injection. All technologies were evaluated across a range of DG production rates and various solids stabilization methods, which assumed various levels of co-digestion of organic high-strength waste (HSW). Alternatives were compared to a status quo alternative that assumed DG would be used to operate the existing cogeneration engines and solids dryer, with the remainder of gas flared when the dryer is down for maintenance. Solids handling alternatives included options to upgrade or enhance digestion capacity and final biosolids quality, including thermophilic digestion (Class B and Class A), thermal hydrolysis process (THP), and Omnivore, as well as mesophilic digestion, EWA's existing stabilization technologies. Nearly all solids processing alternatives were evaluated with both one or two dryer trains in service.

The top 5 end-to-end options evaluated are summarized in Figure ES-2. These alternatives were evaluated over two rounds of modeling and are represented on a net present value (NPV) basis.



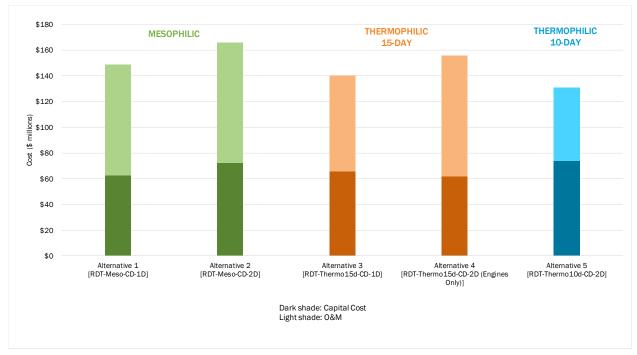


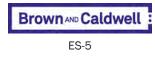
Figure ES-2. Overall NPV for top 5 alternatives

The top 5 end-to-end alternatives all have similar capital and NPV costs; therefore, cannot be screened based on economics alone. In addition, these alternatives have similar near-term project components such as digester improvements and RDTs for co-thickening. For all alternatives, long term projects should be selected based on meeting capacity, resiliency against changes, reducing odor, and reducing truck traffic at the plant.

Key Findings

Alternatives were ranked based on the 20-year NPV model results. The key findings of the analysis are listed below:

- All alternatives benefited from increased DG production from co-digestion of organic HSW.
- Improved thickening with rotary drum thickeners (RDT) provides multiple benefits and has reduced lifecycle costs compared to the existing thickening scheme.
- Thermophilic digestion allows for a higher loading potential of HSW for co-digestion; however, all solids alternatives are compatible with the existing engines or pipeline injection alternatives for DG utilization. There is currently no direct driver to upgrade to thermophilic.
- While the second dryer train does not perform as well on an NPV basis in nearly all alternatives, there are non-cost and practical reasons to implement a second train. The timing of bringing this second train on line to realize the most cost savings will be a very important decision for EWA.
- Upgraded DG for use as vehicle fuel, via pipeline injection, provides the greatest apparent NPV compared to cogeneration systems or in the solids dryer.
- Continued use and operation of the cogeneration system is recommended. Any measures that increase permitted cogeneration energy production or reduce the cost of electricity should be pursued. A net electric metering (NEM) tariff would reduce electric utility costs by eliminating the standby charge—it would also allow for power export and simplify (or eliminate) the EWPCF's

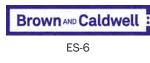


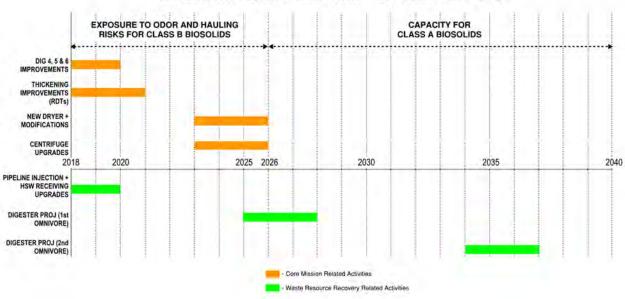
current grid isolation practice. Any air permit revisions to allow for greater DG utilization and energy output are recommended. The addition of upstream DG conditioning and exhaust treatment using a carbon monoxide (CO) catalyst appears to be the best pathway. Any changes that trigger more stringent exhaust treatment measures, such as selective catalytic reduction (SCR) or continuous emissions monitoring systems, should be avoided.

Implementation

Among the top performing alternatives, a series of near term (defined as 0 to 5 years) projects were common. These included digester improvements to address capacity issues, co-thickening improvements (RDTs), high strength waste receiving upgrades, and pipeline injection of biomethane. The BC team recommends that EWA address these near-term projects in its capital planning efforts. The majority of the mid-term (5-10 years from now) also had common elements, including dryer modifications, Class B biosolids truck loadout improvements, an Omnivore project, and centrifuge upgrades. The main differences between these options are that the mid-term projects address a mixture of aging equipment as well as desirable improvements to support high strength waste receiving and biosolids beneficial reuse while the near-term projects address immediate constraints and opportunities associated with the solids and energy processes at the EWPCF. Ultimately, the long-term (10 to 20 years) decisions are what distinguish the top performing alternatives and allow for full implementation of the recommended alternative, which includes a second dryer, an additional Omnivore project, and truck traffic improvements. These long-term projects will address the future increase in solids loadings to the EWPCF.

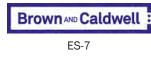
BC worked with EWA to develop a preferred alternative and discussed issues with associated phasing. Ultimately, addressing digester capacity early on in the program allows EWA to expand its co-digestion program and boost digester gas production. Timing on construction of the second dryer can be evaluated in further detail depending on the expansion of the co-digestion program and performance of thickening and digestion improvements with respect to solids reduction. Figure ES-3 shows an implementation schedule for the recommended alternative based on cost, resiliency, ability to meet plant capacity, and reducing truck traffic and odors.





ALTERNATIVE 2: RDT-MESOPHILIC-CENTRIFUGE-2 DRYER

Figure ES-3. Implementation schedule for Alternative 2 (recommended alternative)



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Technical Memorandum

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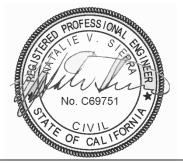
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- Prepared for: Encina Wastewater Authority
- Project Title: Biosolids, Energy and Emissions
- Project No.: 150871.003.001

Technical Memorandum No. 1

- **Baseline Energy Profiles and Projections** Subject:
- February 13, 2018 Date:
- To: Scott McClelland, Assistant General Manager
- From: Scott Lacy, P.E., Managing Engineer



Prepared by:

Natalie Sierra, P.E., Supervising Engineer (C 69751 Exp. June 30, 2018)

Reviewed by:

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Limitations:

This document was prepared solely for Encina Wastewater Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between Encina Wastewater Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by Encina Wastewater Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Encina Wastewater Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List of Figuresiii
List of Tablesiv
List of Abbreviationsv
Executive Summaryvi
Section 1: Introduction1
Section 2: Existing Solids Mass Balance1
2.1 Summary of Solids Process Stream
2.2 Assumptions
2.3 Results
Section 3: Existing Energy Balance
3.1 Electrical Energy Analysis
3.1.1 Electrical Energy Production and Use7
3.1.2 Baseline Electricity Cost Analysis10
3.2 Biogas Production and Use
3.3 Natural Gas Analysis
3.3.1 Natural Gas Usage14
3.3.2 Natural Gas Costs
3.4 Heat Production and Use
Section 4: Future Conditions
4.1 Solids Flows and Loads
4.2 Energy Production and Use
4.3 Biogas Production and Use
4.4 Natural Gas Use
4.5 Heat Production and Use
4.6 Peaking Factors
4.7 Conclusions
References22



List of Figures

Figure ES-1. Process flow diagram describing the mass balance around the solids stream at EWPCF	vii
Figure ES-2. Average percent of electrical usage for each process building or function	ix
Figure 2-1. Solids process stream at EWPCF	2
Figure 2-2. Process flow diagram describing the mass balance around the solids stream at EWPCF	6
Figure 3-1. Biogas and natural gas engine fuel consumption	7
Figure 3-2. Power production, import, and demand by month	8
Figure 3-3. Annual average percent of electrical usage for each process building or function	9
Figure 3-4. Daily energy demand dependence on daily digester loading and determination of baseline energy demand	10
Figure 3-5. Breakdown of monthly SDG&E bills	11
Figure 3-6. Biogas usage during Baseline Period (June 2016 to May 2017)	13
Figure 3-7. Biogas summary: usage and production	14
Figure 3-8. Natural gas use by process/location at EWPCF	15
Figure 3-9. Natural gas costs per process/location at EWPCF	16
Figure 4-1. Solids projections determined from the 2016 PMP and 2017 BEE Plan	18
Figure 4-2. Projected Daily Energy Demand for 2020, 2030, and 2040	20



List of Tables

Table ES-1. Major Non-Digestion Solids Stream Processes and Corresponding Capacities at EWPCF	vi
Table ES-2. Digester Capacity at EWPCF	vii
Table ES-3. EWA Power Production and Demand Summary	viii
Table ES-4. Biogas Production Summary	X
Table ES-5. Heat Production and Usage	X
Table 2-1. Major Non-Digestion Solids Stream Processes and Corresponding Capacities at EWPCF	3
Table 2-2. Digester Capacity at EWPCF	3
Table 2-3. Summary of Average Operating Conditions (2015-2017)	5
Table 3-1. EWA Power Production and Demand Summary	8
Table 3-2. Biogas Production Summary	12
Table 3-3. Natural Gas Baseline Use in Therms	15
Table 3-4. Heat Production and Usage	17
Table 4-1. Projected loads for PS and WAS	18
Table 4-2. Projected Flows for PS and WAS	18
Table 4-3. Projected Solids Feed to the Digester	19
Table 4-4. Projected Energy Demand	19
Table 4-5. Projected Biogas Production	20
Table 4-6. Heat Production and Usage Projections in MMBtu/hr	21
Table 4-7. Summary of Peaking Factors	21





List of Abbreviations

\$/kWh	dollars per kilowatt hour	TOU	time of use
Btu	British thermal units	TS	total solids
Btu/cf	British thermal units per cubic feet	TWAS	thickened waste activated sludge
BEE Plan	Biosolids Energy and Emissions Plan	VS	volatile solids
CEPT	Chemically Enhanced Primary Treatment	VSR	volatile solids reduction
DAF	dissolved air floatation	WAS	waste activated sludge
DGS	Department of General Services Natural Gas Program		-
dtpd	dry tons per day		
EWA	Encina Water Authority		
EWPCF	Encina		
FOG	fats, oil, and grease		
HHV	higher heating value		
IC	internal combustion		
kW	kilowatt		
kWh	kilowatt hour		
kWh/day	kilowatt hour(s) per day		
lb/cf/d	pound(s) per cubic feet per day		
lb/d	pound(s) per day		
lb/hr	pound(s) per hour		
lb/hr/sf	pound(s) per hour per square feet		
lb-VS/(ft ³ d)	pounds volatile solids per cubic foot per day		
MGD	million gallons per day		
MMBtu	million British thermal units		
MMBtu/hr	million British thermal units per hour		
MMscf	million standard cubic feet		
MWh	megawatt hour		
NC	non-coincident		
PMP	2016 Process Master Plan		
ppd	pounds per day		
PS	primary sludge		
RTO	regenerative thermal oxidizer		
scf	standard cubic feet		
scf/Ib-VS _d	standard cubic feet per pound volatile solids destroyed		
scfm	standard cubic feet per minute		
SDG&E	San Diego Gas and Electric		
ТМ	Technical Memorandum		

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Executive Summary

This Technical Memorandum (TM) 1 is the first of seven TMs comprising the Encina Wastewater Authority (EWA) Biosolids Energy and Emissions Plan. TM 1 serves to establish the baseline for planning by providing a summary of the current mass and energy balance for the Encina Water Pollution Control Facility (EWPCF), as well as a projection of future flows and loads. This data will be used in sizing and process related calculations in future tasks.

Tables ES-1 and ES-2 summarize EWPCF's major solids stream processes and their rated capacities for nondigestion and digestion processes, respectively. A mass balance was performed around the solids handling stream incorporating these processes; Figure ES-1 summarizes the results of this calibrated mass balance. All values in the figure describe averages over the 2-year period from May 2015 to June 2017 with loadings rounded to the nearest 100 pounds per day. All assumptions are documented in Section 2.2. This mass balance was reviewed by EWA staff in a workshop setting and subsequently finalized to incorporate additional EWA comments, data, and information. It must be noted that the mass balance was calibrated to agree with assumptions on process parameters and data that were deemed most representative. This was performed after a thorough review of the historic data and in consultation with EWA staff. For some parameters, EWA may wish to change the details of sampling to gain a better understanding and accuracy of those mass balance parameters.

Table ES-1. Major Non-Digestion Solids Stream Processes and Corresponding Capacities at EWPCF								
		No. of Units		Capacity		Percent of Capacity Used		
Process	Technology	Total	Normal Service	Design Loading Rate⁵	Total Service Capacity	Average Annual Condition	Peak Month Condition ⁶	Peak Day Condition ⁶
Thickening	DAF	3	2	0.72 lb/hr/sf	90,000 lb/d1	33%²	40%	53%
Dewatering	Centrifuges	3	2	3,000 lb/hr	144,000 lb/d	26 % ³	32%	42%
Solids Drying	Thermal Dryer	1	1	30 dtpd	30 dtpd	60% ⁴	74%	96%

¹ Calculated assuming two 40-ft diameter DAF units in normal service.

² Calculated using average dry solids loading from calibrated mass balance (29,400 lb/d) to two 40-ft diameter service DAF units.

³ Calculated using average dry solids loading from calibrated mass balance (38,700 lb/d) to service centrifuges.

⁴ Calculated using average dry solids loading from calibrated mass balance (17.8 dtpd) to dryer.

⁵ Thickening and dewatering capacities provided in the 2016 Process Master Plan. Dryer capacity provided by vendor.

⁶ Peaking conditions were applied using the peaking factors developed in section 4.6.

DAF = dissolved air flotation; dtpd = dry tons per day; lb/d = pound(s) per day; lb/hr = pound(s) per hour.



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vi

	Table ES-2. Digester Capacity at EWPCF																			
Process	Technology	No. Total	of Units Normal Service	Condition	Design Loading Rate ¹	Measured Value	Percent of Capacity Used													
Digestion		. 3	. 3	. 3	3												Average Volatile Solids Loading; All units in service	0.15 lb/cf/d	0.08 lb/cf/d	40%
														Average Volatile Solids Loading; Two units in service	0.18 lb/cf/d	0.12 lb/cf/d	67%			
	Mesophilic Digesters					2	Peak 2-week2 Volatile Solids Loading; All units in service	0.18 lb/cf/d	0.16 lb/cf/d	86%										
										Hydraulic Loading; Two units in service	15 days minimum	19.6 days	77%							
				Hydraulic Loading; All units in service	15 days minimum	29.3 days	51%													

¹ Digester capacities based on Brown and Caldwell standard design criteria for mesophilic digestion.

² Peaking condition was applied using the peaking factors developed in section 4.6.

lb/cf/d = pound(s) per cubic feet per day.

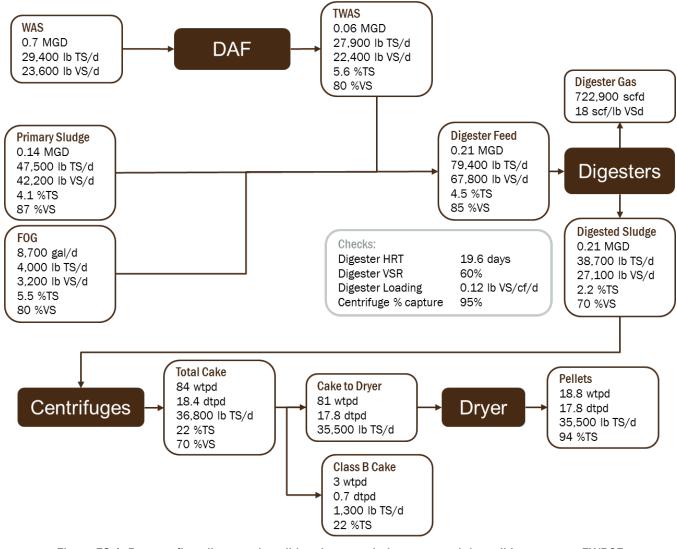


Figure ES-1. Process flow diagram describing the mass balance around the solids stream at EWPCF

Brown AND Caldwell

vii

Electrical and natural gas purchase and production data were analyzed to establish baseline energy values, summarized in Table ES-3. Self-generated electrical power was about 83 percent of the total electrical usage during the baseline period. Annual average production, import, and total usage in terms of kilowatts (kW) was calculated based on 8,760 hours per year.

Table ES-3. EWA Power Production and Demand Summary							
	Annual Production, MWh	Annual Import, MWh	Annual Usage, MWh				
June 2015 to May 2016	13,306	3,956	17,262				
June 2016 to May 2017	13,200	2,796	15,996				
	Annual Average Production, kW	Annual Average Import, kW	Annual Average Usage, kW				
June 2015 to May 2016	1,519	452	1,971				
June 2016 to May 2017	1,507	319	1,826				

¹ Excluding September 2015 from calculation. Power import during this month was an order of magnitude higher than average values.

kWh = kilowatt hour; MWh = megawatt hour.

With respect to electrical costs, the majority of San Diego Gas and Electric (SDG&E) bills are charges for noncoincident (NC) demand and standby demand. On average, from February 2015 to March 2017, NC demand plus standby demand constituted 68 percent of the total SDG&E electricity bill. Average cost for electricity calculated in dollars per kWh (\$/kWh), when all charges were included (total usage [kWh]/total electric charge), ranged from \$0.19 to \$0.40 \$/kWh. If NC and standby demand charges are excluded, the calculated value drops to \$0.09 to \$0.11 \$/kWh.



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viii

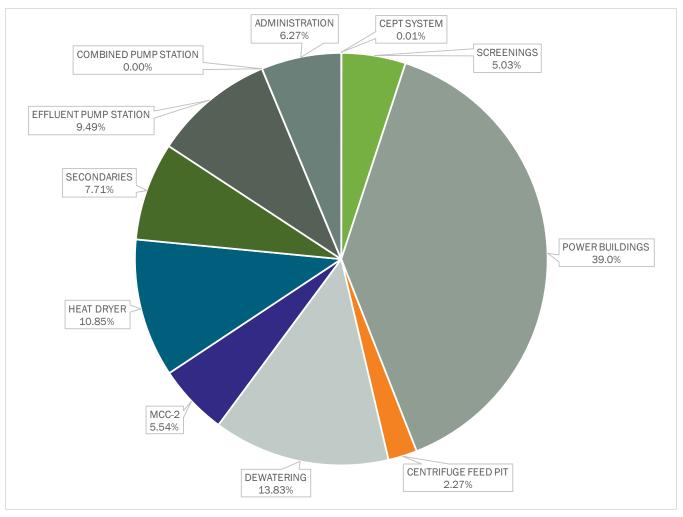


Figure ES-2. Average percent of electrical usage for each process building or function CEPT = Chemically Enhanced Primary Treatment

When measuring biogas production, EWA takes flow measurements from each individual operating digester gas lateral (4, 5, and 6). Historical data from the 'Gas Data Monthly' information provided by Operations were used to determine the baseline biogas production. During this period, the digesters produced an average of 522 standard cubic feet (scf) per minute (scfm). Biogas production in terms of energy, volume, and flowrate that will be carried forward as the project baseline is summarized in Table ES-4. Biogas is used to either fuel the internal combustion engines, supplement gas demands in the solids dryer, or is wasted through the flare.



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Table ES-4. Biogas Production Summary						
	Annual Production, therms	Annual Production, MMscf	Average Flowrate, scfm			
Baseline	1,580,000	263.3	501			

¹ Assuming 600 British thermal units per cubic foot higher heating value for biogas. MMscf = million standard cubic feet.

Natural gas is used at the plant for a variety of uses in the following processes:

- Electrical power production in internal combustion engines (directly and through Eclipse air dilution unit)
- Sludge dryer
- Regenerative thermal oxidizer
- Space and water heating in the Administration and Maintenance Buildings
- Flare pilot light

Natural gas purchases are recorded by an EWPCF master meter and reported in volume (scf) and energy (therms) in monthly invoices. EWA also maintains several internal natural gas meters which were used to develop the baseline natural gas use throughout the plant. The total natural gas purchased by the EWPCF during the period between May 2015 through March 2017 was 1,633,000 therms. In-plant monitoring during that same period reported a usage of 1,610,000 therms—about 1 percent lower. The difference in recorded values is within acceptable tolerances for analysis and shows good agreement on flow meter accuracy. The unit cost for natural gas during the same period fluctuated month by month, ranging from \$0.24 to \$0.39 per therm, with an average of \$0.31 per therm. Natural gas is purchased through a consortium which reduces cost compared to direct purchase from SDG&E.

Heat is produced at the plant via the engines and is utilized by the anaerobic digesters and an absorption chiller. The plant intends on transitioning from the absorption chiller to a conventional heating, ventilation, and air conditioning system; therefore, this demand will not be accounted for in future baseline heat demand. Available heat that can be recovered from the engines is estimated to be 40 percent of the fuel input based on previous studies for similar situations since historical data was not provided. With two 750 kW engines running at full output, approximately 6.0 million British thermal units (MMBtu) per hour (MMBtu/hr) can be recovered to the plant's hot water loop. The remainder of engine heat that is not needed is wasted to the plant's effluent. Dryer/regenerative thermal oxidizer (RTO) waste heat is discharged as hot air. The baseline heat production and usage are summarized in Table ES-5.

Table ES-5. Heat Production and Usage						
	Production, MMBtu/hr Usage, MMBtu/hr					
Engines	6.0	-				
Dryer/RT0	1.4	-				
Digesters	-	1.2				
Total	7.4	1.2				



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Section 1: Introduction

The Encina Wastewater Authority (EWA) has undertaken a Biosolids Energy and Emissions Plan (BEE Plan), which will serve to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan. The BEE Plan has several goals:

- Provide a comprehensive analysis of all project elements, including biosolids treatment, gas use, energy generation, and waste heat.
- Address capacity limitations in the solids handling process at the Encina Water Pollution Control Facility (EWPCF)
- Develop the most cost effective and sustainable solution for EWA
- Move the EWPCF towards greater energy independence
- Reduce greenhouse gas emissions

The outcome of this process is an implementable plan resulting in capital improvements to expand solids processing capabilities, maximize resource recovery capabilities for EWA, and optimize energy production. The BEE has been broken out into discrete tasks as follows:

- 1. Technical Memorandum (TM) 1: Baseline Energy Profiles and Projections
- 2. Technology Evaluation for Biosolids Handling
- 3. Technology Evaluation for Alternative Power Production
- 4. Technology Evaluation for Biogas Production
- 5. Technology Evaluation for Waste Heat
- 6. Air Emissions Evaluation
- 7. Alternative Scenarios Development, Evaluation, and Selection
- 8. Grants and Incentives

Tasks 2 through 5 involve technology evaluation in parallel to allow for the creation of holistic, end-to-end alternatives that include solids treatment, codigestion, gas use, waste heat use, and final biosolids disposition. These end-to-end alternatives are evaluated under Task 7. Task 6 will assess any regulatory limitations associated with emissions from selected processes. Task 8 is ongoing throughout the BEE Plan process and allows for the identification of grants and incentives, including their impact on the financial model used in Task 7.

The purpose of Task 1, summarized in this TM 1, is to establish the baseline for planning purposes. All subsequent sizing and process calculations will be based upon the data presented in this TM. The initial set of calculations described in Sections 2 through 4 was presented in a workshop with EWA staff on August 16, 2017, during which time EWA staff provided feedback and additional information.

Section 2: Existing Solids Mass Balance

A mass balance was performed on the solids handling process, tracking total and volatile solids (VS) through the treatment process at the EWPCF to determine baseline process operating conditions. Calculations were primarily based on 2-year average flows and loads using process data provided by EWA Operations staff ranging from May 2015 to June 2017. This section describes the calculations used in this evaluation and the results of the mass balance. Additionally, a summary of the solids stream process is provided below and several assumptions that were made during this evaluation are documented.



2.1 Summary of Solids Process Stream

The solids process stream at the EWPCF uses a combination of solids thickening, mesophilic digestion, and centrifuge dewatering to produce a Class B cake product. Additionally, a heat dryer is used to produce dried pellets. The process flow diagram in Figure 2-1 shows the major components.

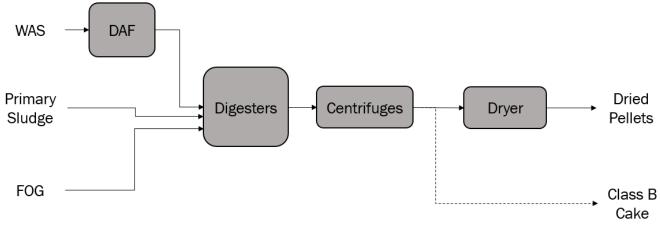


Figure 2-1. Solids process stream at EWPCF

Waste activated sludge (WAS) is thickened using dissolved air flotation (DAF) thickeners. The thickened WAS (TWAS) stream forms part of the digester feed. Primary sludge (PS) is fed directly to the digesters, as are inputs of high strength waste (primarily fats, oil and grease [FOG]), which are trucked in 5 to 6 days a week. Digested sludge is dewatered using centrifuges, and the cake produced is typically dried in a drum dryer. The typical service condition involves the use of one out of three DAF units, two out of three large digesters, two out of three centrifuges, and use of the single drum drying unit to generate granules. Class B dewatered cake is hauled directly to beneficial use sites when the dryer is not in service (i.e., due to extended maintenance outages).

A summary of the rated capacities of each of the solids stream processes is provided in Table 2-1 for nondigestion processes and in Table 2-2 for digestion process. The percent of total capacity that is used with current loading under average and peak conditions is also summarized. Note that these loads are based on the calibrated mass balance described in the next section. It is worth noting that the post-digestion processes may not see peak day solids loads since the digested sludge storage tank provides some buffering capacity. The digested sludge storage tank could provide 0.9 day of retention time at peak day condition.



Table 2-1. Major Non-Digestion Solids Stream Processes and Corresponding Capacities at EWPCF								
		No. of Units		Capacity		Percent of Capacity Used		
Process	Technology	Total	Normal Service	Design Loading Rate ⁵	Total Service Capacity	Average Annual Condition	Peak Month Condition ⁶	Peak Day Condition ⁶
Thickening	DAF	3	2	0.72 lb/hr/sf	90,000 lb/d1	33 % ²	40%	53%
Dewatering	Centrifuges	3	2	3,000 lb/hr	144,000 lb/d	26 % ³	32%	42%
Solids Drying	Thermal Dryer	1	1	30 dtpd	30 dtpd	60% ⁴	74%	96%

¹ Calculated assuming two 40-ft diameter DAF units in normal service.

² Calculated using average dry solids loading from calibrated mass balance (29,400 lb/d) to two 40-ft diameter service DAF units.

³ Calculated using average dry solids loading from calibrated mass balance (38,700 lb/d) to service centrifuges.

⁴ Calculated using average dry solids loading from calibrated mass balance (17.8 DTPD) to dryer.

⁵ Thickening and dewatering capacities provided in the 2016 Process Master Plan. Dryer capacity provided by vendor.

⁶ Peaking conditions were applied using the peaking factors developed in section 4.6.

dtpd = dry tons per day; lb/d = pound(s) per day; lb/hr = pound(s) per hour; lb/hr/sf = pound(s) per hour per square feet.

	Table 2-2. Digester Capacity at EWPCF																		
Process	Technology	No. Total	of Units Normal Service	Condition	Design Loading Rate ¹	Measured Value	Percent of Capacity Used												
		. 3	. 3	Mesophilic Digesters 3	. 3	- 3 9	- 3		Average Volatile Solids Loading; All units in service	0.15 lb/cf/d	0.08 lb/cf/d	40%							
								. 3	. 3	Mesophilic 3 Digesters	. 3	. 3	3	3		Average Volatile Solids Loading; Two units in service	0.18 lb/cf/d	0.12 lb/cf/d	67%
Digestion	· ·														3	3	3	3	3
								Hydraulic Loading; Two units in service	15 days minimum	19.6 days	77%								
				Hydraulic Loading; All units in service	15 days minimum	29.3 days	51%												

¹ Digester capacities based on Brown and Caldwell standard design criteria for mesophilic digestion.

² Peaking condition was applied using the peaking factors developed in section 4.6.

lb/cf/d = pound(s) per cubic feet per day.

2.2 Assumptions

While the mass balance was based on plant data from the 2-year period spanning from May 2015 to June 2017, not all the data were directly applied to the calculations. The mass balance was calibrated using several alterations based on discussions with EWA staff and extensive review of the historic data. This resulted in some parameters that were changed from measured historic values. To summarize the process of developing and calibrating the mass balance, the reported daily masses of dewatered cake and pellets were used, along with an assumption on centrifuge capture rate in order to determine digested sludge loads. Assumptions on VS reduction (VSR) were then used to back-calculate digester loading. WAS and FOG data were deemed reliable by EWA Operations. Therefore, WAS load was used to forward calculate TWAS load, with a DAF capture rate assumption, and this was combined with total digester load to estimate primary sludge load.



Details on the assumptions made in developing and calibrating this mass balance are documented below.

- TWAS data was forward-calculated using the WAS data and an assumed DAF removal of 95 percent. The VS fraction was assumed to be the same for WAS and TWAS based on an average of the percent VS determined in the lab.
- The EWPCF uses Chemically Enhanced Primary Treatment (CEPT) whereby ferric chloride and polymer are added to the wastewater prior to the primary clarifiers to improve clarifier solids removal, reduce the load on the secondary treatment process, and provide a ferric dose in the sludge that acts to limit sulfide content in the digesters and limit the hydrogen sulfide concentration within the digester gas. The dose of ferric chloride used at EWA is about 15 milligrams per liter (as FeCI3). The extra solids removed in the primaries, along with the chemical sludge, is all part of the total PS quantities discussed within this TM.
- Total solids (TS) measurements in the FOG stream were provided by EWA. Due to the high variability in the data (0.4 to 26 percent), the average FOG concentration of 5.5 percent was applied to the entire evaluation period. Additionally, the 2016 Process Master Plan (PMP) assumed that the volatile fraction of total solids was 80 percent; this assumption was used in the mass balance.
- FOG input data during the period from March 28 to April 28, 2017, were excluded because this period included the input of brewery waste, which is not representative of normal operation.
- Daily Class B cake and dried granule production masses were averaged inclusive of zero values. This is because Class B cake and dried pellets are not usually produced simultaneously, based on dryer operation.
- The centrifuge has an assumed capture rate of 95 percent. The assumption was used to back calculate the digested solids.
- VSR was determined using Van Kleeck and mass balance methods, yielding 57 percent and 63 percent, respectively. Based on discussions with operations at EWPCF, 60 percent VSR was used to back calculate the influent load into the digesters.
- Based on discussion with EWPCF staff, the TWAS and FOG feed were held constant and based on historical data. The PS feed was the reminder of the calculated digester feed. However, the PS, TS and VS were based on historical data.

2.3 Results

Figure 2-2 summarizes the results of the mass balance. The mass balance values reported here and shown in Figure 2-2 are based on the average of daily values over the 2-year analysis period, with loadings rounded to the nearest 100 pounds per day (ppd). WAS is thickened in the DAF units from a TS concentration of approximately 0.5 to 5.5 percent. The VS fraction is 80 percent in the WAS stream. Primary sludge is pumped at an average total solids concentration of 4.1 percent, with a volatile fraction of 87 percent, fed directly to the digesters. FOG was assumed to be received at an average total solids concentration of about 5.5 percent with a volatile fraction of 80 percent. Primary sludge contributes to about 62 percent of total solids fed to the digesters; TWAS contributes about 33 percent, and FOG accounts for about 5.4 percent.



The digesters receive an average flow of about 0.21 million gallons per day (MGD) from the above three sources, resulting in a retention time of about 19.6 days with two digesters (2.05 million gallons each) in service. The TS load in the digester feed is about 79,400 ppd, and the VS load is about 67,800 ppd. This results in a digester loading rate of about 0.12 pounds of VS per cubic foot per day. Digested sludge is fed to the dewatering centrifuges at a total solids concentration of about 2.2 percent and a volatile fraction of about 70 percent. This results in centrifuge loading rates of about 38,700 ppd TS and 27,100 ppd VS. The centrifuges produce a Class B cake at a solids concentration of about 22 percent at about 84 wet tons per day or 18.4 dry tons per day. This cake is usually further processed into pellets using a heat dryer, and the pellet product is trucked off site. On rare occasions when the dryer is out of service for unscheduled maintenance, the dewatered Class B cake is hauled off site as is. Averaging these production values over the 2-year analysis period, the dryer was found to produce about 17.8 dtpd of pellets with a solids content of about 94 percent. Class B cake that is not dried is produced at an average rate of about 0.7 dtpd.

Table 2-3 summarizes the major parameters that describe operating conditions in the solids stream at the EWPCF. Figure 2-2 summarizes the mass balance values described above within a process flow diagram. All values in the figure describe averages over the 2-year period (May 2015 to June 2017) with loadings rounded to the nearest 100 ppd. As discussed earlier, it was determined after a thorough review of the historic data and discussions with EWPCF staff that measured values for certain parameters may not have been accurate and some sampling changes should be considered to try and improve accuracy in certain areas and verify the major operating parameters shown in Figure 2-2 are accurate.

Table 2-3. Summary of Average Operating Conditions (2015-2017)						
Parameter	Units	Calculated Value				
Digester Retention Time	days	19.6 ¹				
Digester VSR	percent	60 ²				
Digester Volatile Solids Loading Rate	lb-VS/(ft³⋅d)	0.11				
Digester Gas Production	scf/lb-VS _d	18				
Centrifuge Capture Rate	Percent	95				

¹ Assuming two digesters in service.

² Assumed based on mass balance data, Van Kleeck calculations, and engineering experience.

lb-VS/(ft³ d) = *Pounds VS per cubic foot per day;*

scf/lb-VS_d = standard cubic feet per pound VS destroyed.



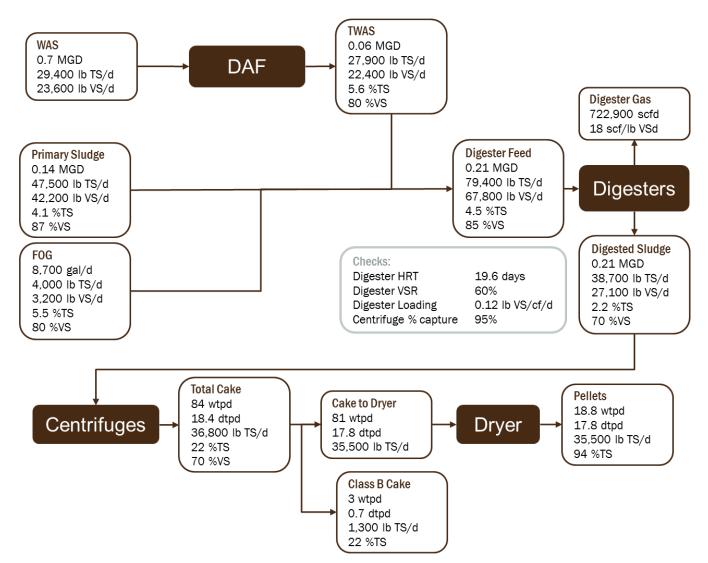


Figure 2-2. Process flow diagram describing the mass balance around the solids stream at EWPCF



Section 3: Existing Energy Balance

The baseline energy balance summarized in this section includes production and demand for biogas, electricity production, purchase and use, and natural gas demand and heat production. Historical data from June 2016 to May 2017 was used to calibrate the baseline values. Trends were plotted over a 2-year period, but Brown and Caldwell was notified that the plant replaced aeration basin diffusers mid-2016, and therefore, the data from June 2016 is more representative of the plant's baseline moving forward. This section describes the data used and the parameters modified to calibrate the model.

3.1 Electrical Energy Analysis

This section summarizes the electrical analysis conducted to support the calculated baseline values model including evaluations of electrical energy production, use, and cost.

3.1.1 Electrical Energy Production and Use

EWA has four total 750 kilowatt (kW) Caterpillar engines, but typically operates two engines continuously at maximum output due to current air permit limitations on carbon monoxide emissions of 100 tons per year. During typical operation, two engines are fueled with unconditioned biogas. When biogas production is low, natural gas is air-diluted in an Eclipse unit and added to the engines' fuel stream to meet full engine output. Additionally, during utility peak power demand periods, the plant often runs a third 750 kW engine on natural gas and physically disconnects (island mode) from the grid to meet the plant's demand. Each engine is equipped with dual fuel capabilities.

Figure 3-1 shows the engine fuel consumption for both biogas and natural gas in units of therms, or energy. It was assumed that biogas has a higher heating value (HHV) of 600 British thermal units (Btu) per cubic foot (Btu/cf) and natural gas has a HHV of 1,000 Btu/cf. Over the baseline period, approximately 91 percent of the engine fuel input is sourced by biogas and the remaining 9 percent is sourced by natural gas. Note that November 2015 data is reported as an outlier due to an increase in natural gas consumption while a biogas flex coupling was being repaired.

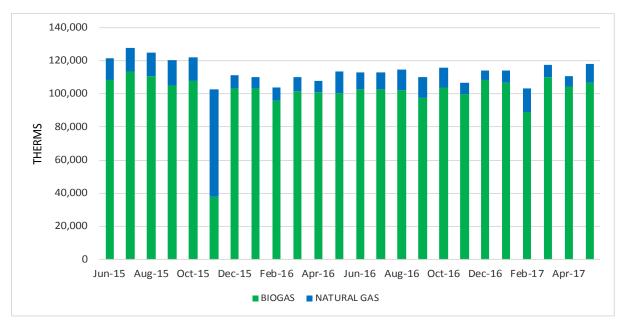


Figure 3-1. Biogas and natural gas engine fuel consumption

Brown AND Caldwell

Historical data over the baseline period was used to determine the power production and import. Plant staff indicated that the aeration diffusers were replaced with more efficient ones in mid-2016 (June), which is consistent with the decreased power usage. The baseline electricity usage will be determined based on data during the time following the installation of the new diffusers. Total annual power production and consumption is summarized in Table 3-1 and Figure 3-2. The annual power production is based on data from the California Energy Commission meters, which includes electricity generated by both the biogas and natural gas. The annual import is based on the 'Gas Data Monthly' information provided by the plant, and total usage is calculated as the sum of the production and import values.

Self-generated electrical power was about 83 percent of the total electrical usage during the baseline period. Annual average production, import, and total usage in terms of kW was calculated based on 8,760 hours per year.

Table 3-1. EWA Power Production and Demand Summary						
	Annual Production, MWh	Annual Import, MWh	Annual Usage, MWh			
June 2015 to May 2016	13,306	3,956	17,262			
June 2016 to May 2017	13,200	200 2,796 15,996				
	Annual Average Production, kW	Annual Average Import, kW	Annual Average Usage, kW			
June 2015 to May 2016	1,519	452	1,971			
June 2016 to May 2017	1,507	319	1,826			

¹ Excluding September 2015 from calculation. Power import during this month was an order of magnitude higher than average values.

MWh = megawatt hour.

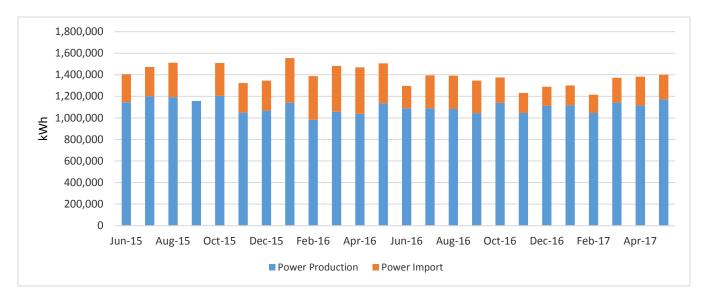


Figure 3-2. Power production, import, and demand by month

Note: Self-generated power is approximately 83 percent of plant usage; September 2015 power import data removed from set as an outlier.



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The following data were used to establish baseline power demand:

- Run hour data was used to approximate the percentage of total electrical usage for each unit process or location.
- Engine output electrical meter data and power import from San Diego Gas and Electric (SDG&E) bills were used to determine the total plant usage (not the "gas monthly" data).

The distribution of electricity use at the EWPCF was estimated based on run hour data provided by EWA. EWA monitors each system's run hours on a monthly basis. These run hours are used to calculate kW hours (kWhs) per month usage using an assumed power factor and average utilization (varied depend on equipment). Run hour data was provided from February 2015 through June 2017. Note that this projection likely overestimates total usage as compared to actual measured generation and SDG&E import and should only be used to qualitatively compare different parts of the plant's electrical usage. The average percent of electrical usage for each process during that period is provided in Figure 3-3. As shown in Figure 3-3, 40 percent of the monthly kWh usage is for the power buildings, which holds equipment such as fans, pumps for hot and chilled water, and blowers. Seventy-nine (79) percent of the power consumed at the plant is dependent on flow and administrative uses, with 21 percent of the total energy use related to solids loading.

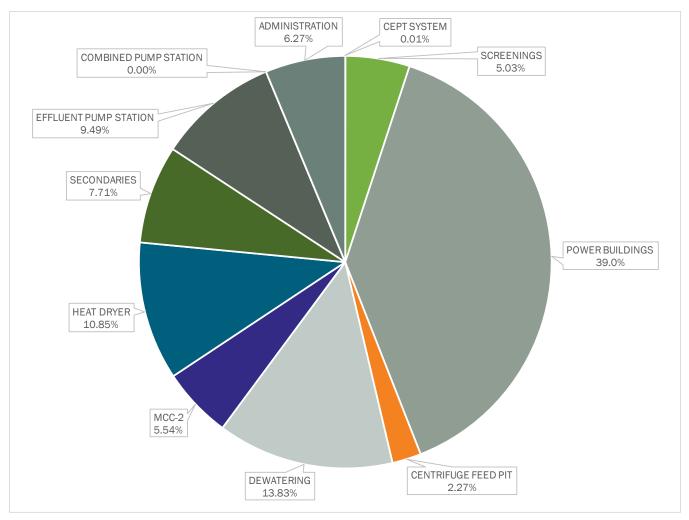
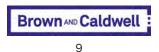


Figure 3-3. Annual average percent of electrical usage for each process building or function



Total monthly energy demands and digester feed loads were used to decouple the energy involved in the solids treatment processes from the energy used for all other processes. Average daily energy demands (kWh per day [kWh/day]) and digester feed loads (lb/day) are plotted in Figure 3-4 for the months between June 2016 and May 2017. June 2016 was chosen as the starting month due to the installation of new aeration basin diffusers which significantly lowered average energy consumption. April 2017 was excluded due to the lack of digester feed loading values. A linear fit of this data provides a distinct relationship between solids loading and solids treatment energy consumption that is independent of the energy demand of liquid stream processes and administrative uses. Extrapolation of the linear fit points to an energy demand of 34,600 kWh/day that is independent of solids loading. The decoupling of energy demands allows for a more accurate prediction of increase in energy demand as it relates to future increases in solids loading. To correct for potentially inaccurate PS solids loading data, a reduction factor was applied to each month's primary sludge total solids loading. The correction factor was determined by the percent decrease in PS total solids from the annual average data to the extrapolated values used to predict future loads.

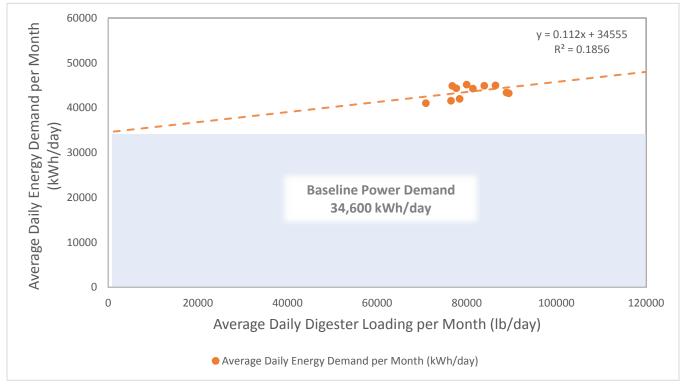


Figure 3-4. Daily energy demand dependence on daily digester loading and determination of baseline energy demand

3.1.2 Baseline Electricity Cost Analysis

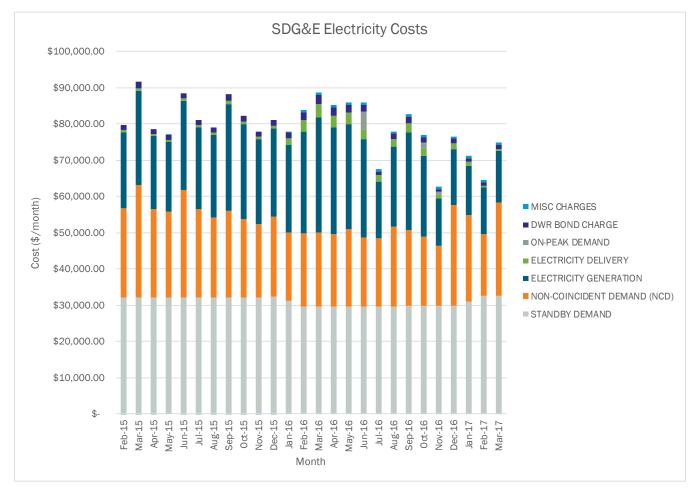
To conduct the baseline electricity cost analysis, EWA provided SDG&E electricity bills from February 2015 through March 2017. However, as described previously, the plant replaced aeration basin diffusers mid-2016; therefore, the data after that replacement is more representative of the plant's baseline energy cost. It should be noted that while SDG&E bills EWA monthly, the pay periods begin and end in the middle of the month. For the purposes of this TM, bills are noted by the end date of the billing period (i.e., "February 2015" represents a pay period from January 13 through February 11, 2015). Thus, the baseline electricity cost was analyzed from July 2016 through March 2017.



Use of contents on this sheet is subject to the limitations specified at the beginning of this document. SC07028_Final TM1_Baseline Energy Profiles_Proj.docx During this analysis period, EWA's monthly power purchase from SDG&E ranged from 167,300 kWh (November 2016) to 341,770 kWh (September 2016). The average monthly kWh purchase during this period was 226,900 kWh

SDG&E bills EWA on a monthly basis, and the costs are a summation of a variety of charges, including:

- Electricity generation: cost per kWh for the source generation of consumed electrical energy.
- Electricity delivery: cost per kWh for the transmission and distribution of consumed electrical energy.
- On-peak demand: cost per kW for the maximum 15-minute power demand during peak periods.
- Non-coincident demand: cost per kW for the maximum 15-minute power demand during non-peak periods (non-coincident with the maximum grid demand).
- Standby demand: fixed charge per kW of on-site generator capacity for SDG&E to reserve an equivalent amount of grid system capacity in the event of a generator shutdown—charged every month whether used or not.



The breakdown of each bill is provided in Figure 3-5.

Figure 3-5. Breakdown of monthly SDG&E bills



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As shown in the figure above, the majority of the SDG&E bill are charges for non-coincident (NC) demand and standby demand. On average, from July 2016 to March 2017, NC demand plus standby demand constituted 71.3 percent of the total SDG&E electricity bill. The standby demand is based on an installed capacity of 2,295 kW. Average cost for electricity calculated in dollars per kWh (\$/kWh), when all charges were included (total usage [kWh]/total electric charge), ranged from \$0.24 to \$0.40 \$/kWh. If NC and standby demand charges are excluded, the calculated value drops to \$0.09 to \$0.10 \$/kWh.

3.1.2.1 SDG&E Electric Rate Schedule

In April 2016, SDG&E implemented, and EWA adopted, a revised time of use (TOU) electric rate schedule called TOU Plus. This new schedule incorporated a demand response element into a normal TOU rate schedule; a summary is provided below.

- Customers select a Capacity Reservation, in kW, with an associated monthly payment of \$6.14/kW
- Up to 18 times a year, the utility calls for Critical Peak Pricing Event Days; during these days, any demand in excess of the Capacity Reservation is billed at a much higher rate
- The EWA has a capacity reservation of 0 kW, meaning no reservation charges are added and no capacity is reserved for peak days

Brown and Caldwell recommends an evaluation of the most applicable rate schedule for EWA as part of the current energy planning effort.

3.2 Biogas Production and Use

The plant measures biogas production from each individual operating digester gas lateral (4, 5, and 6) as well as biogas usage in the engines, dryer, and waste gas flare. Historical data from the 'Gas Data Monthly' information was used to compare the biogas production and usage. In theory, the total production should equal the usage (including wasting), however, data from the baseline period indicates that the digesters produced an average of 521 standard cubic feet (scf) per minute (scfm) of biogas while only 473 scfm was utilized. Another source of digester gas data was from the historical SCADA data. The individual digesters indicate that the digesters produce an average of 502 scfm. Biogas flow meters located closer to the digesters are notorious for inaccuracy, therefore, a third approach using a common VSR calculation was performed. Figure 3-7 illustrates the variance between biogas production and use.

The VSR calculation uses assigned percent VS and VSRs for each digester feedstock (PS, TWAS, FOG) to determine the quantity of VS destroyed in the digester. For every pound of VS destroyed, it was assumed that 18 cubic feet of digester gas are produced. Applying the VSR method to the digester solids loading resulted in a biogas production of 501 scfm, which is more consistent with the end use meters and falls between the range of the production meters and end use meters. The biogas production will be based on the VSR method and is summarized in Table 3-2 in terms of energy, volume, and flowrate.

Table 3-2. Biogas Production Summary						
	Annual Production ¹ , therms Annual Production, MMscf Average Flow					
Baseline	1,580,000	263.3	501			

¹ Assuming 600 Btu/cf HHV for biogas MMscf = million standard cubic feet.



Biogas is used to either fuel the internal combustion (IC) engines, supplement gas demands in the solids dryer, or is wasted through the flare. Figure 3-6 shows the baseline quantity of biogas that is used for each process during the baseline period. Biogas usage in November 2015 is included in the graphical figure but will not be used to determine the baseline biogas use since it was an anomaly month where most of the biogas was flared. Since the solids dryer operates 11 days on, 3 days off, 3/14 of the time, excess biogas not utilized in the engines is flared while the dryer is not operational. Additionally, the gas control valve to the dryer is manually set rather than automated, which results in flaring of biogas when production is high. Brown and Caldwell recommends automating the control valve to allow the dryer to operate on blended biogas and natural gas rather than flaring biogas.

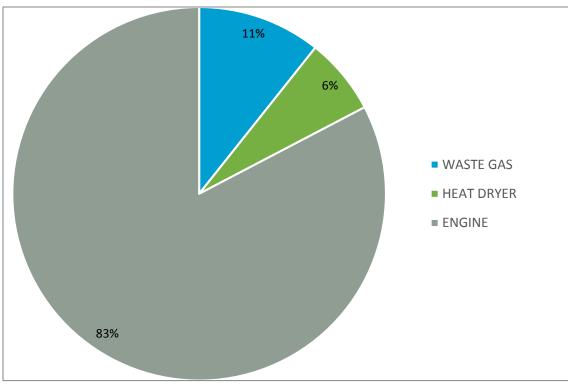


Figure 3-6. Biogas usage during Baseline Period (June 2016 to May 2017)



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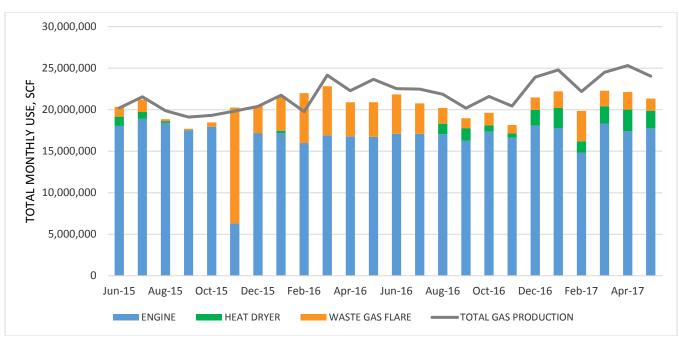


Figure 3-7. Biogas summary: usage and production

3.3 Natural Gas Analysis

This section summarizes the natural gas analysis conducted to support the calculated baseline values during June 2016 to May 2017, which includes evaluations of natural gas usage and cost.

3.3.1 Natural Gas Usage

Natural gas usage is recorded for both plant totals and individual processes. Natural gas is used at the plant for a variety of uses in the following processes:

- Electrical power production in internal combustion engines (directly and through Eclipse blending unit)
- Heat dryer plant operates 11 days on, 3 days off.
- Regenerative thermal oxidizer (RTO) (as part of the sludge dryer exhaust treatment)
- Space and water heating in the Administration and Maintenance Buildings
- Flare pilot

Natural gas purchases are recorded by a master meter and reported in scf by EWA and therms in the monthly invoices. EWA also maintains several internal natural gas meters which were used to develop the baseline natural gas use throughout the plant. EWPCF's natural gas meters recorded usage data that was consistent with the SDG&E billing statements.



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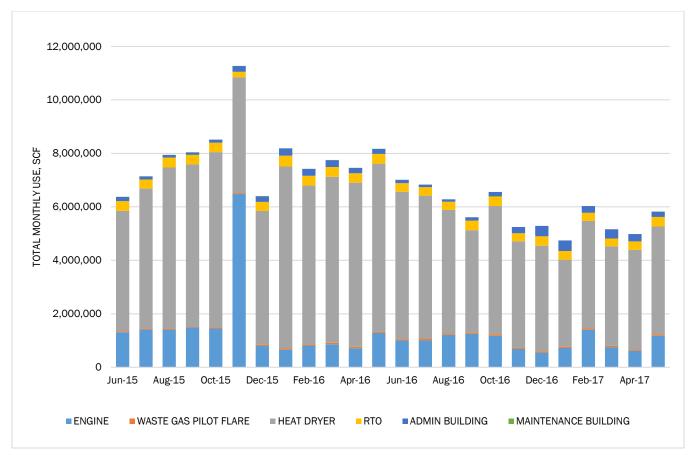


Figure 3-8. Natural gas use by process/location at EWPCF

Table 3-3. Natural Gas Baseline Use in Therms							
	Engine	Pilot Flare	Heat Dryer	RTO	Admin Bldg.	Maintenance Bldg.	Total
June 2015 to May 2016*	132,140	5,857	745,562	45,076	22,906	405	951,546
June 2016 to May 2017	115,630	5,986	507,894	39,294	26,841	11	695,656

*Excluding November 2015 in which natural gas use in the engines was significantly greater than other months, likely due to an operational change.

Totalized natural and digester gas use from both the heat dryer and RTO was used along with totalized digester feed loading to determine a directly proportional relationship between the two for prediction of future gas demands. Since the relationship between natural gas demand and solids drying is not affected by the replacement of aeration basin diffusers, the data used spans over a longer period to provide a better average gas demand per pound of solids. Between the months of February 2016 to May 2017, excluding April 2017, a total of 36.5 million pounds of solids were fed to the digesters while the heat dryer and RTO consumed a total of 85,100 million Btu (MMBtu) worth of natural and digester gas. Energy used to pre-heat the dryer is approximately 2 MMBtu per hour (MMBtu/hr) for 30 minutes; therefore, each time the dryer starts up, 1 MMBtu is consumed. Over the course of a year, this equates to roughly 26 MMBtu, which is less than 1 percent of the typical energy demand. Therefore, it can be assumed that the dryer gas consumption is nearly linear to solids loading. Assuming the dryer and RTO do not consume energy when there is no solids



load, a direct relationship between the two can be established at 0.0023 MMBtu consumed per pound of solids processed.

3.3.2 Natural Gas Costs

EWA purchases natural gas from the Department of General Services Natural Gas Program (DGS) and the costs are calculated as a unit cost per therm. For the cost analysis, EWA provided monthly billing data from May 2015 through March 2017. The total natural gas purchased by the EWPCF during the period between May 2015 through March 2017 was 1,633,000 therms. In-plant monitoring during that same period reported a usage of 1,610,000 therms—about 1 percent lower. The difference in recorded values is within acceptable tolerances for analysis and shows good agreement on flow meter accuracy.

The therms purchased from DGS during that period ranged from 48,600 therms (January 2017) to 120,100 therms (November 2015), and averaged 71,000 therms per month. The per unit commodity cost for natural gas during the same period fluctuated month by month, ranging from \$0.24 to \$0.39 per therm, with an average of \$0.31 per therm. After adding transportation, load management, and DGS service fees, the per unit rate increases to range of \$0.38 to \$0.56 per therm, with an average of \$0.44 per therm. A breakdown of monthly natural gas costs per process is provided in Figure 3-9.

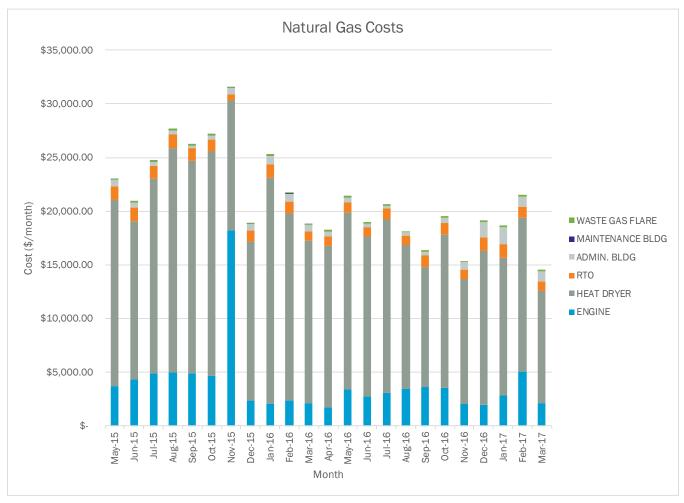


Figure 3-9. Natural gas costs per process/location at EWPCF



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16

EWA's average cost of natural gas of \$0.44 per therm through a separate natural gas procurement mechanism is substantially less than the alternative of at least \$0.62 per therm through SDG&E's GN-3 natural gas rate schedule.

3.4 Heat Production and Use

Heat is produced at the plant via the engines and solids dryer. A portion of the heat produced by the engine is transferred to the plant's hot water loop and is utilized by the anaerobic digesters and an absorption chiller. The plant intends on transitioning from the absorption chiller to a conventional heating, ventilation, and air conditioning system; therefore, these demands will not be accounted for in future baseline heat demand. Engine exhaust heat that is not recovered to the plant's hot water loop is wasted to the plant's effluent and excess heat produced by the solids dryer is wasted to atmosphere as hot exhaust.

Available heat that can be recovered from the engine is estimated to be 40 percent of the fuel input for both jacket water recovery and exhaust recovery since historical data was not provided. With two 750 kW engines running at full output, approximately 6.0 million MMbtu/hour can be recovered. Currently, there is no method for capturing and utilizing waste heat from the RTO and all of the heat is wasted to the atmosphere as exhaust.

Table 3-4. Heat Production and Usage					
Production, MMBtu/hr Usage, MMBtu/hr					
Engines	6.0	N/A			
Dryer/RTO	1.4	N/A			
Digesters	N/A	1.2			
Total	7.4	1.2			

The baseline heat production and usage summarized in Table 3-4. Digester heat demand is based on an estimate from EWA's 2011 Energy and Emissions Strategic Plan.

Section 4: Future Conditions

Recently, the PMP determined the projected solids loading to EWPCF utilizing population growth projections as a means of determining future flows and loads as well as the historical trends method. Annual growth was provided by San Diego Association of Governments for use in the PMP. The projections were then incorporated as the influent loading and modeled through BIOWIN to obtain the WAS and PS loadings to the digesters. As part of Task 1, Brown and Caldwell reviewed EWPCF's historical data, comparing it to the PMP. This section will review the projected solids flows and loads. Furthermore, this section will review the projected energy demand and production, biogas production, natural gas use, and heat production based on estimated future loads. Finally, Brown and Caldwell will present the peaking factors that will be used for future analysis and design.

4.1 Solids Flows and Loads

With aggressive water conservation efforts in California, projecting flows in a wastewater treatment plant can be challenging. Solids loading to the facility, however, can be estimated as it scales with population growth. In that regard, Brown and Caldwell projected solids loads utilizing linear interpolation. The current loads



determined in the mass balance and the growth rate from the PMP were used to create a linear expression. Table 4-1 summarizes the projected loads determined by Brown and Caldwell for 2020, 2030, and 2040. Table 4-2 summarizes the flows associated with the annual average solids loadings. Figure 4-1 compares the solids projection curve from the PMP to the one developed in this study. The loads shown here for current conditions are based on the calibrated mass balance presented in Section 2, They are higher than the loads projected in the PMP because influent loadings to the plant were likely underestimated in the PMP due to the use of non-representative grab samples. A rate of increase was applied to the 2017 loads determined by using the calibrated mass balance, on par with the rate used in the PMP, per EWA's direction. The projection rate used in the PMP was based on applying an annual population growth rate of 0.74 percent to the influent flow and modeling the subsequent solids production rates.

Table 4-1. Projected loads for PS and WAS						
	Current	2020	2030	2040		
PS, ppd	47,500	50,600	60,800	71,100		
WAS, ppd	29,400	31,600	39,000	46,300		

Table 4-2. Projected Flows for PS and WAS						
Current 2020 2030 2040						
PS, MGD ₁	0.13	0.14	0.17	0.20		
WAS, MGD ₂	0.71	0.76	0.94	1.11		

 1 PS assumes a total solids content of 4.3 percent

² WAS assumes a total solids content of 0.5 percent

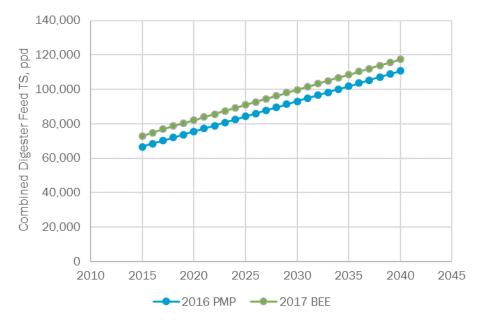


Figure 4-1. Solids projections determined from the 2016 PMP and 2017 BEE Plan



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To project the energy and gas use and production, the projected PS and WAS were used to determine digester feed. Primary sludge remained as is at 4.3 percent solids. The WAS was thickened in the DAF at an assumed 95 percent capture rate. Finally, the FOG was assumed to be the same as the current load. These values are summarized in Table 4-3.

Table 4-3. Projected Solids Feed to the Digester							
	Current 2020 2030 2040						
PS, ppd	47,500	49,800	57,500	65,200			
TWAS, ppd	27,900	29,900	36,600	43,200			
FOG, ppd	4,000	4,000	4,000	4,000			
Combined Digester solids load, ppd	79,400	83,700	98,100	112,400			

4.2 Energy Production and Use

Based on the analysis of existing energy usage, 79 percent of the power consumed at the plant is dependent on flow and administrative uses, with 21 percent of the total energy use related to solids loading. As the solids loading projections at the plant increase, so too will the percentage of total energy associated with solids treatment. Energy projections are summarized in Table 4-4. The projected energy demands for each decade are also plotted on Figure 4-2 alongside the historical data presented earlier.

Table 4-4. Projected Energy Demand						
	Current	2020	2030	2040		
MWh/year	16,000	16,000	16,600	17,200		
kWh/day	44,000	43,900	45,500	47,100		



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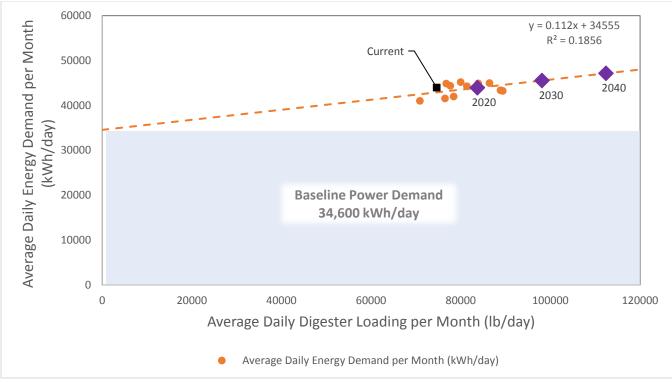


Figure 4-2. Projected Daily Energy Demand for 2020, 2030, and 2040

Until a decision has been made regarding EWA's request to modify the air permit to allow for the operation of three engines, it is assumed that the plant will continue to operate the engines as they do currently. Therefore, the baseline and future projections assume 1,500 kW of continuous engine output.

4.3 Biogas Production and Use

Biogas projections are expected to increase at a proportional rate based on the solids projections—for every pound of VS destroyed in the digesters, an additional 18 cubic feet of biogas will be produced, which is consistent with the historical data. A VSR of 60 percent was assumed in the projections, which aligns with the current biogas meter data. The biogas projections are summarized in Table 4-5.

Table 4-5. Projected Biogas Production					
	Current	2020	2030	2040	
scfm	501	544	703	766	
therms/year	1,581,000	1,666,000	1,951,000	2,235,000	

Biogas can be used in the IC engines to generate enough power to meet the plant's demands; however, this is pending EWA's August 2017 request to revise the air permit for operation of three IC engines. Until a decision has been reached regarding the permit modification, it is assumed the engines will run on biogas, with the remainder of gas used in the solids dryer. See Section 4.4 for biogas use in the heat dryer and RTO.



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20

4.4 Natural Gas Use

Natural gas and digester gas use in the heat dryer and RTO is expected to increase as solids loading to the digesters increase. Based on the relationship developed between the two in Section 3.3.2, projected gas demands for 2020, 2030, and 2040 are 71,200, 83,500, and 95,700 MMBtu per year, respectively. Use in the engine will vary depending on the quantity of biogas available as solids loading projections increase and depending if the plant can operate a third engine on biogas. Therefore, use of additional natural gas as engine fuel is not included in the projected values noted previously. The administration and maintenance buildings and pilot flare are expected to remain constant and are not flow dependent.

4.5 Heat Production and Use

Heat production is expected to remain constant in the engines since operating conditions are assumed to match the existing baseline. Heat production in the solids dryer and RTO is expected to increase proportional to the increased solids loading to the dryer presented in Section 4.1. Likewise, digester heating projections are scaled proportionally to the projected flows for PS, TWAS, and FOG to the digesters in referenced in Section 4.1. These projections are conservative in that roughly 20 percent of the heat demand is typically lost through the digester shell, with about 80 percent used to warm-up the incoming sludge. Theoretically, shell losses should remain constant and only sludge heating projections would increase. A summary of these heat projections is summarized in Table 4-6.

Table 4-6. Heat Production and Usage Projections in MMBtu/hr								
	Base	Baseline		2020 2		30	2040	
	Production	Usage	Production	Usage	Production	Usage	Production	Usage
Engines	6.0	N/A	6.0	N/A	6.0	N/A	6.0	N/A
Dryer/RT0	1.4	N/A	1.49	N/A	1.80	N/A	2.11	N/A
Digesters	N/A	1.2	N/A	1.28	N/A	1.55	N/A	1.81
Total	7.4	1.2	7.49	1.28	7.80	1.55	8.11	1.81

4.6 Peaking Factors

In addition to determination of the flows and loads projections, the solids projection peaking factors were established. Sufficient data were unavailable to accurately determine the solids peaking factors as total and VS are only analyzed weekly. Brown and Caldwell will use the peaking factors previously determined in the PMP for peak month and peak day. Peak 14 day and Peak 7 day were determined based on historical data and engineering judgment.

Table 4-7. Summary of Peaking Factors						
	Peak Month ¹	Peak 14 day	Peak 7 day	Peak day ¹		
PS	1.23	1.3	1.4	1.60		
WAS	1.23	1.3	1.4	1.60		
Combined Sludge	1.23	1.3	1.4	1.60		

¹ Values referenced from the PMP.



21

4.7 Conclusions

The data discussed in this TM will be used as the basis for future work in the BEE Plan. This includes identifying capacity issues in the solids handling system. Solids and energy demand projections will be used to size corresponding process units in the development of alternatives under Task 7.

References

Carollo Engineers, Process Master Plan for the Encina Water Pollution Control Facility, Encina Wastewater Authority, Encina, CA. November 2016.

Black and Veatch, Energy and Emission Strategic Plan, Encina Wastewater Authority, Encina, CA. April 2011.



22



Technical Memorandum

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FINAL

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- Project No.: 150871.002.001

Technical Memorandum 2

- Technology Evaluations for Biosolids Handling Subject:
- January 8, 2018 Date:
- To: Scott McClelland, Assistant General Manager
- From: Scott Lacy, Project Manager



Prepared by:

Natalie Sierra, P.E., C 69751, Expiration June 30, 2018

Reviewed by: <u>Jen</u>

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Limitations:

This document was prepared solely for Encina Wastewater Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between Encina Wastewater Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by Encina Wastewater Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Encina Wastewater Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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- Tom Chapman, P.E.
- Tracy Chouinard
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Table of Contents

Ackn	owledge	ements	ii
List o	of Figure	S	iv
List o	of Tables	5	iv
List o	of Abbre	viations	V
Exec	utive Su	mmary	iv
Evalu	uation P	rocess	iv
	-	Biosolids End-Use Pre-Screening	
	Step 2	Fatal-Flaw Screening	iv
	Step 3	Ranking of Screened Technologies	V
•		ion Considerations	
Next	Steps		vi
Secti	on 1: In	troduction	1-1
Secti	on 2: E\	aluation Methodology for Biosolids Technologies	2-1
2.1	Role of	Biosolids End Use	2-1
2.2	Fatal-Fl	aw Screening	2-3
2.3	Evaluat	ion Criteria Development and Ranking	2-3
2.4	Solids-\	Nater-Energy-Evaluation Tool	2-5
Secti	on 3: Id	entification of Biosolids Technologies	3-1
3.1	Thicker	ning Technologies	3-1
	3.1.1	Primary Clarifier Thickening	3-2
	3.1.2	Dissolved Air Flotation Thickening	3-2
	3.1.3	Rotary-Drum Thickening	
3.2	Stabiliz	ation Technologies	3-3
	3.2.1	Mesophilic Anaerobic Digestion	3-3
	3.2.2	Mesophilic High-Solids Digestion	3-3
	3.2.3	Staged Mesophilic Anaerobic Digestion	
	3.2.4	Acid-Gas Phase Digestion	
	3.2.5	Thermophilic Anaerobic Digestion	
	3.2.6	Temperature-Phased Anaerobic Digestion	
	3.2.7	Thermal Hydrolysis Process	
	3.2.8	Enzymatic Hydrolysis	
	3.2.9	Thermo-Chemical Hydrolysis	
		Lystek	
		Summary of Fatal-Flaw Evaluation	
3.3		ring Technologies	
	3.3.1	Centrifuge	3-10

Brown AND Caldwell

	3.3.2	Belt Filter Press	3-10
	3.3.3	Screw Press	3-10
	3.3.4	Rotary Press	3-11
	3.3.5	Volute Press	3-11
	3.3.6	Bucher Press	3-11
	3.3.7	Summary of Fatal-Flaw Evaluation	3-11
3.4	Post-De	watering Technologies	3-12
	3.4.1	Direct Drum Drying	3-12
	3.4.2	Indirect Drying	3-12
	3.4.3	Solar Drying	3-12
	3.4.4	Gasification	3-13
	3.4.5	Pyrolysis	3-13
	3.4.6	Incineration	3-13
	3.4.7	Deep-Well Injection	3-14
	3.4.8	Dehydration	3-14
	3.4.9	Fatal-Flaw Evaluation	3-14
Secti	on 4: Ra	anking of Screened Technologies	4-1
4.1	Evaluat	ion Approach	4-1
4.2	Results	and Discussion	4-1
	4.2.1	Stabilization	4-1
	4.2.2	Dewatering	4-3
Secti	on 5: Im	plementation Considerations	
5.1	Thicken	ning and Stabilization	
5.2	Therma	I Drying	5-3
Secti	on 6: Co	onclusions and Next Steps	6-1
Attac	hment A	A: Workshop Meeting Minutes	A-1
Attac	hment E	3: Map of California Land Application Ordinances	B-1
Attac	hment C	C: Digestion Volume Calculations	C-1



iii

List of Figures

Figure ES-1. Biosolids treatment technology options for EWCPF end-to-end project alternatives	vii
Figure 3-1. Rotary-drum thickener	3-2
Figure 3-2. Cambi thermal hydrolysis process	3-6
Figure 3-3. Exelys digestion-lysis-digestion process	3-7
Figure 3-4. SolidStream Cambi process	3-8
Figure 5-1. Preliminary layout for thermophilic digestion with a second dryer and expanded facilities for high strength waste receiving	5-1
Figure 5-2. Preliminary layout for THP where the smaller digesters are demolished for the THP units	5-2
Figure 5-3. Preliminary layout for THP where the DAFs are demolished for the THP units	5-3
Figure 6-1. Biosolids treatment technology options for EWCPF end-to-end project alternatives	6-1

List of Tables

Table ES-1. Biosolids Treatment Technologies Selected for Evaluation	iv
Table ES-2. Biosolids Treatment Technologies Evaluation Criteria	V
Table 2-1. Paired Stabilization Processes, Products, and Associated Beneficial Uses	2-3
Table 2-2. Biosolids Technology Evaluation Criteria	2-4
Table 2-3. Biosolids Technology Evaluation Criteria Weighting Values	2-5
Table 3-1. Biosolids Treatment Technologies Selected for Evaluation	3-1
Table 3-2. Solids Stabilization Fatal-Flaw Results	3-9
Table 3-3. Dewatering Technologies Fatal-Flaw Results	3-11
Table 3-4. Post-Dewatering Fatal-Flaw Results	3-15
Table 4-1. Summary of Screening Technologies	4-1
Table 4-2. Stabilization Technology Results	4-1
Table 4-3. Dewatering Technology Results	4-3



List of Abbreviations

°F	degree(s) Fahrenheit	TIRE	Terminal Island Renewable Energy
Advantek	Advantek Waste Management Services	TM	technical memorandum
BC	Brown and Caldwell	TPAD	temperature-phased anaerobic digestion
BEE	Biosolids Energy and Emissions	TS	total solids
BFP	belt filter press	TWAS	thickened waste activated sludge
Btu	British thermal unit(s)	VAR	vector attraction reduction
CASA	California Association of Sanitation Agen-	VS	volatile solids
	cies	VSR	volatile solids reduction
CDFA	California Department of Food and Agricul- ture	WAS	waste activated sludge
CH4	methane	WWTP	wastewater treatment plant
CO	carbon monoxide		
CO ₂	carbon monoxide		
DAFT	dissolved air flotation thickener		
DLD	digestion-lysis-digestion		
DS	digested sludge		
EPA	U.S. Environmental Protection Agency		
EWA	Encina Wastewater Authority		
EWPCF	Encina Water Pollution Control Facility		
ft ³	cubic foot/feet		
GET	GeoEnvironment Technologies		
GHG	greenhouse gas		
H ₂ S	hydrogen sulfide		
HRT	hydraulic retention time		
lb	pound(s)		
MAD	mesophilic anaerobic digestion		
mgd	million gallons per day		
OLR	organic loading rate		
0&M	operations and maintenance		
PMP	Process Master Plan		
ppm	part(s) per million		
PS	primary sludge		
RDT	rotary-drum thickener		
RTO	regenerative thermal oxidizer		
SRT	solids retention time		
SWEET	Solids Water Energy Evaluation Tool		
TAD	thermophilic anaerobic digestion		
TCHP	thermo-chemical hydrolysis process		
THP	thermal hydrolysis process		

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Executive Summary

The Encina Wastewater Authority (EWA) is developing a plan to expand solids-processing capabilities due to near-term capacity issues in the heat dryer at the Encina Water Pollution Control Facility (EWCPF), maximize resource recovery capabilities for EWA, and optimize the facility's energy production. This Technical Memorandum (TM) 2 describes the development of screening and evaluation criteria used to assess biosolids treatment technologies for solids handling.

Evaluation Process

Treatment technologies were evaluated for thickening, stabilization, dewatering, and post-dewatering processes. Technologies were selected for further evaluation through the three-step process described below.

Step 1: Biosolids End-Use Pre-Screening

Step 1 assessed viable end uses for a range of biosolids products. Technologies that passed the end-use filter are listed in Table ES-1. Technologies that did not generate viable beneficial uses in the Southern California region were eliminated from further consideration.

Table ES-1. Biosolids Treatment Technologies Selected for Evaluation						
Thickening Technologies	Stabilization Technologies	Dewatering Technologies	Post-Dewatering Technologies			
 Primary Clarifier DAFT RDT 	 Mesophilic digestion Mesophilic high-solids digestion Acid/gas digestion Staged digestion Thermophilic digestion TPAD Enzymatic hydrolysis Chemical hydrolysis Lystek THP: Class A THP: Exelys-DLD THP: SolidStream Cambi 	 Centrifuge BFP Screw press Volute press Bucher press 	 Drum dryer Indirect dryer Gasification Pyrolysis Partial solar drying Deep-well injection Dehydration Incineration 			

BFP = belt filter press; DAFT = dissolved air flotation thickener; RDT = rotary drum thickener; THP = thermal hydrolysis process; TPAD = temperature-phased anaerobic digestion.

Step 2: Fatal-Flaw Screening

Step 2 involved the development of fatal-flaw criteria, for which a technology would pass or fail. Treatment technologies had to meet the following fatal-flaw criteria to be considered for further evaluation:

- There must be at least one full-scale installation of the technology at a wastewater treatment plant (WWTP) in North America
- There must be at least one successful installation of the technology at a facility of similar size to EWPCF to ensure compatibility



iv

- The technology must be accommodated within EWPCF's limited available footprint
- The technology must be capable of being integrated into the existing treatment infra-structure

Step 3: Ranking of Screened Technologies

EWA previously evaluated thickening technologies in its Process Master Plan (PMP). Thus, EWPCF's current thickening (primary clarifiers for primary sludge [PS] and dissolved air flotation units for waste activated sludge [WAS]), and the recommended thickening process from the PMP (rotary-drum thickeners) were all advanced without further evaluation by the Brown and Caldwell (BC) team.

Stabilization and dewatering technologies that passed the fatal-flaw screening were further assessed using the evaluation criteria listed in Table ES-2, which were developed to reflect EWA's values and project goals. The pre-screened technologies were ranked based on these criteria in a workshop with EWA staff, held on August 16, 2017.

Table ES-2. Biosolids Treatment Technologies Evaluation Criteria				
Criterion	Description			
End-use market compatibility	 Onsite technology directly produces one of the recommended product alternatives Alternatively, onsite technology product compatible with product alternatives 			
Proven technology performance	 Proven and reliable technology with same configuration intended at EWCPF Long-term successful operating track record 			
Minimize life-cycle costs	 Qualitative metric of program cost Capital and O&M costs based on existing EWA data or similar experience at other WWTPs Potential revenues from sales Product/market geographic proximity 			
Energy/resource recovery	 Biogas production increased through advanced digestion Co-digestion of organic waste supported Renewable energy recovered Biosolids product beneficially reused 			
O&M impacts	 Impacts to existing WWTP 0&M staff levels Complexity of new technology 0&M and control systems Reliability of new technology (potential downtime) Minimal impacts to WWTP safety 			
Environmental impacts	Impacts to carbon footprint and air permitting			
Community and stake-holder impacts	 Minimal nuisance impacts such as dust, odors, vectors, aesthetics, noise, and traffic Impacts to partner agency issues/values, and local planning codes and requirements 			
Project site compatibility	 Compatibility of technology with available WWTP footprint Incorporation into existing treatment process 			

O&M = operations and maintenance



V

Stabilization Technologies. Thermophilic digestion scored the highest, followed by mesophilic digestion and Class A thermal hydrolysis process (THP). Thermophilic digestion yields a dewatered Class B cake that can be beneficially used in agriculture in Arizona or sent to regional compost facilities for further processing, and has proven long-term performance records at WWTPs of various sizes. Thermophilic digestion provides the greatest potential to minimize life-cycle costs through revenue generated by importing high-strength waste. Thermophilic digestion also delivers greater proportional gas yield than the other technologies as compared to the relatively modest increased energy demand.

Dewatering Technologies. Belt filter presses (BFPs) scored the highest, followed by centrifuges. The evaluated technologies scored similarly in three of the criteria: life-cycle costs, environmental impacts, and community and stakeholder impacts. Differentiating criteria in this technology category included end-use market compatibility, proven technology performance, operations and maintenance (O&M) impacts, and project

site compatibility. With respect to proven technology performance, BFPs and centrifuges are the most widely used dewatering technologies in the United States. With respect to end use, research suggests that low-shear dewatering processes, like BFPs, yield cake with lower odors than high-shear processes like centrifuges.

Implementation Considerations

Thermophilic digestion occupies essentially the same footprint as mesophilic digestion, which is the stabilization process currently used at EWPCF. More heat exchanger capacity would be needed for thermophilic digestion, which could be accomplished by replacing the existing units with taller, higher-capacity units.

Two thermophilic scenarios will be explored in the alternatives analysis phase: (1) a 15-day thermophilic process, which guarantees Class B quality, but is limited by the ability to receive high-strength waste based on hydraulic capacity, and (2) a 10-day process, which allows EWA to receive greater quantities of high-strength waste. A new receiving station could be constructed to accommodate the increased quantities of waste.

One of the major questions to be addressed is whether a second thermal dryer is necessary to meet EWA's goals. As the existing building is space-constrained, a new building may need to be constructed to accommodate a second dryer, although efforts are underway to identify building modification alternatives. Ultimately, in the event construction of a new building was deemed desirable, the BC team prepared preliminary layouts for the second dryer that require demolition of the existing dissolved air flotation thickeners (DAFTs). Thus, if a second thermal dryer is required, thickening upgrades would need to be performed prior to the installation of the second dryer.

Next Steps

The biosolids treatment technologies selected through this screening process will be included in end-to-end project alternatives to expand solids-processing capabilities at EWCPF. Technology combinations, shown in Figure ES-1, will be combined with the results of Tasks 3, 4, and 5 to create end-to-end alternatives for further analysis. The three stabilization alternatives—mesophilic digestion, thermophilic digestion, and Class A THP—will each be evaluated with and without a second thermal dryer. Development of end-to-end alternatives will be performed in cooperation with EWA staff prior to analysis.



vi

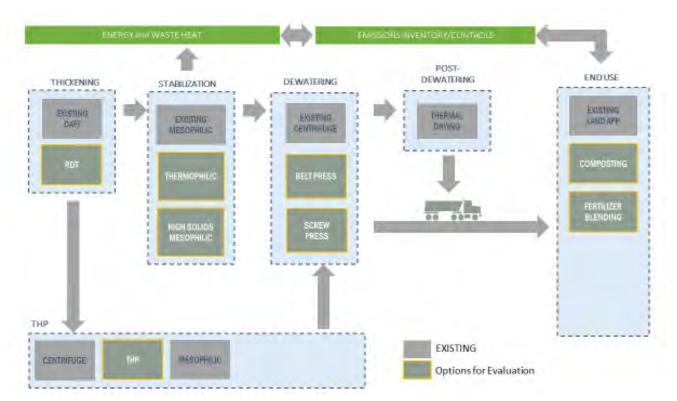


Figure ES-1. Biosolids treatment technology options for EWCPF end-to-end project alternatives.



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vii

Section 1: Introduction

The EWA is developing a Biosolids Energy and Emissions (BEE) Plan, which will serve to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed PMP. The BEE Plan has several goals:

- Provide a comprehensive analysis of all project elements, including solids treatment, waste heat handling, gas processing, and energy generation and use
- Address capacity limitations in the solids and gas handling processes, energy and emissions at the EWPCF
- · Assess which alternative is likely to be the most cost-effective and sustainable solutions for EWA
- Move the EWPCF toward greater energy efficiency and independence
- Reduce greenhouse gas (GHG) emissions

The outcome of this process is an implementable plan resulting in capital improvements to expand system capacities as needed and appropriate, maximize resource recovery capabilities for EWA, and optimize energy production. Under Task 2 of the BEE, the BC team developed a methodology for screening and evaluating technologies for solids handling. Technologies were evaluated for thickening, stabilization, dewatering, and post-dewatering. Stabilization technologies evaluated included alternatives for production of Class A and Class B biosolids. Recommended technologies selected under this task will be advanced for further analysis and will be combined with gas use, energy production, and waste heat alternatives developed under Tasks 3 through 5. This TM describes the evaluation methodology for solids processing and biosolids technologies, the technologies evaluated, and how these technologies were screened and ranked. Screening and ranking of technologies was performed in a workshop with EWA staff, held on August 16, 2017. Meeting minutes from this workshop are provided as Attachment A.

This TM is preceded by TM 1, which addressed the baseline energy profiles and projections, established a mass balance for the solids-handling system, and defined solids projections which are used in the PMP. Calculations performed and discussed in TM 2 are based on the values defined in TM 1.



Section 2: Evaluation Methodology for Biosolids Technologies

The BC team developed a three-part evaluation process for assessing solids processing technologies. The first two parts, described in Sections 2.1.2 and 2.1.3, were performed under Task 2. Use of the Solids Water Energy Evaluation Tool (SWEET) will be performed under Task 7.

The approach to evaluating solids technologies involved a three-step process outlined here:

- First, a pre-screening step incorporating biosolids end-use considerations was performed. Biosolids end use in California is highly regulated and can be complicated. Thus, it is important to incorporate considerations for those technologies that generate a desirable end product that can be beneficially used. These end-use considerations eliminated certain technologies from consideration.
- Next, the selected technologies from the pre-screening step were then evaluated through a fatal-flaw analysis.
- Finally, those technologies that passed the fatal-flaw test were evaluated and ranked using evaluation criteria developed in conjunction with EWA.

These three steps are described in more detail in the following sections.

2.1 Role of Biosolids End Use

By starting with biosolids end use, the BC team evaluated only those technologies that would generate a product suitable for beneficial use in the region. Beneficial use generally refers to those end uses that avoid landfill disposition and provide a benefit, such as soil conditioning or carbon sequestration. While use of biosolids in alternative daily cover has historically been considered a beneficial use, CalRecycle has stated that it intends to phase out this definition in support of overall policies encouraging the diversion of organics from landfills. Other typical beneficial uses include:

- **Cement kilns:** Biosolids have been used in cement plants to produce clinker, the main component of cement, which is an energy-intensive operation. Biosolids have recoverable calorific value that can be used as fuel in making cement—replacing a portion of conventional fossil fuels—if they meet industry specifications. While biosolids have a lower heating value than coal, and generate more ash per British thermal unit (Btu) than coal, biosolids also contain useful minerals that are incorporated into the clinker to make cement.
- Land reclamation: Across the United States, biosolids have been used to reclaim marginal lands including abandoned mines and fire ravaged lands. In this particular end use, large quantities of biosolids are used for a limited period (no more than a few years) to remediate a given parcel or parcels of land. In California, the U.S. Environmental Protection Agency (EPA) Region IX has expressed interest in the use of Class A biosolids to remediate damaged lands.
- **Bulk agriculture:** Use of biosolids in land application is a common and well-established practice in California; more than 60 percent of biosolids generated in the state are managed this way. Land application provides beneficial use of biosolids, applied at agronomic rates as a soil amendment in agriculture.
- Bulk horticulture and landscaping: Class A biosolids can be used in horticultural activities such as landscaping and nursery production (e.g., sod production, establishment of field beds, preparing container mixes for specialty plants, etc.). Products grown in these applications generally have a higher value than those in bulk agriculture and include ornamental flowers, trees, and shrubs.



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- Fertilizer blending: Commercial fertilizer blenders enhance dried biosolids with micro- and macronutrients and then package and market the blend for sale in retail outlets. Blending requires a hard, size-graded pellet or granule product of the type that is typically produced by drum dryer systems. Fertilizers have additional regulatory oversight and requirements by the California Department of Food and Agriculture (CDFA).
- Soil blending: Commercial soil blenders mix native soils, organics, and other ingredients such as sand to produce custom soil blends for a variety of non-agricultural uses, such as in construction, landscaping, and development of green infrastructure. Using dewatered Class A biosolids as an ingredient in the production of blended landscape soils is a newer biosolids management technique.
- Local distribution: Some utilities have been able to successfully distribute Class A biosolids products directly to residents and/or to local users (e.g., road and highway departments, establishment of street trees). This typically requires a value-added Class A product, such as granules, compost, or soil blend, that shares characteristics with commercially available amendments rather than dewatered cake.

Based on market research performed recently by the BC team, EWA's size (i.e. capacity, solids production) makes it difficult to access cement kilns, as EWA has experienced in the past, which require larger volumes of biosolids for use in onsite energy generation. Land reclamation is a practice more common in the northeastern United States, and typically requires large volumes of biosolids over a relatively short period. Bulk agriculture is the primary end use for California biosolids, although it is important to note that some local county ordinances restrict the use of biosolids. Thus, many Southern California wastewater agencies, including EWA, send their biosolids to western Arizona for agricultural land application. Class B biosolids cannot be land-applied in Southern California, while some counties do permit land application of Class A biosolids. A map of the county ordinances, created by the California Association of Sanitation Agencies (CASA), is provided in Attachment B.

Bulk horticulture and fertilizer blending have both been destinations for EWA's dried granules. Bulk horticulture has also absorbed some Class A compost generated by regional composting facilities. Soil blending is a well-established practice, but experience with using biosolids in blends is limited to a few facilities using Class A compost generated by the Inland Empire Regional Compost Facility.

Viable beneficial uses were paired with biosolids products, which in turn were linked to onsite solidshandling processes. The exception is offsite composting—capacity in regional composting facilities exists for the offsite conversion of Class B cake to Class A compost. Stabilization processes were defined generally (e.g., Class A digestion) and, in some cases, several processes will yield a given product, as discussed in greater detail in Section 3.2. These stabilization processes form the starting point for the biosolids technology evaluation. Table 2-1 summarizes the relationship between stabilization processes, relevant post-dewatering processes, products, and beneficial uses.



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Table 2-1. Paired Stabilization Processes, Products, and Associated Beneficial Uses				
Stabilization Process	Post-Dewatering Process	Resulting Product	Associated Beneficial Use(s)	
Class B digestion	None	Class B cake	Bulk agriculture (Arizona only)	
Class B digestion	Class A composting (off site)	Class A compost	Bulk agriculture Bulk horticulture Soil blending Local distribution	
Class B digestion	Thermal drying	Class A granules	Bulk agriculture Bulk horticulture Fertilizer blending Soil blending Local distribution	
Class A digestion	None	Class A cake	Bulk agriculture Soil blending Land reclamation	
Class A THP	None	Class A THP cake	Bulk agriculture Bulk horticulture (with aging) Soil blending Land reclamation	

2.2 Fatal-Flaw Screening

Beginning with the end use, acceptable biosolids technologies capable of generating products for beneficial use were identified. These technologies were then examined through a fatal-flaw filter, which was applied uniformly across all technologies: biosolids, alternative power production, and waste heat use. The four criteria below were developed in conjunction with EWA staff:

- At least one successful North American installation of technology: There must be at least one full-scale installation of the technology at a WWTP in North America.
- At least one successful installation in a facility of similar size: The technology should be sufficiently developed that it is applicable at a facility of comparable size to EWPCF to ensure compatibility.
- Available space: The technology must be accommodated within the limited available footprint at EWPCF.
- Compatibility with plant site and any existing equipment: The technology must be capable of being integrated into the existing WWTP infrastructure.

A discussion of how the fatal-flaw criteria were applied to individual treatment technologies is provided in Section 3.

2.3 Evaluation Criteria Development and Ranking

For those technologies that passed the fatal-flaw filter, further evaluation and ranking was performed. The BC team worked with EWA staff to develop a series of evaluation criteria that reflect the project goals, EWA's values, and EWA's general operational practices. Criteria weights were assigned in a workshop with EWA staff. Criteria are presented in Table 2-2. These criteria were applicable for stabilization technologies. The "energy/resource recovery" criterion was not applicable for the dewatering technologies, which results in a different weighting system. Table 2-3 presents the two different weights associated with the stabilization and dewatering technologies. Evaluation of individual biosolids technologies is discussed in Section 4.



Table 2-2. Biosolids Technology Evaluation Criteria				
Criterion	Description	Scoring Description		
End-use market compatibility	Onsite technology directly produces one of the recommended product alternatives Alternatively, onsite technology product is compatible with product alternatives	Low-score indicates technology product that has not been identified as part of the product list and is not compatible with the product list High-score indicates technology product that is		
		compatible with Class B cake, Class A cake, Class A THP cake, and dried Class A pellet		
	Proven and reliable technology with same configuration intended at EWPCF	Low-score indicates no successful large-scale operating installations in North America or Europe, no		
	Long, successful operating track record	successful demonstration-scale installations in North America or Europe, and unknown safety or reliability record		
Proven technology performance		High-score indicates more than one successful operating installation in North America or Europe, more than one operating installation at a WWTP of at least 40 mgd in North America or Europe, a track record duration > 5 years, and vendors in western United States		
Minimize life-cycle costs	Qualitative metric of program cost Capital and O&M costs based on existing EWA data or similar experience at other WWTPs	Low-score indicates high capital cost to build onsite facilities, high O&M costs, expensive end-use market, and high transportation costs		
	Potential revenues from sales Product/market geographic proximity	High-score indicates low capital cost to build onsite facilities, low O&M costs, potential product revenue, and product destination within 100 miles		
Energy/resource recovery	Increases biogas production through advanced digestion Supports co-digestion of organic waste Recovery of renewable energy	Low-score indicates high energy requirement for onsite technology, no increase in biogas production, technology does not recover energy as biogas, no recovery of renewable energy in biosolids, and no biosolids resource recovery		
	Beneficial use of biosolids product	High-score indicates a higher biogas production, compatible with co-digestion of organic waste, and biosolids resource recovery		
0&M impacts	Impacts to existing WWTP O&M staff levels Complexity of new technology O&M and control systems Reliability of new technology (potential downtime)	Low-score indicates more 0&M time required, complex mechanical and control systems required compared with existing WWTP facilities, potential equipment downtime, and new chemicals or hazards		
	Minimal impacts to WWTP safety	High-score indicates reduction in O&M staff time required, new technology is simple to operate and maintain, reliable with minimal downtime, and no new chemicals or hazards		
Environmental impacts	Impacts to carbon footprint and air permitting	Low-score indicates high carbon footprint for technology, high travel distance to end use, difficult to treat sidestreams, and new permitting for environmental regulatory requirements		
		High-score indicates low carbon footprint for technology, low travel distance to end use, minimal sidestream generation or impacts, and no additional permitting for environmental regulatory requirements		



Table 2-2. Biosolids Technology Evaluation Criteria				
Criterion	Description	Scoring Description		
Community and stakeholder impacts	Minimize nuisance impacts such as dust, odors, vectors, aesthetics, noise and traffic	Low-score indicates that nuisance factors for onsite technology are difficult to mitigate		
community and stakeholder impacts	Assess impacts to partner agency issues/values as well as local planning codes and requirements	High-score indicates that nuisance factors can be mitigated at WWTP site		
	Assess compatibility of technology with available WWTP footprint Incorporation into existing treatment process	Low-score indicates lack of site space for new facilities, requires abandonment of existing facilities, and difficult integration with existing WWTP		
Project site compatibility		High-score indicates available footprint for new facilities and maintains space for future facilities, and ease of integration with existing processes and facilities		

O&M = operations and maintenance

Table 2-3. Biosolids Technology Evaluation Criteria Weighting Values				
Criterion	Stabilization Weight	Dewatering Weight		
End-use market compatibility	15%	15%		
Proven technology performance	15%	25%		
Minimize life-cycle costs	10%	20%		
Energy/resource recovery	20%	N/A		
O&M impacts	10%	15%		
Environmental impacts	10%	5%		
Community and stakeholder impacts	10%	5%		
Project site compatibility	10%	15%		

2.4 Solids-Water-Energy-Evaluation Tool

Under Task 7, biosolids treatment technologies will be combined with biosolids beneficial use, alternative power production, and waste heat technologies to create holistic end-to-end alternatives. BC's SWEET will be used to efficiently evaluate the feasibility and energy and economic profiles of brainstormed alternatives, and compare those alternatives with the current program to provide a baseline for measurement. SWEET tracks volatile solids (VS), inert solids, and water through potential process alternatives and considers energy required to power/heat those processes and forecast energy production and material recovery. It also allows comparison of energy balances with integration of multiple feedstocks, and estimation of the carbon footprint of each alternative. Two notable advantages of SWEET include its ability to evaluate alternatives in real time during workshops and its transparency of all the factors used.

Key model outputs to facilitate alternative selection included:

- Capital costs
- Operations and maintenance (O&M) costs
- Economic net present value



Another advantage of SWEET is that it allows for an iterative evaluation process; if aspects of certain alternatives appear to provide strong benefits; these aspects can be incorporated to create an optimized set of alternatives for evaluation. In this evaluation, the iterative evaluation is used to develop the most advantageous program for EWA.



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Section 3: Identification of Biosolids Technologies

Table 3-1 contains a general description of the technologies needed to generate the desired end products. Specific thickening, digestion, dewatering, and post-dewatering technologies identified in

Workshop 2 with EWA staff are summarized in Table 3-1. Descriptions of each of the identified technologies follow in this section. Some technologies were eliminated at the outset. Although a number of technologies could be accommodated at the site, EWA staff were comfortable with the recommendation from the PMP to install rotary-drum thickeners (RDTs) for the thickening process. In the alternatives evaluation, these will be compared against the currently installed thickening equipment. With respect to stabilization processes, several processes were eliminated from the outset. Lime stabilization was briefly considered but produces an odorous product in a region where agricultural demand for lime is low. In addition, it would require installation of new equipment at EWPCF, including appropriate odor control. Aerobic digestion was also considered but is not compatible with the size of EWPCF or the energy goals of EWA.

Table 3-1. Biosolids Treatment Technologies Selected for Evaluation				
Thickening Technologies	Stabilization Technologies	Dewatering Technologies	Post-Dewatering Technologies	
Primary clarifier	Mesophilic digestion	Centrifuge	Drum dryer	
DAFT	Mesophilic high-solids digestion	BFP	Indirect dryer	
RDT	Acid/gas digestion	Screw press	Gasification	
	Staged digestion	Volute press	Pyrolysis	
	Thermophilic digestion	Bucher press	Partial solar drying	
	TPAD		Deep-well injection	
	Enzymatic hydrolysis		Dehydration	
	Thermo-chemical hydrolysis		Incineration	
	Lystek			
	Class A THP			
	Exelys THP: DLD			
	THP: SolidStream Cambi			

BFP = belt filter press; DAFT = dissolved air flotation thickener; TPAD = temperature-phased anaerobic digestion

3.1 Thickening Technologies

Selection of a thickening process is critical to the design and performance of downstream digestion. The more efficient the thickening process is, the more concentrated the solids being sent to digestion are, allowing for better digestion performance. Thickening technologies were evaluated for the thickening of PS, waste activated sludge (WAS), and a combination of the two. Currently EWA operates sludge thickening at EWPCF using primary clarifier thickening for PS as well as a dissolved air flotation thickener (DAFT) process for WAS; details of these technologies are also included below.



3.1.1 Primary Clarifier Thickening

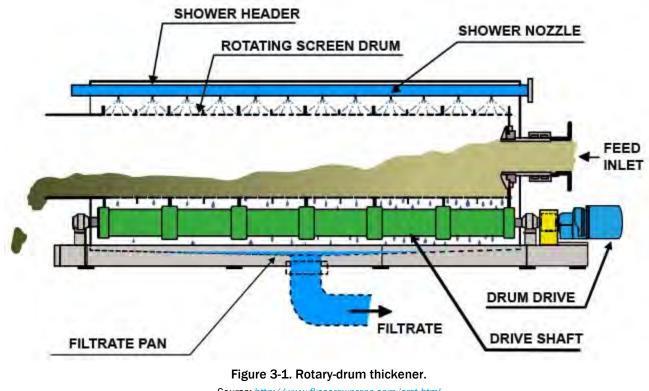
In primary clarifier thickening, sludge settles by gravity in the primary clarifier and is pumped out to the digester feed system via a dedicated line. Historical use of this process shows an improvement in digester performance as compared to sending thin PS to digestion. EWA typically achieves 4.1 percent total solids (TS) in the PS using primary clarifier thickening. The process is easy to operate and is space-efficient, but does not achieve as high a TS content as some of the other processes detailed herein.

3.1.2 Dissolved Air Flotation Thickening

As mentioned above, DAFT is the current process used to thicken WAS at EWPCF. The DAFT process works by forming air bubbles in a tank to which suspended solids attach. The adhered solids float to the surface, where they can be removed with the aid of a skimming device. Polymer is often added as a coagulant aid. DAFTs have the advantage of being relatively simple to operate, and EWPCF typically achieves 5.6 percent TS from its DAFT process. While currently used only for WAS, DAFTs can be used to co-thicken PS and WAS if desired; however, operating in this configuration may generate more odors.

3.1.3 Rotary-Drum Thickening

RDTs feed sludge into a rotating perforated drum with a screw to carry sludge to allow water to separate from sludge material while solids are conveyed to a discharge point for piping. A polymer is typically added upstream of the RDT to encourage large solids flocs. Figure 3-1 shows a typical RDT system.



Source: http://www.fkcscrewpress.com/crst.html



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Because of the enclosed system design, RDTs typically have low odor control requirements, require smaller footprint, are simple to operate, and have low capital and O&M costs as compared to other mechanical thickening equipment such as gravity belt thickeners and thickening centrifuges. The PMP evaluation noted that the O&M costs associated with RDTs are also lower than those associated with the existing thickening system. However, RDTs are also known to be sensitive to sludge feed concentrations and require a significant wash water demand.

3.2 Stabilization Technologies

Digestion is the core stabilization technology for the purpose of reducing pathogens, reducing vector attraction, and generally making a biosolids product capable of meeting regulatory requirements associated with beneficial use. Individual digestion technologies evaluated in this process are described below. As discussed previously, only anaerobic digestion technologies were considered in this evaluation.

3.2.1 Mesophilic Anaerobic Digestion

Mesophilic anaerobic digestion (MAD) is a conventional sludge stabilization process. MAD employs operating temperatures between 95 and 102 degrees Fahrenheit (°F) and solids are digested under anaerobic conditions. Typically, MAD systems are operated at a minimum hydraulic retention time (HRT) of 15 days, which, when requirements for vector attraction reduction (VAR) are met, guarantees Class B pathogen status for beneficial use. This stabilization process has the longest operational history of all the processes under consideration, with the most supporting operational data to date.

Although this alternative provides the major benefits of operational simplicity and a long history of operation, the process has its disadvantages when compared to newer, more aggressive technologies. While MAD operates efficiently, the degradation rates are relatively low when compared with other advanced digestion processes. This lower biological degradation rate manifests itself in terms of lower VS destruction, lower gas production, more tankage volume required, and additional mass of solids for disposal relative to the other processes evaluated. In addition, use of MAD allows for less available capacity for co-digestion substrates because of the inherently lower organic loading rate (OLR) associated with the process. As MAD is the current stabilization technology at EWPCF, it passed the fatal-flaw filter.

3.2.2 Mesophilic High-Solids Digestion

A high-solids MAD or recuperative thickening is a process that thickens digested sludge (DS) from the digester and returns it back to the digester, increasing solids retention time (SRT) and returning anaerobic bacteria to the digester to increase biological activity. Thickening processes include centrifuges, gravity belt thickeners, and DAFT.

The major benefit of this process is the increase in SRT, which means that more capacity is available in the digester. This is often beneficial when a tank is taken out of service for maintenance, or may prolong construction of future additional digesters. However, this process can be complex to operate, requires process equipment in addition to process equipment for the digester system, and requires additional polymer. Industry experience with this process is fairly limited; current installations are on digesters of much smaller volume than those at EWPCF. The BC team recommended that this process pass the fatal flaw filter, but only for installation on the smaller digesters at EWPCF (which would need to be rehabilitated for such an installation). If EWA chose to implement such an alternative, it would enable them to gain experience in operating a high-solids digestion system prior to installing it on the large digesters.



3.2.3 Staged Mesophilic Anaerobic Digestion

In a conventional MAD system, digesters are operated in parallel. In staged MAD, the digesters are operated in series. The first stage consists of heating and mixing the feed sludge to sufficiently stabilize the influent sludge. In this first stage, an HRT of 7 to 10 days is used but a higher OLR may be selected to reduce the overall footprint. The second stage receives, heats, and mixes sludge from the first stage, but operates at a lower HRT because the bulk of digestion takes place in the first stage.

The advantage of this process is significantly reduced short circuiting, which in turn improves VS reduction (VSR) and final product stability. Thus, higher-quality biosolids are typical when compared against a singlestaged mesophilic system operated at an equivalent detention time, although in both cases, Class B biosolids are produced. Finally, a minor increase in gas production may be observed with this process. Despite these advantages, this alternative requires a larger overall footprint than conventional MAD and may require additional heating as compared to the current system. Given the limited available digestion footprint at EWPCF, this technology did not pass the fatal-flaw filter.

3.2.4 Acid-Gas Phase Digestion

Acid-gas phase digestion (also known as multi-phase or two-phase digestion) is a two-phase process in which two separate tanks are designed around different process goals, allowing the conditions in each tank to be optimized for the desired metabolic process. The first phase, the acid phase, is characterized by short HRT, typically 1 to 2 days, and low pH. Under these conditions, the acid-forming bacteria respire optimally, converting the particulate organics to volatile acids. The gas phase receives sludge from the acid phase, and has a longer HRT. The high level of volatile acids in the sludge supports a strong methanogen population.

As with conventional MAD, a total 15-day HRT is desirable in the acid-gas digestion process, and the sum of both the acid phase and the gas phase HRT are used to achieve this goal. However, most of the gasification of organics occurs in the second phase rather than the first. It is important to note that the acid phase sludges and gases are corrosive, and appropriate equipment and construction materials are required. Optimization of the fermentation stage is important for effective operation of acid-gas digestion. Gas from the acid phase includes carbon dioxide (CO₂), methane (CH₄), and hydrogen sulfide (H₂S), and is commonly connected to the digester gas system. If the gas phase is not connected to the gas system, extensive odor control may be required. Excessive retention times in the acid phase may increase odorous compounds, including H₂S. These compounds may impact the operational life or performance of gas utilization equipment and may generate odors at the flares. In addition, acid-gas digestion can be very challenging to operate correctly, despite its apparent similarities to MAD. For these reasons, acid-gas digestion did not pass the fatal-flaw filter.

3.2.5 Thermophilic Anaerobic Digestion

Thermophilic anaerobic digestion (TAD) is a means of enhancing digestion capacity at the facility through anaerobic digestion at thermophilic temperatures, ranging from 122 to 132°F. The high-temperature operation increases reaction rates and provides additional gas production, solids destruction, and increased pathogen inactivation. TAD can accommodate approximately double the OLR of MAD, up to 0.4-pound VS per cubic foot per day (Ib-VS/ft³-d).



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Thermophilic digestion can be configured to generate Class A biosolids. This can be accomplished with batch tanks, for example, where the sludge is held for 24 hours at thermophilic temperatures (131°F or greater) to meet EPA requirements for Class A. Some wastewater treatment facilities, like the City of Los Angeles, have produced Class A biosolids using thermophilic digestion with limited-size batch tanks, which results in somewhat less time and temperature stipulated by the Class A criteria; however, additional sampling and testing of the biosolids is required to demonstrate Class A compliance in such instances. TAD would easily integrate within EWPCF and, as a well-proven technology, it passed the fatal-flaw filter.

3.2.6 Temperature-Phased Anaerobic Digestion

A temperature-phased anaerobic digestion (TPAD) system operates in two distinct temperature phases, digesting sludge in different tanks arranged in series. The first phase is the thermophilic phase, which typically operates at an HRT between 5 and 10 days. This is followed by a mesophilic phase typically operated between 6 and 15 days HRT. If Class B biosolids are desired, the TPAD system would be designed such that the combined retention time meets the 15-day HRT requirement. As with the TAD system, the OLR is approximately double MAD, at 0.4 lb-VS/ft³-d, applied to the first-stage thermophilic digester. This high loading rate can allow for smaller digesters or fewer digesters to be constructed, reducing footprint relative to the overall system capacity, if the relevant criterion for total system HRT is met.

By phasing the digestion process through the thermophilic phase to the mesophilic phase, the advantages of thermophilic digestion are gained but carry an additional benefit of allowing the mesophilic phase to "polish" the volatile acid concentrations, improve VSR, and reduce odors. The thermophilic digestion process is typically characterized by high biogas production rates, high VS destruction (65 to 65 percent), and significantly enhanced pathogen kill. Essentially, most of the stabilization occurs in the thermophilic phase. In this phase because of the higher OLR and temperature, there are higher volatile acid and ammonia concentrations. When cooled and allowed to enter the mesophilic phase, these concentrations are polished, decreasing volatilized ammonia and other odorous compounds. Like TAD, TPAD can be configured to generate Class A biosolids. The footprint required for TPAD, however, cannot be accommodated within the available area of EWPCF, and therefore this technology did not pass the fatal-flaw filter.

3.2.7 Thermal Hydrolysis Process

THP is an anaerobic digestion pretreatment system that results in more efficient wastewater solids processing and energy production and, in certain configurations, achieves Class A biosolids. The three types of THP systems presented and screened are Class A THP, Exelys digestion-lysis-digestion (DLD), and SolidStream[™] Cambi.

3.2.7.1 Class A THP

Class A THP is a mature technology in Europe and world-wide with full-scale facilities in service since 1995; the first installation in the United States (DC Water) has been operating since late 2014 and other U.S. installations are in the planning, design, and construction phases. There are two primary manufacturers of Class A THP – Cambi and Veolia. Class A THP uses medium-pressure steam to create high temperature and pressure conditions, which lyse bacterial cells and promote the release and solubilization of particulate organic material, making the feed solids more amenable to digestion. Figure 3-2 below depicts a typical process flow of the Cambi Class A THP system. THP can also be used in a WAS-only configuration, where it would generate Class B biosolids. This process will be discussed and evaluated in TM 4.



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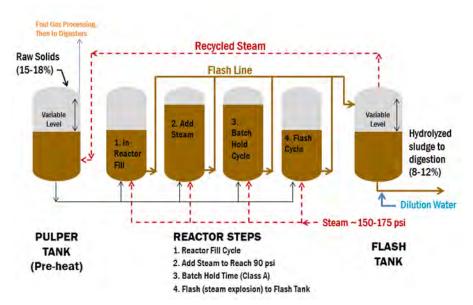


Figure 3-2. Cambi thermal hydrolysis process.

The vast majority of Class A THP systems have been implemented by Cambi. However, competitor THP systems have been installed in Europe, and Veolia's Biothelys system has been installed in the United Kingdom at a size comparable to EWPCF. THP systems can approximately double MAD OLRs because of the modified characteristic of the feedstocks. This more efficient use of digester volume reduces the number of digesters required. Ancillary buildings and equipment are required to operate a THP system, including steam boilers, pre-dewatering centrifuges, raw cake storage, and sludge cooling systems. While THP systems can reduce digester volume required, these ancillary systems impact total system cost, complexity, and footprint. Given that this technology is proven and can be integrated into the EWPCF foot-print, it passed the fatal-flaw filter.

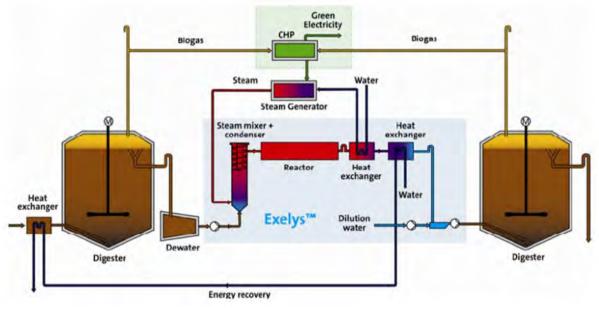
3.2.7.2 Exelys Digestion-Lysis-Digestion

Exelys-DLD is a process developed by Veolia. While many THP systems use a batch process, Exelys uses a continuous flow reactor. In the DLD configuration, hydrolysis does not occur on the digester feed. Hydrolysis is placed between two digestion steps instead of prior to digestion, as shown in Figure 3-3. This configuration helps digestion by hydrolyzing solids that are resistant to digestion. The readily digested material has already been digested in the first digestion stage, leaving only the harder-to-digest organics. This material is now more digestible in the second-stage digester. Relative to MAD, this system would produce more biogas and destroy more solids. The process requires more digestion tankage than more common THP approaches and this makes it infeasible for EWA. In addition, Exelys-DLD does not have full-scale installations in North America. This technology thus failed the fatal-flaw filter.



3-6

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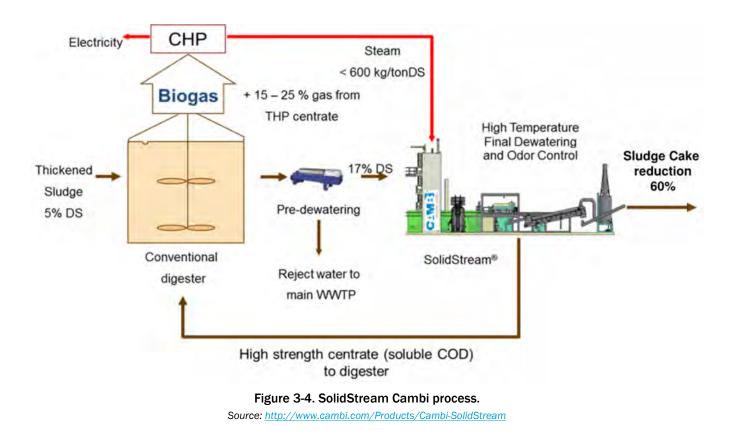


3.2.7.3 SolidStream Cambi

SolidStream Cambi is different from Cambi's traditional Class A THP in that it does not hydrolyze the solids prior to digestion. The sludge is digested in a digester, such as MAD, and then the DS is dewatered. Dewatered sludge enters the SolidStream system where it is hydrolyzed and final dewatered as a hot material. In this process, the dewaterability of the sludge is increased by increasing the temperature and pressure. This degrades the extracellular polymeric substances, which causes the release of more water from the sludge. Immediately following hydrolyzing, the solids are dewatered using a centrifuge without the addition of polymer. The centrate is fed to the digester and cake can be a Class A material. Figure 3-4 provides an overview of this process. The benefit of SolidStream Cambi is the increased dewaterability of the solids and the additional soluble COD from the centrate can increase gas production. This technology has yet to be installed in North America and it has not been demonstrated on the scale of EWPCF. Therefore, this technology failed the fatal-flaw filter.



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3.2.8 Enzymatic Hydrolysis

Enzymatic hydrolysis is a stabilization method that enhances enzyme activity of the anaerobic bacteria by using six serial reactor vessels. The initial enzymatic hydrolysis process tanks operate between 95°F and 108°F with short detention times (e.g., 3 days) to promote acidogenic bacterial growth. The subsequent process tanks can operate at upwards of 95°F, which promotes the growth of methanogens.

The company Monsal (<u>www.monsal.com</u>) is the major technology provider in Europe with about 11 reference installations in the United Kingdom. Monsal claims that its high-rate hydrolysis technology and equipment can be retrofitted to existing digestion plants for upgrade or developed as part of new build turnkey digestion plants. Claimed key benefits of Monsal advanced digestion technology include: (1) high digester loading greater than 0.19 to 0.38 lb-VS/ft³-d; (2) improved solids dewatering—up to 30 percent DS; and (3) high biogas yields. This technology has not been installed full-scale in North America, and it thus failed the fatal-flaw filter.

3.2.9 Thermo-Chemical Hydrolysis

The thermo-chemical hydrolysis process uses chemicals and elevated temperature to expedite the hydrolysis step. The major technology provider is CNP Technologies and its Pondus TCHP process. CNP currently operates a full-scale pilot operation at the Kenosha WWTP in Kenosha, Wisconsin.



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TCHP is designed to focus on TWAS pretreatment. In this process, TWAS is mixed with caustic soda (1,500 to 2,000 parts per million [ppm]) to reach a pH of approximately 11. TWAS is then heated to thermophilic temperatures (150°F to 160°F), using heat exchangers prior to being fed to the reactor. Detention time of the reactor is between 2.0 and 2.5 hours, during which the hydrolysis breaks down the cell walls and releases internal organic acids. The hydrolyzed sludge is then sent to the digesters for digestion. The Pondus TCHP has seen reported benefits of higher VSR, biogas production, and dewaterability of cake. The nature of the chemical storage and the addition of a new reactor in proximity to digestion was believed to be an incompatibility with the EWPCF site, and this technology thus failed the fatal-flaw filter.

3.2.10Lystek

Lystek is a Canadian company with several full-scale installations in Canada and one full-scale installation in the United States. Lystek uses a process that thermally hydrolyzes the solids after digestion and dewatering. This process can be performed on digested or raw sludge. The result is a Class A fertilizer product. Additionally, Lystek claims that the solid material after it has undergone its process can be fed back into the digester to provide more biogas production and higher VSR. It can also be used as a carbon source for biological nutrient removal. Lystek opened its first U.S. installation in Fairfield, California, in 2016. This is a regional facility treating solids from several Bay area treatment plants, roughly equivalent to the solids production from a 150 mgd treatment plant. There are concerns whether the product meets vector attraction reduction requirements. As a proven process that could be accommodated within EWPCF's footprint, Lystek passed the fatal-flaw filter.

3.2.11Summary of Fatal-Flaw Evaluation

Table 3-2 displays the results of the fatal-flaw analysis for stabilization technologies. Passing the fatal-flaw filter are MAD, high solids mesophilic digestion, thermophilic digestion, Class A THP, and Lystek as presented and discussed during Workshop 2. All the stabilization technologies selected have a sound technological basis and could theoretically be integrated into the site given sufficient footprint; thus, none of the technologies failed the compatibility criterion. Technologies that failed fatal-flaw criteria did so as follows:

- Technology maturity: Enzymatic hydrolysis, Exelys-DLD, and SolidStream Cambi do not have full-scale installations in North America and thus failed on this criterion.
- Successful operation of comparable size: Enzymatic hydrolysis, Exelys-DLD, and SolidStream Cambi have been proved at demonstration scale only outside of North America.
- Available space: Preliminary calculations were performed to assess the ability to incorporate staged digestion processes such as acid-gas, TPAD, staged MAD, or Exelys-DLD. These calculations are provided for reference in Attachment C. The results indicated that the site cannot accommodate any of the staged digestion processes within the existing digestion area footprint and tankage.

Table 3-2. Solids Stabilization Fatal-Flaw Results				
Technology	Technology Maturity	Successful Operation of Comparable Size	Available Space	Compatibility
Mesophilic digestion	Pass	Pass	Pass	Pass
Mesophilic with high solids	Pass	Pass ¹	Pass	Pass
Staged digestion	Pass	Pass	Fail	Pass
Acid/gas phased digestion	Pass	Pass	Fail	Pass
Thermophilic digestion	Pass	Pass	Pass	Pass



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Table 3-2. Solids Stabilization Fatal-Flaw Results				
Technology	Technology Maturity	Successful Operation of Comparable Size	Available Space	Compatibility
TPAD	Pass	Pass	Fail	Pass
Class A THP	Pass	Pass	Pass	Pass
Exelys-DLD	Fail	Pass	Fail	Pass
SolidStream Cambi	Fail	Fail	Pass	Pass
Enzymatic hydrolysis	Fail	Fail	Pass	Pass
Chemical hydrolysis	Pass	Pass	Pass	Fail
Lystek	Pass	Pass	Pass	Pass

¹ Passes fatal flaw filter for inclusion on small digesters at EWPCF only.

3.3 Dewatering Technologies

This section presents dewatering technologies the BC team looked at as part of this evaluation. EWA has utilized both centrifuges and belt filter presses (BFPs) for dewatering; the team expanded the evaluation to newer technologies as well.

3.3.1 Centrifuge

Centrifuge dewatering is a well-known technology in the wastewater industry. It uses centrifugal force to push solids to the outside of the conveyor for collection and allow water to separate and collect in the center for discharge. Polymer may also be added to increase solids accumulation and separation. The downside of centrifuges is their higher energy demand. Centrifuges are the current dewatering technology employed at EWPCF and passed the fatal-flaw filter.

3.3.2 Belt Filter Press

Another common dewatering technology, BFPs have been in the wastewater industry for decades. BFPs apply mechanical pressure to sludge by pressing two belts together. They use cloth and rollers to remove water from sludge. The machine is basically divided into three zones: (1) gravity, where free-draining water is removed, (2) wedge zone, where sludge is prepared for high-pressure application, and (3) pressure, where high pressure is applied between belts to remove water. Typically, a BFP can achieve solids content of 12 to 35 percent, depending largely on feed characteristics. Maintenance is relative simple; however, odors may be a problem. While BFPs have been used previously at EWPCF, they could not be accommodated in the current dewatering area and would need to be located elsewhere, potentially at the exclusion of other improvements. This aspect of siting will be addressed in the construction of alternatives and will be described in TM 7. BFPs pass the fatal-flaw filter.

3.3.3 Screw Press

Screw presses are a relatively new technology compared to centrifuges and BFP. However, there are many installations in North America. A screw press is a conical screw shaft surrounded by cylindrical sieves. As the screw rotates, the sludge slowly moves along the shaft and water is pressed out through the sieves. Screw press manufacturers claim that this technology offers less maintenance, lower wash water consumption, and lower energy consumption. This proven technology could be integrated into the EWPCF footprint; although, as noted with belt presses, they could not be accommodated in the current dewatering area and



would need to be located elsewhere, potentially at the exclusion of other improvements. Screw presses passed the fatal-flaw filter.

3.3.4 Rotary Press

Rotary press is a simple technology. Sludge enters the channel and rotates between two filtering elements. The water passes through these filters as the sludge continues to travel along the channel. The dewatered sludge collects at the exit of the channel where it is extruded as cake. Manufacturers claim that rotary presses have few mechanical parts, reducing maintenance. This proven technology could be integrated into the EWPCF footprint, although, as noted with belt presses, they could not be accommodated in the current dewatering area and would need to be located elsewhere, potentially at the exclusion of other improvements. Rotary presses passed the fatal-flaw filter.

3.3.5 Volute Press

A volute press is similar to a screw press. However, instead of using a shafted screw, it contains main discs stacked together horizontally. As the sludge moves along the discs, water is pressed between the discs. The volute press is found primarily in industrial applications, but there are a few municipal installations in North America. This is, however, a proven technology that could be integrated into the EWPCF footprint; although, as noted with belt presses, they could not be accommodated in the current dewatering area and would need to be located elsewhere, potentially at the exclusion of other improvements. Volute presses passed the fatal-flaw filter.

3.3.6 Bucher Press

The Bucher press has installations worldwide including one installation in Victoriaville, Quebec. This installation dewaters excess sludge and dairy waste and is at a comparable capacity as EWPCF. However, it is not a domestic wastewater treatment facility, thus, the Bucher press failed the fatal flaw filter. The Bucher press operates in cycles, lasting 70 to 120 minutes. The cylinder, which contains filter cloth (filter sleeves), is filled with sludge. A press piston is moved forward, forcing the liquid through the filter cloth. The press piston expands, allowing the sludge to loosen and the process is repeated until the desired solids content has been achieved.

3.3.7 Summary of Fatal-Flaw Evaluation

Table 3-3 displays the results of the fatal-flaw analysis for dewatering technologies. In this category, all but the Bucher press passed the fatal-flaw filter. While there are installations of the Bucher press in Canada and Europe, there are no known municipal sludge installations in North America. Also, the complexity of operation and additional cost was felt to be incompatible with an installation at EWPCF.

Table 3-3. Dewatering Technologies Fatal-Flaw Results				
Technology	Technology Maturity	Successful Operation	Available Space	Compatibility
Centrifuge	Pass	Pass	Pass	Pass
BFP	Pass	Pass	Pass	Pass
Screw press	Pass	Pass	Pass	Pass
Rotary press	Pass	Pass	Pass	Pass
Volute press	Pass	Pass	Pass	Pass
Bucher Press	Pass	Fail	Pass	Fail



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3.4 Post-Dewatering Technologies

Post-dewatering technologies allow for further processing and the creation of new biosolids products. The existing technology—direct drum drying—is discussed along with other potential process train additions.

3.4.1 Direct Drum Drying

A drum dryer is a direct drying process that mixes heated air with biosolids in a triple-pass rotary system. The heated air comes in contact with the biosolids in the rotating drum, evaporates water from the biosolids, and produces a granule. Drying begins when dewatered sludge is mixed with the recycled solids to control the moisture content of the mixture and minimize sticking to the inner surface of the drum and to allow the wetter sludge to absorb the finer solids coming from the crusher. Air heated to between 850°F and 950°F is introduced in the drum while the sludge mixture tumbles through and exits the other end. From the dryer, the dried solids are fed to a separator to separate the hot air from the solids. The solids are then screened; particles of the appropriate size are conveyed to storage silos while other solids are sent to the crusher. The crushed biosolids are blended with fresh dewatered sludge as described previously. Air emission and odor control systems consist of polycyclones, impingement trays, condensers/sub-coolers, venturi scrubbers, and regenerative thermal oxidizers (RTOs) for the process of off-gas emission control. Up to 75 percent of exhaust gas recirculation is applied to increase the efficiency of the drying system and reduce total dryer system air emissions and odor potential. This existing post-dewatering technology on site at EWPCF passed the fatal-flaw filter.

3.4.2 Indirect Drying

Indirect drying systems use convection heat transfer processes as opposed to conduction heat transfer used in direct dryers. Conduction systems are often called "indirect" dryers because the biosolids do not come in direct contact with the heat medium. A conduction system has significantly less exhaust air to treat than a convection system and typically has a smaller footprint than a similarly sized convection system. But conduction systems such as paddle or vertical tray dryers typically produce an irregular shaped product with a relatively high concentration of fines, although some can produce more uniform granules with reasonably low dust concentrations. Convection systems can operate in the 300°F to 1,000°F range, depending on the specific dryer.

There are a number of manufacturers of indirect dryers. While some indirect drying technologies can produce Class A biosolids, they yield a product with different characteristics from the drum dryer. The complexity of operating two different drying technologies and managing two different products was believed to be an incompatibility with the EWPCF site, and indirect drying thus failed the fatal-flaw filter.

3.4.3 Solar Drying

Solar drying uses radiant and convective heat transfer methods in a greenhouse system to dry the solids. The greenhouse system is typically constructed with multiple large bays that allow for isolating a bay once it is fully loaded. Dewatered solids are spread in thin layers inside a drying chamber. A microprocessor controls vents and fans to optimize the humidity level within the chamber to promote drying. A small automatic mobile mixer agitates the solids on the bed to promote drying. Solar drying is typically used to dry to between 40 and 90 percent TS. Higher TS concentrations require more time in the drying chamber. Demonstrating compliance of solar drying with Class A criteria may require testing of each batch of material. The primary advantage of solar drying is the low energy needed to create a partially dried biosolids product. The primary disadvantage of solar drying is that it requires significant site space; in the case of EWPCF, it requires a greater footprint than that available and it thus failed the fatal-flaw filter.



3.4.4 Gasification

Gasification is a partial oxidation process, where sub-stoichiometric quantities of air (oxygen) are injected with biosolids into a gasifier to allow partial combustion of carbon to CO₂, which then reacts with carbon to produce carbon monoxide (CO). The gasification process takes place at temperatures ranging from 1,472°F to 1,832°F. The gaseous products from biosolids gasification are CO, hydrogen, and CH₄ with trace amounts of nitrogen, CO₂, and H₂S. The product gases (called syngas) can be combusted directly after removal of particulates and acid gases, or further purified to a higher value (greater thermal energy) gas. The process generates a solid residue (char) that can be used for a variety of applications such as for making asphalt or as filler material in building and landscaping.

Gasification of biosolids is considered to be an emerging technology in the United States, with no operating full-scale facilities at this time. It is a complex process that requires drying of the biosolids prior to gasification. There have been numerous pilot studies, and one full-scale system constructed, but that facility was closed for financial reasons during an extended startup phase that encountered numerous difficulties processing the solids. One supplier of gasification systems has recently developed a wood waste gasifier in Tennessee and is processing relatively small quantities of biosolids with the wood waste. As an emerging technology, gasification failed the fatal-flaw filter.

3.4.5 Pyrolysis

Pyrolysis is a thermochemical conversion process that is performed in the absence of oxygen. Like gasification, pyrolysis systems tested to date with biosolids require drying of the solids to 90 percent TS prior to being introduced into the pyrolysis unit. The process converts the biosolids to biochar and syngas. Pyrolysis occurs at temperatures of approximately 1,000 °F. The syngas is a low-grade energy source with a heat value of approximately 500 Btu per standard cubic foot and is composed of a mixture of CH₄, CO₂, and hydrogen, with other contaminants. The biochar can be sold as a slow-release fertilizer.

Like gasification, pyrolysis is considered to be in its infancy. One system supplier, KORE Infrastructure, conducted a 6-year pilot test at Los Angeles County Sanitation District that concluded in 2015. KORE is planning for a full-scale system in San Bernardino County with a capacity of reportedly 150 dry tons per day (dtpd). As an emerging technology, pyrolysis failed the fatal-flaw filter.

3.4.6 Incineration

Incineration of dewatered solids achieves the greatest reduction in volume and mass for subsequent reuse or disposal by eliminating the water content of the solids and oxidizing the organic material in the sludge. The resulting sterile ash consists of the inert portion of the dry solids. The overall reduction is greater than 90 percent of wet solids feed. While there are opportunities for beneficial use of the ash, it is typically sent to landfill for disposal.

Incineration is particularly suited for plants with limited space, large solids generation, no anaerobic digestion, and continuous, controlled operation despite weather conditions. The primary concern with incineration is public perception that an incinerator produces harmful air emissions. These perceptions combined with regulatory requirements can result in a need for additional time for planning to obtain an air emissions permit. Complex and advanced air emissions control equipment is required to meet regulation. Because of the public perceptions, stringent regulatory requirements, and heavy onus on the owner to prove environ-mental compliance of this technology, new incineration facilities have not been developed in the United States in decades. In California, only two active incinerators exist at WWTPs, and the incinerator used by the Palo Alto Regional Water Pollution Control Facility will be shut down within the next 5 years. Plans for a new incinerator in Southern California, proposed by Liberty Energy, were sidelined by public opposition and



challenges in gaining permit approvals. The likelihood of getting a new incinerator permitted in a timely fashion was believed to be an incompatibility and it thus failed the fatal-flaw filter.

3.4.7 Deep-Well Injection

Deep-well injection for biosolids is a proprietary technology of GeoEnvironment Technologies (GET), which was recently acquired by Advantek Waste Management Services (Advantek), located in Houston. Using this process, undigested sludge would be thickened and then pumped to an injection facility, consisting of a screening system, mixing tank, and high-pressure injection pumps. The high-pressure injection pumps would convey thickened sludge at around 2.5 percent TS content through deep injection wells to an underground suitable geologic formation deeper than 5,000 feet. In the underground formation biosolids would undergo anaerobic digestion, with stabilization of solids and production of CO₂ and CH₄.

The first full-scale demonstration of deep-well injection of biosolids was developed for the City of Los Angeles at the Terminal Island WWTP. The project, referred to as the Terminal Island Renewable Energy (TIRE) project, began operation in 2008 and was scheduled to be a 5-year demonstration project, but has operated for the past 8 years. The process accommodates approximately 13 percent of the City's biosolids production. The success of this technology is geologically specific, and Advantek has been challenged to find other suitable locations, thus causing this technology to fail the fatal-flaw filter.

3.4.8 Dehydration

Dehydration is another term for thermal drying of biosolids. This technology has been used mainly for food waste. Recently, it has been proposed to use with dewatered biosolids. This may be feasible, but experience has shown that it can take years for manufacturers of drying systems used for various materials to learn how to apply the technology for drying biosolids. The difficulties of providing a homogenous source to the dryer and the physical characteristics of the sludge can make thermal drying difficult. As an emerging technology, dehydration failed the fatal-flaw filter.

3.4.9 Fatal-Flaw Evaluation

Table 3-4 contains the results of the fatal-flaw analysis for post-dewatering. The current technology in use, a drum dryer, passed the fatal-flaw filter. The other technologies evaluated failed in all but the available space category, as follows:

- Technology maturity: While biosolids-to-energy technologies have advanced in the past decade, there has yet to be a full-scale installation of pyrolysis or gasification at a municipal WWTP.
- Successful operation: Gasification and pyrolysis pilot and demonstration units have been installed at WWTPs but none of these have been of a size comparable to what would be required for EWPCF.
- Compatibility: While indirect dryers are a well-established technology, EWA already has a direct dryer installed. The difficulty of operating two separate drying technologies and managing two separate dried products presents a fundamental incompatibility with EWA's operations.



Table 3-4. Post-Dewatering Fatal-Flaw Results					
Technology	Technology Maturity	Successful Operation	Available Space	Compatibility	
Thermal drying: high-quality (drum dryer)	Pass	Pass	Pass	Pass	
Thermal drying: low-quality (indirect dryer)	Pass	Pass	Pass	Fail	
Partial solar drying	Pass	Pass	Fail	Fail	
Gasification	Fail	Fail	Pass	Pass	
Pyrolysis	Fail	Fail	Pass	Pass	
Incineration	Pass	Pass	Pass	Fail	
Deep-well injection	Pass	Pass	Pass	Fail	
Dehydration	Fail	Fail	Pass	Pass	



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Section 4: Ranking of Screened Technologies

This section describes the results of applying the evaluation criteria described in Section 2.3 to further screen and rank the technologies that passed the fatal-flaw filter.

4.1 Evaluation Approach

Following application of the fatal-flaw filter, Table 4-1 summarizes the technologies that were further evaluated using established criteria. The final scores and weightings were fixed in Workshop 2 with EWA staff. Thickening and post-dewatering technologies were not evaluated in this step, as there was no need to further screen these; the technologies listed in Table 4-1 will be carried forward for inclusion in end-to-end alternatives.

Table 4-1. Summary of Screening Technologies							
Thickening Technologies	Stabilization Technologies	Dewatering Technologies	Post-Dewatering Technologies				
Primary clarifier	Mesophilic digestion	Centrifuge	Drum dryer				
Dissolved air flotation	Mesophilic high-solids digestion	Belt filter press					
Rotary drum thickener	Thermophilic digestion	Screw press					
	Class A THP	Rotary Press					
	Lystek	Volute Press					

4.2 Results and Discussion

In this analysis, a weighted average score of 3 or less led a technology to be eliminated from further consideration. The rationale behind the scoring for each technology area is described below and agreed to during Workshop 2.

4.2.1 Thickening

The thickening technologies were not screened further as EWA expressed during Workshop 2 that they wanted all three thickening options listed in Table 4-1 evaluated.

4.2.2 Stabilization

Table 4-2 displays the scoring results for the stabilization technologies that passed the fatal-flaw filter. Among these, thermophilic digestion scored the highest, followed by mesophilic digestion and Class A THP. The rationale behind individual criterion scores is discussed below.

Table 4-2. Stabilization Technology Results								
Criterion	Mesophilic Diges- tion	Mesophilic Digestion with High Solids	Thermophilic Diges- tion	Class A THP	Lystek			
End-use market compatibility	3	3	3	5	2			
Proven technology performance	5	2	5	4	2			
Minimize life-cycle costs	3	3	4	2	2			
Energy/resource recovery	3	4	5	4	3			



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Table 4-2. Stabilization Technology Results								
Criterion	Mesophilic Diges- tion	Mesophilic Digestion with High Solids	Thermophilic Diges- tion	Class A THP	Lystek			
0&M impacts	4	3	4	3	3			
Environmental impacts	4	4	4	4	3			
Community and stakeholder impacts	4	4	4	4	2			
Project site compatibility	5	3	5	2	4			
Total Score	3.80	3.25	4.20	3.65	2.50			

With respect to end-use market compatibility, mesophilic digestion, mesophilic digestion with high solids, and thermophilic digestion all yield a dewatered cake with similar properties. Assuming a Class B cake, this product can be beneficially used in agriculture in Arizona or sent to regional compost facilities for further processing—both end uses are widely employed by other Southern California agencies. Thus, these three technologies received a score of 3 for this criterion. Class A THP produces a low-odor, more granular Class A cake, the aesthetic properties of which make it more acceptable to end users, thus, yielding a higher score. Lystek produces a Class A liquid fertilizer that would be more logistically challenging and expensive to haul the long distances typically required to access sufficient agricultural acreage. In addition, the product is untested in the Southern California region and is questionable in meeting regulatory requirement for vector attraction reduction, resulting in a lower score than the digestion technologies.

For the criterion of proven technology performance, mesophilic digestion and thermophilic digestion are both well proven with long performance records at WWTPs of various sizes. While not as well established as these digestion technologies, Class A THP (primarily Cambi) has nearly 50 worldwide installations, mainly in Europe, with a 20-year performance record. This resulted in a maximum score of 5 for mesophilic and thermophilic digestion and a score of 4 for Class A THP. Lystek has only one U.S. installation of its technology, causing it to receive a score of 2. Additionally, mesophilic digestion with high solids receives a score of 2 because it a less proven technology with only one case study in the U.S. However, there are several full-scale installations using similar non-propriety technology.

Mesophilic digestion and mesophilic digestion with high solids received a score of 3 for minimizing life-cycle costs. Thermophilic digestion allows for greater importation of high-strength waste, a revenue source, and was thus assigned a slightly higher score of 4. Lystek and Class A THP both involve additional processes that have their own personnel and energy demands, resulting in a lower score of 2.

Biogas production, the ability to import high-strength waste, ability to beneficially use biosolids, and net energy demand all influenced the score for the "energy/resource recovery" criterion. Thermophilic digestion offers a greater ability to import high-strength waste. Thermophilic digestion has a higher VSR, which corresponds to a greater gas yield. Conservatively, the energy required to heat a thermophilic digester can be assumed to be equivalent to the gain in VSR, an assumption that will be refined during the alternatives analysis. Improved proportional gas yield and the ability to take in more high strength waste resulted in thermophilic digestion receiving the highest score. Class A THP allows for greater biogas generation but also has somewhat higher energy demands. While Class A THP likely has the highest energy demand of the technologies listed, it also yields a favorable biosolids product, as discussed above. Class A THP received a score of 4. Similarly, mesophilic digestion with high solids received a score of 3. Lystek uses mesophilic digestion at its core, and while a version of the process can boost biogas production, it also



requires importation of chemicals, additional trucks to haul the material to beneficial-use sites, and a slightly larger energy demand than either mesophilic or thermophilic digestion.

With respect to O&M impacts, most of the technologies scored similarly. Mesophilic digestion scored a 4, one point higher than the other technologies, because it reflects a technology that is well established and understood by EWPCF staff.

Most of the technologies are fairly benign from an environmental standpoint and received a score of 4 under the "environmental impacts" criterion. Lystek received a score of 3 because of the need to import chemicals and the generation of additional truck traffic because of the liquid nature of the product. The addition of truck traffic, a sensitive issue in the community around EWPCF, also caused Lystek to be scored lower on the "community and stakeholder impacts" criterion. The other technologies were believed to perform similarly from this standpoint and received a score of 4.

Ability to integrate into the site with respect to both footprint and treatment process compatibility created differentiation among the technologies for the "project site compatibility" criterion. As the established technology at EWPCF, mesophilic digestion received the highest score, a 5. Thermophilic digestion would not significantly change the operation or footprint at EWPCF and thus received the same score. Mesophilic digestion with high solids and Lystek requires additional footprint and a change to the existing operational scheme, causing it to score lower. Class A THP requires operation of a steam plant, additional footprint, and integration of a novel process to the WWTP. As a result, it received the lowest score.

The weighted scores result in thermophilic digestion ranking first, followed by mesophilic digestion, Class A THP, mesophilic digestion with high solids, and Lystek. Based on the final scores, Lystek was eliminated from further consideration. Mesophilic digestion, mesophilic digestion with high solids, thermophilic digestion, and Class A THP will all be included in end-to-end alternatives evaluated under Task 7.

4.2.3 Dewatering

Table 4-3 displays the results of the evaluation for the dewatering technologies. For three of the criteria—lifecycle costs, environmental impacts, and community and stakeholder impacts—the technologies were scored similarly. The more limited performance record of the screw press, rotary press, and volute press caused these technologies to be scored lower from a life-cycle cost standpoint. The open-air nature of a BFP requires additional odor control, which is rated by the lower score for environmental impacts.

Table 4-3. Dewatering Technology Results							
Criterion	Centrifuge	BFP	Screw Press	Rotary Press	Volute Press		
End-use market compatibility	3	5	4	3	3		
Proven technology performance	5	5	3	2	2		
Minimize life-cycle costs	4	3	3	3	3		
O&M impacts	5	4	3	2	2		
Environmental impacts	3	2	3	3	3		
Community and stakeholder impacts	4	4	4	4	4		
Project site compatibility	5	4	2	3	3		
Total Score	4.35	4.10	3.05	2.65	2.65		

Differentiating criteria in this technology category included end-use market compatibility, proven technology performance, O&M impacts, and project site compatibility. With respect to end use, a body of research



suggests that dewatering processes employing high-shear processes, such as centrifugation, yield cake with higher odors. Low-shear processes, like BFPs and screw presses, received higher scores than the other technologies. The limited experience with the products from rotary and volute presses also caused these technologies to be scored lower for end-use compatibility.

With respect to proven technology performance, centrifuges and BFPs are the most widely used dewatering technologies in the United States and thus received the highest possible score. Screw presses have been installed at several WWTPs over the past decade, but the performance record of these, including some in California, is mixed, resulting in a lower score. The lowest score, 2, was assigned to rotary and volute presses, whose track record is much more limited. Scoring fell along much the same lines for O&M impacts—both centrifuges and BFPs have been successfully used at EWPCF and operations staff are comfortable operating either one. The other technologies would represent a shift in process.

Centrifuges received the highest score for project site compatibility, as this is the dewatering technology currently employed by EWA. BFPs were used previously for dewatering, but were located in a different process area. As noted earlier, reconfiguration of the plant layout would be necessary to accommodate a change back to this technology. Screw presses require the largest footprint of any of the technologies and, like belt presses, would need to be located elsewhere.

Based on the weighted scores, BFPs scored the highest, followed by centrifuges, screw presses, rotary presses, and volute presses. The latter two scored below a 3 and were thus eliminated from further consideration.

4.2.4 Post-Dewatering

As previously mentioned, all of the post-dewatering technologies failed the fatal flaw filter, except drum drying. Therefore, the drum dryer will be the only option carried forward for further evaluation.



Section 5: Implementation Considerations

The BC team further evaluated the best-ranked technologies by presenting implementation considerations in a workshop with EWA staff held on September 19, 2017. Preliminary feedback on site layouts, process integration, and construction sequencing was considered for incorporation into the future alternatives analysis.

5.1 Thickening and Stabilization

The PMP established a location for the RDT units, shown in Figure 5-1. Thickening improvements can help make the digestion process more efficient and will create more hydraulic capacity by removing water from the sludge. With respect to the stabilization processes, several figures were developed to demonstrate potential siting considerations and construction sequencing. These are presented as Figures 5-1 through 5-3 and are discussed further below.

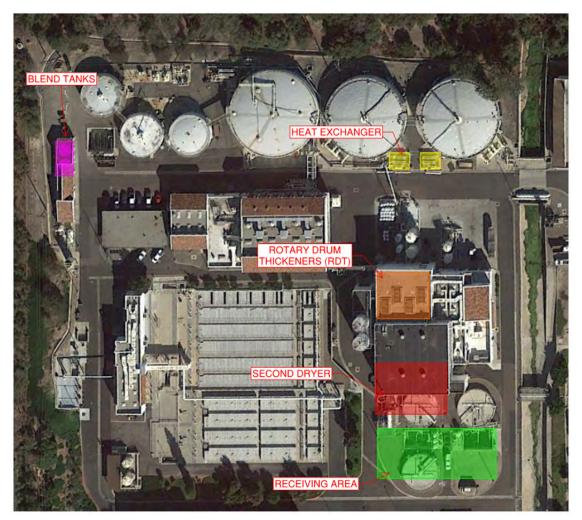


Figure 5-1. Preliminary layout for thermophilic digestion with a second dryer and expanded facilities for high strength waste receiving.



Use of contents on this sheet is subject to the limitations specified at the beginning of this document. SC07037_Final_TM2_Tech Eval Biosolids Handling_20180108.docx Mesophilic digestion is the current stabilization process. Preliminary calculations indicate that the existing tankage is insufficient to accommodate future flows and loads, particularly if there is a desire to import greater quantities of high-strength waste. If mesophilic digestion were to be maintained, the smaller, 300,000-gallon digesters (digesters 1, 2, and 3) would need to be rehabilitated and brought on line.

Thermophilic digestion occupies essentially the same footprint as mesophilic digestion. More heat exchanger capacity would need to be brought on line; this could be accomplished by replacing the existing units with taller, higher-capacity units. For the alternatives analysis, two thermophilic scenarios will be explored. The first is a 15-day HRT scenario, which guarantees Class B quality, but is limited by the ability to receive high-strength waste based on hydraulic capacity. A second scenario is a 10-day thermophilic process. Digestion remains stable at a 10-day HRT and EBMUD and others have successfully operated this process for years. This scenario allows EWA to receive greater quantities of high-strength waste, and a new receiving station could be constructed where some of the smaller digesters are currently located (Figure 5-1). Co-digestion capacity in these scenarios will be analyzed and described further in TM 4.

Implementation of THP (Figures 5-2 and 5-3) is somewhat more complicated, as creating space for the THP units requires demolition of existing process units. Figure 5-2 shows a layout in which the smaller digesters are demolished in favor of the THP units and the high strength waste receiving area shown in Figure 5-1 has been moved in closer proximity to the dryer building. A second layout developed requires demolition of the existing DAFTs to accommodate the THP units. In this scenario, shown in Figure 5-3, thickening upgrades would need to be performed prior to installation of the THP units.

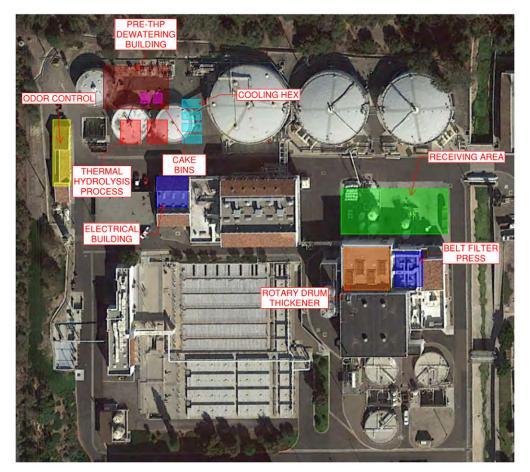
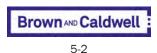


Figure 5-2. Preliminary layout for THP where the smaller digesters are demolished for the THP units.



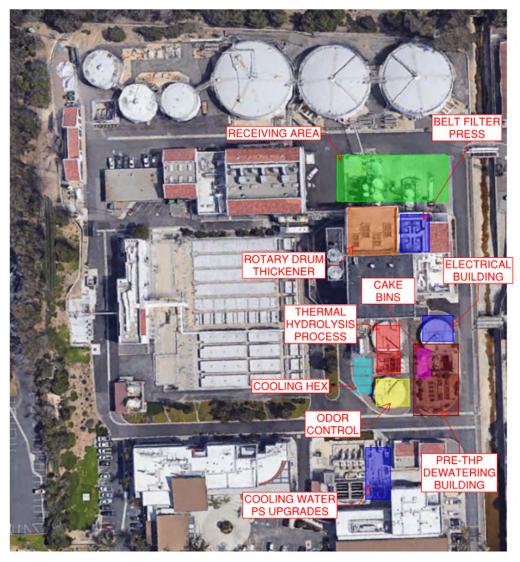


Figure 5-3. Preliminary layout for THP where the DAFs are demolished for the THP units.

5.2 Thermal Drying

One of the major questions to be addressed by the BEE is whether a second thermal dryer is necessary to meet EWA's goals. The existing building is space-constrained and a building modification may need to be constructed to accommodate a second dryer. Discussions on such modifications are currently underway and appropriate costs will be incorporated into the alternatives evaluation. In the event a new building is deemed necessary, the BC team prepared preliminary layouts for the second dryer that require demolition of the existing DAFTs. Under this scenario, thickening changes may need to be performed prior to the installation of the second dryer.



5-3

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Section 6: Conclusions and Next Steps

Screening of biosolids technologies resulted in a final selection of technologies to be included in end-to-end alternatives. The technology combinations are represented in Figure 6-1 and will be combined with the results of Tasks 3, 4, and 5 for the creation of end-to-end alternatives for analysis in the SWEET model. The three stabilization alternatives—mesophilic digestion, thermophilic digestion, and Class A THP—will each be evaluated both with and without the second drying train necessary to accommodate future growth. Development of end-to-end alternatives will be performed in cooperation with EWA staff prior to analysis.

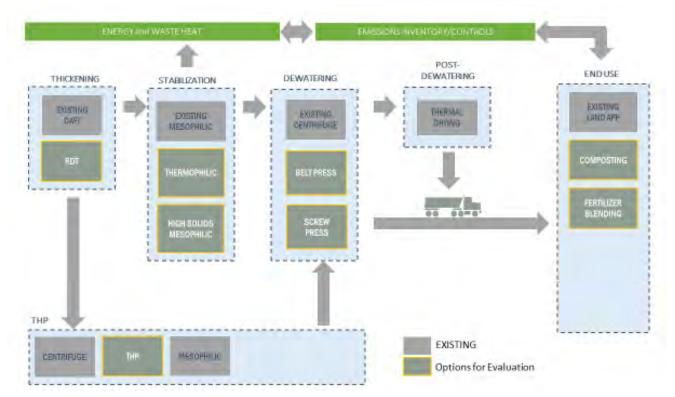


Figure 6-1. Biosolids treatment technology options for EWCPF end-to-end project alternatives.



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Attachment A: Workshop Meeting Minutes



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A-1



Meeting Minutes

9665 Chesapeake Drive, Suite 201 San Diego, CA 92123

T: 858.571.8822 F: 858.571.8833

Prepared for:Encina Wastewater AuthorityProject Title:Energy & Emissions Strategic Plan & Biosolids Management Plan UpdateProject No.:150871

Purpose of Meeting:	Workshop #2	Date: August 16, 2017
Meeting Location:	Encina Wastewater Authority	Time: 1:30 - 5:00 PM
Minutes Prepared by:	Hari Seshan and Jocelyn Lu, Brown and Caldwell	

Attendees:Doug Campbell, Encina, JPAAScott McClelland, Encina JPAHJimmy Kearns, Encina JPAHMike Steinlicht, Encina JPAHOctavio Navarrete, Encina JPASNathan Chase, RMCH

Adam Ross, Brown and Caldwell Hari Seshan, Brown and Caldwell Jocelyn Lu, Brown and Caldwell Natalie Sierra, Brown and Caldwell Scott Lacy, Brown and Caldwell Tom Chapman, Brown and Caldwell

Attachments:

• Workshop #2 Presentation Slides

Decisions

The following is a list of decisions made as a result of the meeting discussion:

- BC team to evaluate RDTs against the current status quo of primary clarifier and DAFT.
- Stabilization technologies that moved to the next round of evaluation: Mesophilic Digestion, Mesophilic Digestion with High Solids, Thermophilic Digestion, and Traditional CAMBI.
- Dewatering technologies that moved to the next round of evaluation: Centrifuges and Belt Presses.
- Post-dewatering technology that moved to the next round of evaluation: Thermal Drying High Quality (Drum Dryer).
- Alternative power production technologies that moved to the next round of evaluation: Internal Combustion Engines (Status Quo), Internal Combustion Engines – with Gas Conditioning, Internal Combustion Engines – with Exhaust Treatment, Digester Upgrading – Pipeline Injection, Micro-Turbines, Biosolids Drying – Direct Use of Biogas, Large Scale Photovoltaics (PV), Small Scale Rooftop PV.
- Waste heat technologies that moved to the next round of evaluation: Small-Scale Steam Turbines, and Thermo/THP.

Action Required

The following is a list of actions required as a result of the meeting discussion:

- Jimmy to send Adam maintenance schedule costs.
- Octavio to send WAS daily flow data to Hari Seshan (Hari).
- Scott L to send list of additional data/document requests over to Scott M after updating based on discussion.
- Scott M to send a list of EWA attendees for the Waste Haulers Meeting to BC.
- Adam to send a draft agenda of the Waste Haulers meeting to EWA and finalize per any EWA comments.
- Octavio to send EWA's SDG&E point of contact to Adam. EWA and BC to discuss initial contact with SDG&E regarding biomethane pipeline injection.
- Octavio to send Hari lab data on the performance of the centrifuges.
- Tom to work with Octavio on refining the solids mass balance.
- Adam to present a big picture view of the power production alternatives at the next workshop.
- BC to identify technologies that would be beneficial to visit at WEFTEC.
- BC will set up a meeting with Anaergia to discuss project goals and opportunities. This meeting will be separate from the Waste Hauler meeting.
- Scott L and Scott M will schedule Workshop 3 for mid-September aim for conducting the Waste Hauler meeting on the same day.
- EWA will take the dryer out of service in September/October. BC requests that any condition assessment results be shared with the team particularly related to the increased use of digester gas (siloxane or hydrogen sulfide issues).
- BC to check in with EWA to confirm is any support is needed related to the next board meeting on Oct 11.

Summary

Workshop #2 was held for the Encina Water Authority (EWA) Energy & Emissions Strategic Plan & Biosolids Management Plan Update. The purpose of this Workshop was to review pending administrative tasks and provide task updates. A summary of the discussion is provided below:

Introductory Items

BC started off the meeting by reviewing the schedule and goals for the meeting. The goals are to generate content and direction for the project team moving forward.

- This month, the Brown and Caldwell (BC) team will be:
 - Preparing a baseline report, to be reviewed by EWA in September.
 - o BC will also be preparing report sections of Tasks 2 and 3 by September.
 - In October and November, BC will be developing SWEET alternatives and providing more clarity on how the pieces interact.
- Adam Ross (Adam) stated that he expects to have more questions about permitting, cogeneration (cogen), electrical rates, and where to send digester gas, and would appreciate dialogue between now and the next workshop. EWA staff recommended for him to work with Octavio Navarrete (Octavio).

New Data Request Items

BC reviewed new data request items with EWA. They included:

- Trussell food waste capacity report Scott McClelland (Scott M) stated that he has the data, but not the report, on the Trussell study. Preliminary conclusions of the report indicate that EWA could accept an additional 80,000 gal/week of FOG and 25,000 gal/week of brewery waste. EWA expect it'll take about another month before the report is ready. Imported wastes are received Monday – Friday/Saturday. A constant feed to the digesters is provided until around Saturday afternoon. A potential limitation to high strength waste acceptance is truck offloading capacity. A food waste pilot program began on Monday, 9/14.
- O&M costs for cogen engines Adam asks if EWA has annual O&M costs for the engines. Jimmy Kearns (Jimmy) states that EWA has annual costs for the maintenance schedule.
 - ACTION: Jimmy to send Adam maintenance schedule costs.
- WAS flow data
 - o BC requests the WAS flow data, and Octavio indicates that EWA does have that data.
 - ACTION: Octavio to send WAS daily flow data to Hari Seshan (Hari).
- Air permitting summaries or progress
 - o Doug Campbell (Doug) sent Adam the latest email from Don King (Don).

Outstanding Data Requests

BC reviewed outstanding data requests with EWA. They included:

- Cogen drawing and cut-sheets
 - o Natalie Sierra (Natalie) points out that BC has received drawings from Andritz.
- Information on energy management
- High strength waste storage (typical day operating procedure)
- ACTION: Scott L to send list of additional data/document requests over to Scott M after updating based on discussion.

There was a subsequent discussion on wasted gas that was being flared. Octavio explains that the operators need to manually control the digester gas flow to the dryer, which results in some flaring. Operators generally try to set the digester gas flow rate to avoid drawing down the gas system and triggering natural gas blending at cogen. This typically results in a conservative offtake of digester gas to the dryer which results in some flaring. Mike Steinlicht (Mike) asks how much is being flared, and Adam calculated that about 180 kW of gas was being flared (averaged over a month) in current operation.

Cogeneration operation was discussed. EWA operates two engines on digester gas 24/7. A third engine operates on natural gas during peak power rates. EWA physically disconnects from the power grid to avoid demand and consumption charges.

FOG is fed to the digesters at a constant rate of 12 gallons per minute. FOG is fed to only one or two digesters, not all. The FOG feeding begins on Monday with first deliveries of the week, and continues into Saturday to pump down material from the last deliveries on Friday.



Meeting with Waste Haulers

BC reviewed the timing, attendees, and goals of the Waste Haulers Meeting. Below is a summary of the discussion:

- Scott L reviewed the potential list of attendees, which included: EWA representatives, BC representatives, Waste Management (WM), Republic, EDCO, and potentially LES or Anaergia.
 - ACTION: Scott M to send a list of EWA attendees for the Waste Haulers Meeting to BC.
- Scott M stated that the intent of the meeting is to develop a public-private partnership and noted increase grant eligibility by having this kind of relationship.
- Mike emphasized that the elected officials want all of the waste haulers at the table, especially those that operate within EWA's service area.
- Adam reviewed the draft Waste Hauler Agenda, which would cover background on the plant, current operation, and a discussion of potential capacity.
- Scott M stated that he would like to have an agenda finalized and sent out to each waste hauler 30 days in advance of the meeting, to give them adequate prep time.

• ACTION: Adam to send a draft agenda of the Waste Haulers meeting to EWA and finalize per any EWA comments 30-days in advance of the meeting.

• Adam stated that another discussion point for the meeting is the waste haulers potential interest in accepting compressed natural gas (CNG). Scott M stated that SDG&E should be involved in these conversations as well. A meeting should be arranged with SDG&E.

• ACTION: Octavio to send EWA's SDG&E point of contact to Adam.

Different gas delivery options, tube trailer vs. pipeline, were discussed. Adam stated that a tube trailer has less stringent standards than a pipeline, but there would be tube trucks coming in and out of the facility. However, the pipeline would have more stringent sampling/reporting requirements and the investment for an interconnection for the pipeline could cost \$1 – 2 million dollars. This will be developed as the alternatives analysis is advanced.

Other Outstanding Items

BC reviewed their understanding of the discussion with Anaergia:

Adam stated that Anaergia is promoting Omnivore as a process treatment option, which may
or may not be the right fit at EWA. However, there might be opportunity for Anaergia to work
with waste haulers for pre-processing food waste.

Review of Mass Balance and Project Flows and Loads

BC presented the project flows and loads:

- Mass Balance
 - Hari reviewed the assumptions made to calculated WAS. Octavio responded that the actual WAS flow is around 0.75 MGD, and that he could send that data to BC (ACTION above).
 - Adam stated that the VSR value of 65% seemed suspiciously high. Octavio stated that EWA's VSR value was closer to 55%.
 - Hari stated that the centrifuge % capture right now is 78%. Octavio responded that the capture rate for the centrifuges is consistently 95%, and that the calculated value is probably lower because of values during start-up and shut-down.
 - ACTION: Octavio to send Hari lab data on the performance of the centrifuges.

- Tom requested that the BC team review the data with Octavio after he send is to BC.
 - ACTION: Tom to send up conference call with Octavio after reviewing the data.
- Solids Mass Balance Comparison
 - Tom presented a graph that shows that BC's calculated solids loading was higher than the calculated values in the Process Master Plan (2016).
 - Octavio stated that one reason for the increase might be a 2015 change in how EWA sampled the influent flow.
 - ACTION: Tom to work with Octavio on refining the solids mass balance.
- Power Loads and Gas Usage
 - Adam reviewed the gas usage graphs with EWA.
 - Digester Gas Usage Summary Total gas production is trending up, probably due to the increase in high strength waste deliveries. Adam pointed out that the yellow "Total Gas Production" line didn't match up with the top of the bars, which is normal. Scott M pointed out that the important part is that the yellow line followed the same trend as the bars.
 - Natural Gas Usage Summary Most of the natural gas is being used for the heat dryer and cogen, which is expected.
 - Power Production and Import Currently, EWA is making about 80% of their electricity needs. This means that EWA could potentially export power. A look into the SDG&E power bills also showed that the actual kWh power that EWA is purchasing only constitutes \$10,000 out of a \$70,000 bill. The majority of the bill is non-coincident and standby power.
 - Mike stated that he had talked to SDG&E about the standby charges and haven't been able to get around them.
- Engine Fuel Use
 - Octavio explained that the increase in natural gas in November 2015 was because they needed to switch to natural gas to stay below emission limits.

Screening of Technologies

BC the fatal flaw filter and evaluation criteria, and then evaluated each process technology against that criteria. The results of the evaluation are summarized below and more details are included in the attached Workshop #2 PowerPoint slides.

- There were four fatal flaw filters:
 - o At least one successful North American installation of the technology
 - o At least one successful installation in a facility of similar size
 - o There is available space to implement that technology
 - Compatibility with plant size and any existing equipment
- The technologies that passed the fatal flaw filter were then scored for each evaluation criteria, which included: end use market compatibility, proven technology performance, life cycle costs, energy/resource recovery, O&M impacts, environmental impacts, community and stakeholder impacts, and project site combability.
 - Each evaluation criteria was then weighted to reflect EWA's priorities.

- Technologies that scored lower than a 3 were eliminated, and technologies that scored greater than a 3 would be evaluated through the SWEET model.
- O&M impacts criteria will be clarified to describe reduction in O&M staff time.
- Thickening Technologies
 - Prior planning efforts recommended evaluating rotary drum thickeners (RDTs) against the existing primary clarifier and dissolved air flotation thickeners (DAFTs). EWA concurred with that recommendation.
 - Natalie asked if the team should add Anaergia's Omnivore to the list of technologies to evaluate. Scott L proposed that that decision to be made after a meeting with Anaergia takes place.
 - DECISION: BC team to evaluate RDTs against the current status quo of primary clarifier and DAFT.
- Stabilization Technologies
 - Technologies that failed the fatal filter: Staged Digestion, Acid/Gas Phased Digestion, Temperature Phased Anaerobic Digesion, Enzymatic Hydrolysis, Chemical Hydrolysis, THP – DLD, and Solid Stream CAMBI.
 - Technologies that scored lower than a 3 in the evaluation criteria: Lystek.
 - (DECISION) Stabilization technologies that moved to the next round of evaluation: Mesophilic Digestion, Mesophilic Digestion with High Solids, Thermophilic Digestion, and Traditional CAMBI.
- Dewatering Technologies
 - Technologies that failed the fatal filter: Bucher Press.
 - Technologies that scored lower than a 3 in the evaluation criteria: Screw Press, Rotary Press, and Volute Press.
 - (DECISION) Dewatering technologies that moved to the next round of evaluation: Centrifuges and Belt Press.
- Post-Dewatering Technologies
 - Technologies that failed the fatal filter: Thermal Drying: Low Quality (Indirect Dryer), Gasification, and Pyrolysis.
 - o Technologies that scored lower than a 3 in the evaluation criteria: N/A
 - (DECISION) Post-dewatering technologies that moved to the next round of evaluation: Thermal Drying: High Quality (Drum Dryer).
- Alternative Power Production Technologies
 - Technologies that failed the fatal filter: Fuel Cells and Wind Turbines.
 - Technologies that scored lower than a 3 in the evaluation criteria: Energy Storage (Batteries), Large Scale Solar Photovoltaics
 - (DECISION) Alternative power production technologies that moved to the next round of evaluation: Internal Combustion Engines (Status Quo), Internal Combustion Engines – with Gas Conditioning, Internal Combustion Engines – with Exhaust Treatment, Digester Upgrading – Pipeline Injection, Micro-Turbines, Biosolids Drying – Direct Use of Biogas, Large-Scale Solar Photovoltaics (PV), and Small Scale Rooftop PV.
- Waste Heat Technologies
 - Technologies that failed the fatal filter: Absorption and Adsorption Chillers, Organic Rankine Cycle, and Gasification of Biosolids.

- o Technologies that scored lower than a 3 in the evaluation criteria: N/A
- (DECISION) Waste heat technologies that moved to the next round of evaluation: Small-Scale Steam Turbines, and Thermo/THP.

Creation of End to End Alternatives

The BC team reviewed initial alternatives that were to be evaluated, as well as different power production alternatives. The power production alternatives included:

- Baseline: existing cogen and drying
- Baseline with gas conditioning
- Existing cogen with vehicle fuel (via pipeline injection or tube trailer)
- Existing cogen with microtubines
- Existing cogen with steam boiler/turbine
- New cogen permit, CO catalyst and selective catalytic reduction (SCR), with gas conditioning
- Vehicle fuel (primary use of digestive gas) with existing cogen
- ACTION: Adam to present a big picture view of the power production alternatives at the next workshop.

Grant Updates

BC provided an overview of different grant programs, and explained how the program would fit into the SWEET model. The programs included:

- Self-Generation Incentives Program
- Low Carbon Fuel Standard
- Renewable Fuel Standard
- Organics Grant Program
- Healthy Soils Program
- Green Project Reserve

Air Permitting Discussion

BC and EWA discussed the current efforts of the air permit modification. EWA is submitting a request for permit modification in one week. If successful, it would increase the permitted cogen capacity by \sim 20%.

Look Ahead & Wrap-Up

The meeting ended with a look ahead and reviewing pending action items.

- Workshop #3 will take place in mid-September, and the team will try to schedule the Waste Hauler Meeting on the same day.
- The team will present the following in Workshop #3:
 - Baseline SWEET model
 - o Conceptual layouts and details of alternatives for consensus and feedback
 - o Air permitting impacts on power production alternatives
 - o Grant updates
- WEFTEC is also taking place in early-October. Mike stated that it would be beneficial to walk the floor together with BC to look at potential technologies.
 - ACTION: BC to identify technologies that would be beneficial to visit at WEFTEC.

• ACTION: BC to check in with EWA to confirm is any support is needed related to the next board meeting on Oct 11.





Energy & Emissions Strategic Plan & Biosolids Management Plan Update



Workshop #2 – August 16, 2017 &

Encina Water Pollution Control Facility



Project Schedule

- Progress On Schedule
- Task 1 Energy Baseline Complete
- Other Tasks (except 7) are Under Way,
- Workshop #2 Today

 Task 1 Energy Base 	eline	Comp	lete						
 Other Tasks (exception) 	ot 7) a	re Un	der V	Vay					
 Workshop #2 Toda 	у								
 Task 1 Energy Base Other Tasks (exception) Workshop #2 Toda Q.EX Combined Project Schedule TASK 1 - Baseline Energy 				ent h					
Combined Project Schedule	JUL '17	AUG '17	SEP '17	OCT '17	NOV '17	DEC '17	JAN '18	FEB '18	MAR '18
TASK 1 - Baseline Energy			-	1000					8
TASK 2 - Biosolids Tech	ler-	_			L				
TASK 3 - Power Tech									-
TASK 4 - Biogas Tech									
TASK 5 - Waste Heat Tech					-				
TASK 6 - Air Emissions Evaluation		-		-	-			-	I
TASK 7 - Alternatives and Evaluation TASK 8 - Grants/Incentives		-		-		-	-		-
TASK 9 - Management/QC		-				-	1		
Workshops	W 1	♦ W2	🔶 W:	3		W 4	◆ W5	-	W6
	COLOR KEY	/:	Evaluation	Analyze	Report	Client R	leview	Final Repo	*

Agenda

- Administrative (20 min)
 - Status of data requests
 - Comments on waste hauler agenda
 - Discussion with Anaergia
- Review Mass Balance and Projected Flows and Loads (45 min)
- Review Fatal Flaw and Screening Criteria (30 min)
- Screen Technologies (1 hr)
- Discussion of Preliminary End to End Alternatives (30 minutes)
- Grants Update (10 min)
- Air Emissions Review (5 min)
- Wrap-Up/Review Action Items (10 min)

New Data Requests

- Trussell food waste capacity report
- O+M costs for the engines (have costs for electricity for the system, but not for gas treatment, upkeep, general maintenance, etc.)
- WAS daily flow data (back-calculated for mass balance)
- FOG TS and VS data (used assumptions from 2016 PMP for mass balance)
- Any air permitting summaries or progress between EWA and Don King

Outstanding Data Requests

- Cogen and solids systems drawings, engine cut sheets
- Dryer system drawings and cut sheets
- Recent air permitting efforts progress, memos, contact info
- Copies of current air permits (SDAPCD and Title V)
- Energy Management typical day operating procedure:
 - Cogen strategy
 - Peak period disconnect from utility
 - HSW storage and feed strategy

Waste Hauler Agenda

- Timing: September (coordinate with Workshop 3) nissions Strategic Plan & Nagement Plan Update
- Attendees:
 - EWA Scott, Jimmy
 - BC Adam, Ari
 - WM
 - Republic
 - EDCO
 - LES?
 - ids Mana Anaergia?
- Goals:
- and Caldwell Workshop #2 Provide background info to haulers about EWA's goals and BEE effort
 - Determine availability of pre-processed food waste, market demand for an EWA initiative to receive more material, tipping fee range for SWEET analysis
 - Gauge interest in a renewable CNG partnership
 - Discuss "next steps" such as letter of intent, future coordination

Other Outstanding Items

- Discussion with Anaergia
 - Omnivore as an alternative
 - plan & Orex or Biorex for food waste pre-processing
 - Just with Republy Just dried product? Status of food waste receiving project(s) with Republic
 - Capacity at Rialto facility for dried product? Riosolids N

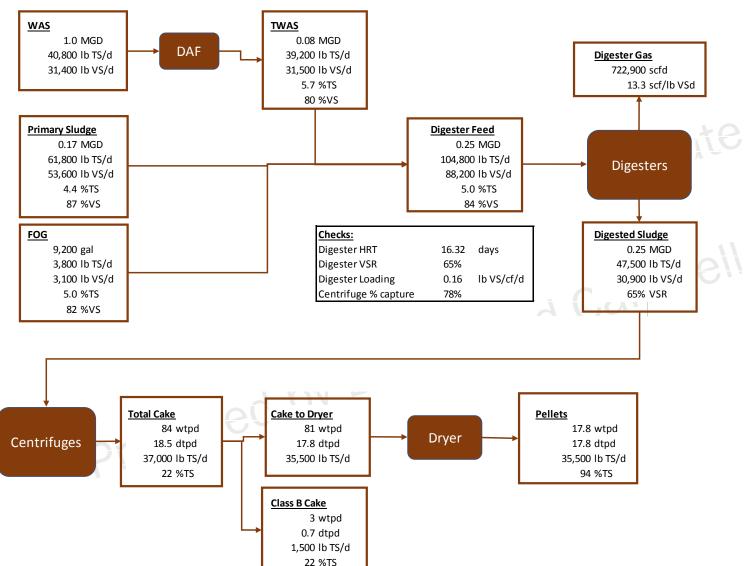


Review of Mass Balance and Projected Flows and Loads



Mass Balance

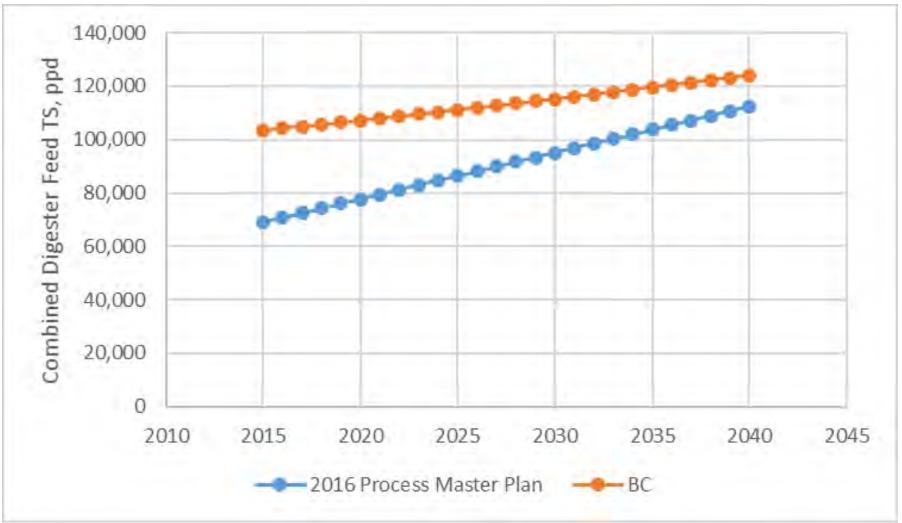




Mass Balance Assumptions

- TWAS flows that were zero and subsequent loads when TWAS flow was zero were excluded. Assumed percent capture rate for the DAFTs is 95%.
- TWAS flows were taken from DAFT totalizer data and digester feed meters.
- The digester feed flow from July 1, 2016 to June 2017 were subtracted daily to obtain a daily digester feed volume. This was based on the assumption that the flow values were cumulative from a meter reading starting 7/1/16.
- The Class B cake data were averaged with zero data to obtain an annualized daily average.
- FOG data were a daily average of the volumes received. This assumes FOG is fed 24/7/365. Assumes %TS and %VS are 5% and 82%, respectively.
- To calibrate the mass balance as shown, 2,300 lbs TS/d and 1,900 lbs VS/d were added to Primary Sludge.

Solids Mass Balance Comparison



Brown and Caldwel

11

Sludge Production Peaking Factors

	Max Month	Peak 2-Week	Peak Week	Peak Day
Primary Sludge	1.23	1.3	1.4	1.60
WAS	1.23	1.3	1.4	1.60
Combined Sludge	1.23	1.3	1.4	1.60

Notes:

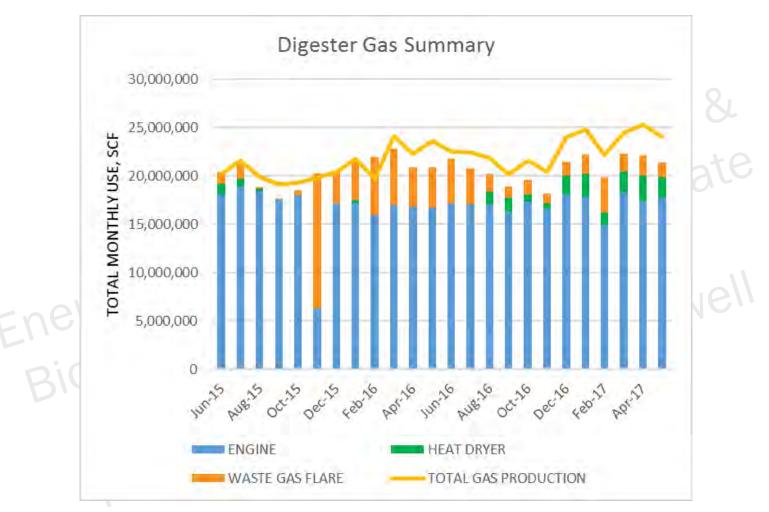
- us rkchon # Peaking factors for maximum month and peak day conditions are developed based • on 2016 PMP solids projections.
- Peaking factors for maximum 2-week and maximum week conditions are proposed ٠ based on historical data.

Power Loads and Gas Usage

• Power:

- Monthly production: 1,500 kW (2, 750 kW engines full output) - 80% of total electrical demand)
- Monthly import: 385 kW equivalent (1,390 MWh per year)
- Digester gas:
 - Average production: 1,645,000 therms per year Caldwell
 - Engines: 1,263,000 therms per year
 - Waste gas: 229,000 therms per year
 - Heat dryer: 57,000 therms per year
- Natural gas: 856,000 therms per year
 - Engines: 156,000 therms/year
 - Other plant use: 700,000 therms/year

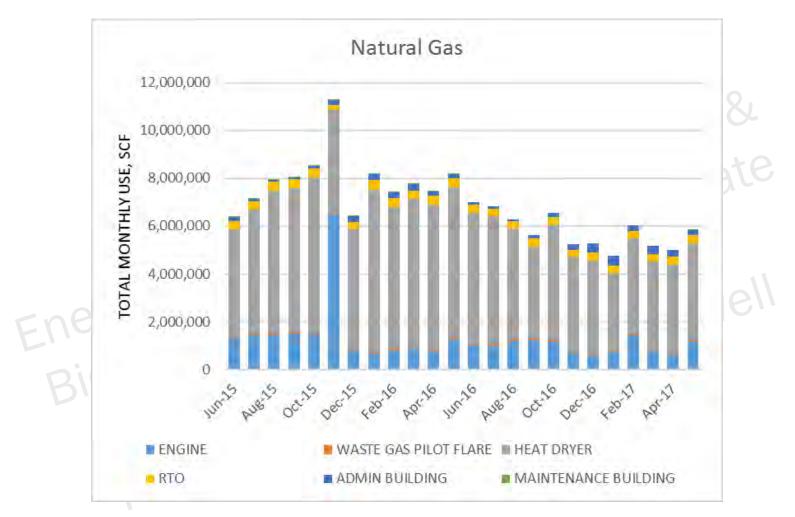
Digester Gas Usage Summary – Last 2 years



1) What happened November 2015? DG outage?

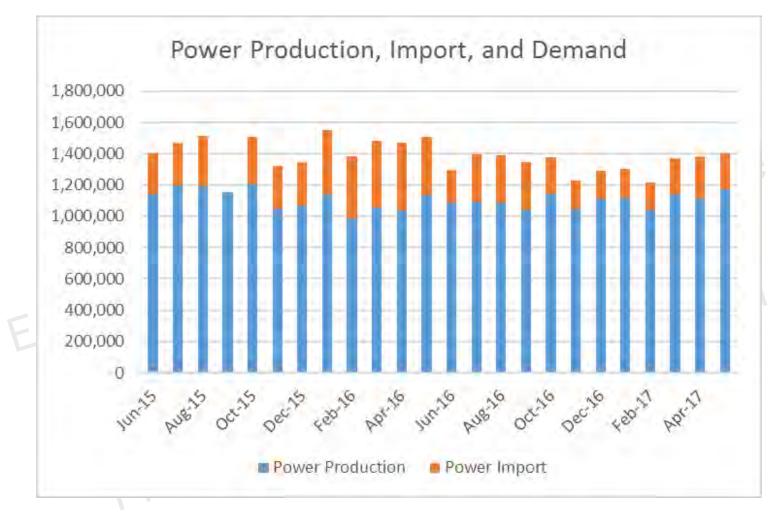
- 2) Divergence of "total gas production" from sum of other meters
- 3) When DG is sent to the heat dryer, what contributes to flaring?
- 4) Flared gas, over the course of the last year, represents 179 kW of "potential" power production

Natural Gas Usage Summary – Last 2 years



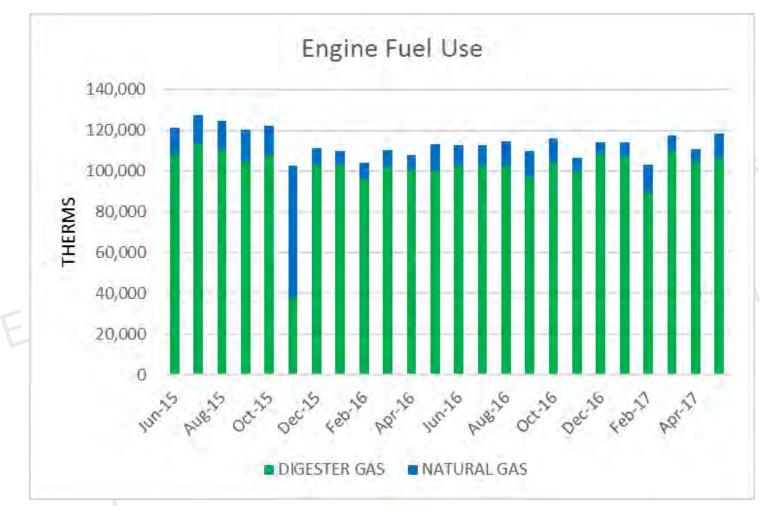
1) What is the NG control strategy to cogen? Why is there NG contribution to cogen in months where DG is being sent to dryer or flare?

Power Production and Import – Last 2 years



- 1) Consistently operating at 2-engine output
- 2) Operating a third engine at full output (if DG production increases and/or permit is modified) would result in power export

Engine Fuel Use – Last 2 years



- 1) Consistent operation
- 2) What is NG blending strategy?



Screening of Technologies



Fatal Flaw Filter

- Applied uniformly across all technologies
- Four criteria:
 - At least one successful North American installation of technology
 - At least one successful installation in a facility of similar size
 - Available space
 - Compatibility with plant size and any existing equipment
 Bio
 Bio

Evaluation Criteria

Criterion	Criterion Description	Scoring Description
End Use Market Compatibility	 Onsite technology directly produces one of the recommended product alternatives. Alternately, onsite technology product is compatible with product alternatives. 	 Low score indicates technology product that has not been identified as part of the product list nor compatible with the product list. High score indicates technology product that is compatible with Class B cake, Class A cake, Class A THP cake, and dried Class A pellet.
Proven Technology Performance	 Proven and reliable technology with same configuration intended at Encina. Long successful operating track record. 	 Low score indicates no successful large scale operating installations in North America or Europe, no successful demonstration scale installations in North America or Europe, and unknown safety or reliability record. High score indicates more than one successful operating installation in North America or Europe, more than one operating installation at a WWTP of at least 40 mgd in North America or Europe, track record duration > 5 years, and vendors in Western USA.
Minimize Life Cycle Costs	 Qualitative metric of program cost. Capital and O&M costs based on existing Encina data or similar experience at other WWTPs. Potential revenues from sales. Product/market geographic proximity. 	 Low score indicates high capital cost to build onsite facilities, high 0&M costs, expensive end use market, and high transportation costs. High score indicates low capital cost to build onsite facilities, low 0&M costs, potential product revenue, and product destination within 100 miles.

Evaluation Criteria (cont.)

Criterion	Criterion Description	Scoring Description
Energy/Resource Recovery	 Increases biogas production through advanced digestion. Supports co-digestion of organic waste. Recovery of renewable energy. Beneficial use of biosolids product. 	 Low score indicates high energy requirement for onsite technology, no increase in biogas production, technology does not recover energy as biogas, no recovery of renewable energy in biosolids, and no biosolids resource recovery. High score indicates a higher biogas production, compatible with co-digestion of organic waste, and biosolids resource recovery.
O&M Impacts	 levels. Complexity of new technology O&M and control systems. Reliability of new technology (potential downtime). 	 Low score indicates more O&M time required, complex mechanical and control systems required compared with existing plant facilities, potential equipment downtime, and new chemicals or hazards. High score indicates reduction in O&M staff time required, new technology is simple to operate and maintain, reliable with minimal downtime, and no new chemicals or hazards.
	Minimal impacts to plant safety.	

Evaluation Criteria (cont.)

Criterion	Criterion Description	Scoring Description
Environmental Impacts	 Impacts to carbon footprint and air permitting. 	 Low score indicates high carbon footprint for technology, high travel distance to end use, difficult to treat side-streams or impacts to GWRS, and new permitting for environmental regulatory requirements. High score indicates low carbon footprint for technology, low travel distance to end use, minimal side-stream generation or impacts, no additional permitting for environmental regulatory requirements.
Community & Stakeholder Impacts	 Minimize nuisance impacts such as dust, odors, vectors, aesthetics, noise and traffic. Assess impacts to partner agency issues/values as well as local planning codes and requirements. 	 Low score indicates nuisance factors for onsite technology are difficult to mitigate. High score indicates nuisance factors can be mitigated at plant site.
Project Site Compatibility	 Assess compatibility of technology with available plant footprint. Incorporation into existing treatment process. Ability to accept co-digestion substrates. 	 Low score indicates lack of site space for new facilities, requires abandonment of existing facilities, and difficult integration with existing plant. High score indicates available footprint for new facilities and maintains space for future facilities, easy of integration with existing processes and facilities.

Evaluation Criteria Weighting

Criterion	Weight Stabilization	Weight Dewatering	Weight Biogas Use and Waste Heat
End Use Market Compatibility	15%	15%	NA
Proven Technology Performance	15%	25%	20%
Minimize Life Cycle Costs	10%	20%	10%
Energy/Resource Recovery	20%	NA	25%
O&M Impacts	10%	15%	10%
Environmental Impacts	10%	5%	15%
Community & Stakeholder Impacts	10%	5%	10%
Project Site Compatibility	10%	15%	10%

Thickening Technologies

- Primary Clarifier (Existing)

- Rotary Drum Thickener (RDT)
 Recommendation from prior planet status quo Brown and Calower Prepared by Brown evaluate RDTs compared to status quo

Starting with the End in Mind – Market Compatibility

- Class B Cake Land application (Arizona) or contract composting
- Class A Cake Land application in CA and AZ (soil blending and land reclamation possible)
- Class A THP Cake Land application and soil blending (land reclamation possible)
- Class A granules (high quality) Land application, horticulture, fertilizer blending, soil blending (land reclamation possible)
- Class A granules (low quality) Land application (land reclamation possible)
- Class A Lystegro Land application

Options to produce end-use product alternatives

Product Alternatives	Technology Options
Class B Cake	Class B digestion
Class A Cake	Class A digestion (thermophilic or TPAD)
Class A THP Cake	THP/digestion
Class A Dried Granule (high quality)	Class A or B digestion + two dryer trains
Class A Dried Granule (low quality)	Class A or B digestion + maximize existing dryer
Class A Lystegro	Class A or B digestion + Lystek
Class A Lystegro Prepared by Bro	

Stabilization Technologies

- Mesophilic Digestion

- Brown and Caldwell

 - Chemical Hydrolysis
 - Lystek
 - Thermal Hydrolysis Process (THP) Traditional CAMBI
 - THP Digestion-Lysis-Digestion (DLD)
 - THP Solid Stream CAMBI

Stabilization Technologies – Fatal Flaw

	Technology Maturity	Successful Operation of Comparable Size	Available Space	Compatibility
Mesophilic Digestion	Pass	Pass	Pass	Pass
Mesophilic with High Solids	Pass	Pass	Pass	Pass
Staged Digestion	Pass	Pass	Fail	Pass
Acid/Gas Phased Digestion	Pass	Pass	Fail	Pass
Thermophilic Digestion	Pass	Pass	Pass	Pass
Temperature Phased Anaerobic Digestion	Pass	Pass	Fail	Pass
Enzymatic Hydrolysis	Fail	Fail	Pass	Pass
Chemical Hydrolysis	Pass	Fail	Pass	Pass
Lystek	Pass	Pass	Pass	Pass
Traditional CAMBI	Pass	Pass	Pass	Pass
THP - DLD	Fail	Fail	Fail	Pass
Solid Stream CAMBI	Fail	Fail	Pass	Pass

Stabilization Technologies - Screening

	Mesophilic Digestion	Mesophilic Digestion with High Solids	Thermophilic Digestion	Lystek	Traditional CAMBI
End Use Market Compatibility	3	3	3	2	5
Proven Technology Performance	5	2	5	2	4
Minimize Life Cycle Costs	3	3	4	2	2
Energy/Resource Recovery	3	4	5	3	4
O&M Impacts	4	3	4	3	3
Environmental Impacts	4	4	4	3	4
Community & Stakeholder Impacts	4	4	4	2	4
Project Site Compatibility	5	3	5	3	2
Weighted Score	3.80	3.25	4.30	2.50	3.65

Dewatering Technologies

- Centrifuge

- volute press Bucher press
 - Prepared by Brown and Caldwell

Dewatering Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility			
Centrifuges	Pass	Pass	Pass	Pass			
Belt Press	Pass	Pass	Pass	Pass			
Screw Press	Pass	Pass	Pass	Pass			
Rotary Press	Pass	Pass	Pass	Pass			
Volute Press	Pass	Pass	Pass	Pass			
Bucher Press	Fail	Fail	Pass	Pass			
Volute PressPassPassPassBucher PressFailFailPass							

Dewatering Technologies - Screening

	Centrifuges	Belt Press	Screw Press	Rotary Press	Volute Press		
End Use Market Compatibility	3	5	4	3	3		
Proven Technology Performance	5	5	3	2	2		
Minimize Life Cycle Costs	4	4	3	3	3		
0&M Impacts	5	5	2	2	2		
Environmental Impacts	3	2	3	3	3		
Community & Stakeholder Impacts	4	4	4	4	4		
Project Site Compatibility	5	4	2	3	3		
Weighted Score	4.35	4.45	2.90	2.65	2.65		
weighted score 4.35 4.45 2.50 2.05 2.05 2.05							

Post-Dewatering Technologies

- Thermal drying high quality granules
- Thermal drying low quality granules (indirect dryer) nt Plan Update

- Junyons
 Partial solar drying
 Deep well injection
 Dehydration
 Incineration Julon Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell

 - Incineration

Post-Dewatering Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility	
Thermal Drying: Low Quality (Indirect Dryer)	Pass	Pass	Pass	Fail	
Thermal Drying: High Quality (Drum Dryer)	Pass	Pass	Pass	Pass	
Gasification	Fail	Fail	Pass	Pass	
Pyrolysis	Fail	Fail	Pass	Pass	
Gasinication Fail Fail Pass Pass Pyrolysis Fail Fail Pass Pass Figle Fail Fail Pass Pass					

Alternative Power Production Technologies

- Internal Combustion Engines
- Digester gas upgrading
 - For pipeline injection
 - For vehicle fueling (CNG)
- Microturbines
- Biosolids Drying direct use of biogas and Caldwell
- Energy Storage (Batteries)
- Fuel Cells
- Large Scale Solar Photovoltaics (PV)
- Small Scale/Rooftop Solar Photovoltaics
- Wind Turbines
- Direct sale to adjacent power plant

Alternative Power Production – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility
Internal Combustion Engines	Pass	Pass	Pass	Pass
Digester Upgrading: Pipeline Injection	Pass	Pass	Pass	Pass
Digester Upgrading: Vehicle Fueling (CNG)	Pass	Pass	Pass	Pass
Microturbines	Pass	Pass	Pass	Pass
Biosolids Drying - Direct Use Of Biogas	Pass	Pass	Pass	Pass
Energy Storage	Pass	Pass	Pass	Pass
Fuel Cells	Fail	Fail	Pass	Pass
Large Scale Solar Photovoltaics	Pass	Pass	Pass	Pass
Small Scale/Rooftop Solar Photovoltaics	Pass	Pass	Pass	Pass
Wind Turbines	Pass	Pass	Fail	Fail

Alternative Power Production – Screening

	Internal Combustio n Engines - Status Quo	Engines - With Gas	Engines - With Exhaust	Digester Upgrading: Pipeline Injection	Digester Upgrading: Vehicle Fueling (CNG)	Micro- turbines	Biosolids Drying - Direct Use Of Biogas	Energy Storage (Batteries)	Small Scale Rooftop PV	Large Scale Photovoltaics
Proven Technology Performance	5	5	4	2	3	4	5	3	5	5
Minimize Life Cycle Costs	3	3	4	4	4	3	3	3	4	4
Energy/Resourc e Recovery	4	4	5	4	4	4	2	1	5	5
O&M Impacts	3	4	3	4	4	4	3	4	5	5
Environmental Impacts	3	3	4	5	5	5	3	3	5	4
Community & Stakeholder Impacts	4	4	5	5	5	4	3	3	5	5
Project Site Compatibility	5	5	4	4	4	4	5	3	2	2
Weighted Score	3.95	4.05	4.25	3.85	4.05	4.05	3.35	2.60	4.60	4.45

Waste Heat Technologies

- Small Scale Steam Turbines
- Absorption and Adsorption Chillers
 Organic Rankine Cycle (ORC)
 Gasification of Biosolids
- Workshop #2 Workshop #2 Prepared by Brown and Caldwell
- Biosolids

Waste Heat Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility
Small Scale Steam Turbines	Pass	Pass	Pass	Pass
Use For Thermo/THP	Pass	Pass	Pass	Pass
Absorption And Adsorption Chillers	Pass	Pass	Pass	Fail
Organic Rankine Cycle	Fail	Fail	Pass	Pass
Gasification Of Biosolids	Fail	Fail	Pass	Pass
Gasification Of BiosolidsFailPassPass				

Waste Heat Technologies – Screening

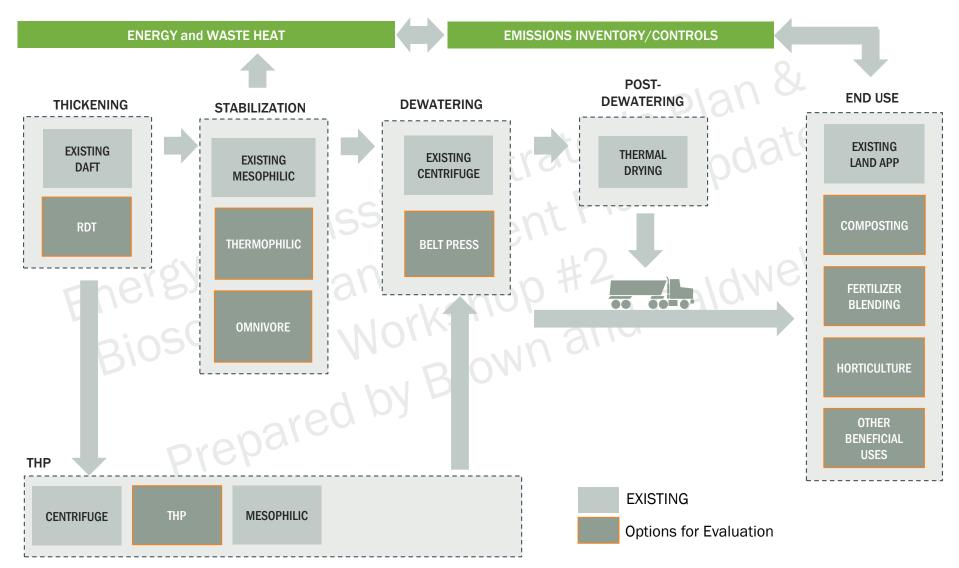
	Small-Scale Steam Turbines	Thermo/THP
Proven Technology Performance	2	5
Minimize Life Cycle Costs	3	5
Energy/Resource Recovery	4	4
O&M Impacts	3	3
Environmental Impacts	3	4
Community & Stakeholder Impacts	3	4
Project Site Compatibility	3	4
Weighted Score	3.05	4.2
Weighted Score 3.05 4.2		



Creation of End to End Alternatives



Evaluating Technologies and Markets Together



Brown and Caldwel

Initial Alternatives

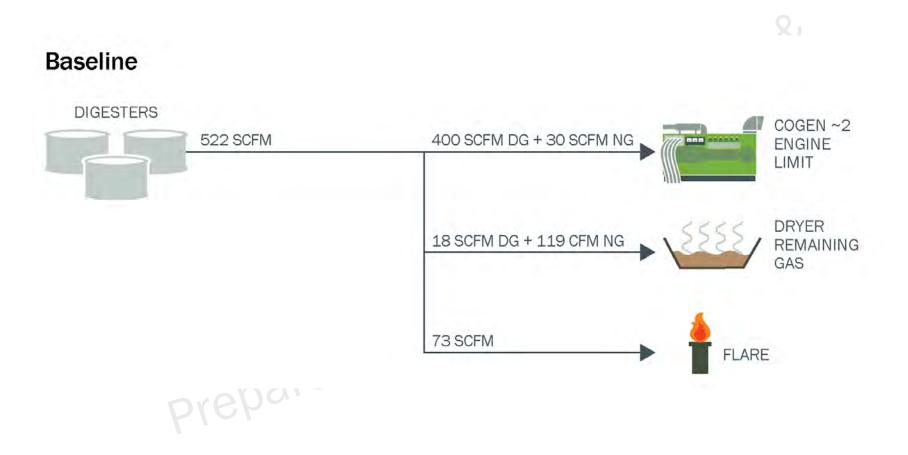
- Meso plus second dryer
- Meso plus Class B hauling
- Thermophilic
 - Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell With and without second dryer
- Cambi (traditional)
 - With and without second dryer

- Additional Layers
 - Thickening
 - Dewatering
 - Energy alternatives
 - End use markets

Alternatives: Power Production

- Baseline: Existing cogen + drying
- Baseline + gas conditioning
 - Gas conditioning serves to reduce O&M costs associated with engines and dryer
- Existing cogen + vehicle fuel (via pipeline injection or tube trailer)
 - No permit modification to cogen / no DG to dryer
 - Continue to operate two engines
 - Additional gas routed to vehicle fuel
- Existing cogen + microturbines
 - Includes gas conditioning
 - No permit modification to cogen / no DG to dryer
- Existing cogen + steam boiler/turbine
 - No permit modification to cogen / no DG to dryer
 - Additional gas routed to steam boiler; steam used in small turbine
- New cogen permit, CO catalyst and SCR, gas conditioning
 - Need to consider plant demand as a limit on power production
- Vehicle Fuel (primary use of DG) + existing cogen (natural gas + tail gas)
 - "All in" on vehicle fuel

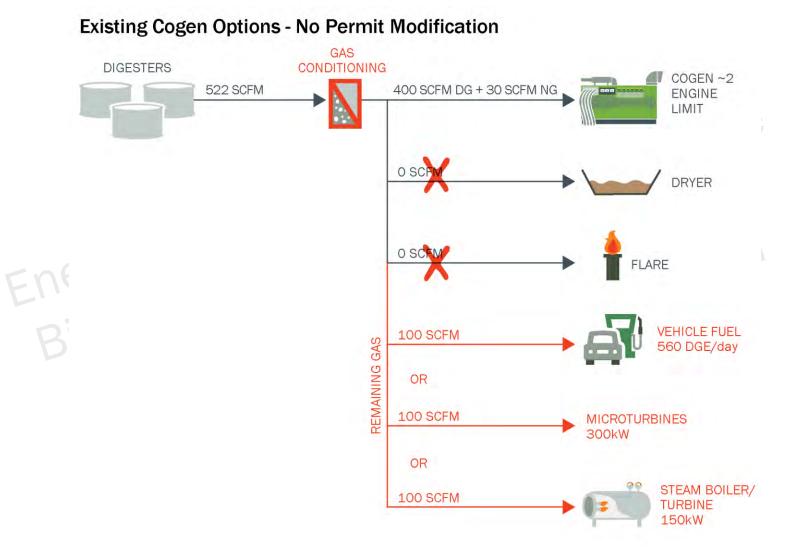
Baseline includes cogeneration (permit limited), dryer and some flaring



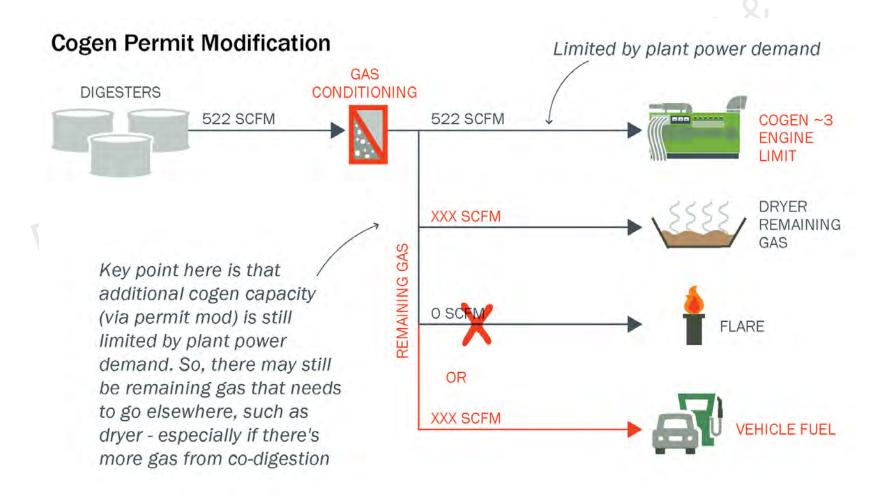
Gas conditioning could reduce engine and dryer O&M costs associated with siloxanes

Baseline with Gas Conditioning GAS DIGESTERS CONDITIONING COGEN~2 522 SCFM 400 SCFM DG + 30 SCFM NG 000 -ENGINE LIMIT DRYER 18 SCFM DG + 119 CFM NG REMAINING GAS 73 SCFM FLARE

With the existing permit in place, where else can we send digester gas to get highest value?

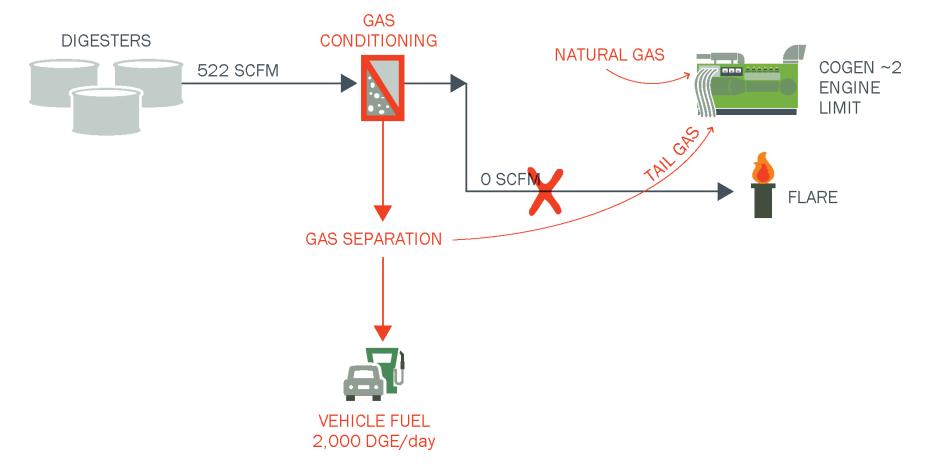


A permit modification allows EWA to meet plant electricity demand, but any additional gas would need to go to a non-generating use



An all-vehicle-fuel option may deliver the best economics

Vehicle Fuel



Alternatives to be presented at next workshop

- Process schematic
- sprint Potential locations solons for plan agend to the plan

 - Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell



Grant Updates



Self Generation Incentive Program

Program	Self-Generation Incentive Program (SGIP)
Agency	California Energy Commission / administered by SDG&E
Eligible Projects	Self-generation projects such as new engines, microturbines, or steam turbines – increased incentives for renewable/biogas projects; Energy storage / batteries
Funding	Incentives based on anticipated power output – based on fuel availability, not nameplate capacity; 50% paid upfront / 50% paid over 5 years based on performance
Schedule	Funding available each year / first-come, first-served Battery funding decreases as tiers fill up Projects must be operational within 18 months of award
How much are we talking?	~\$500k - \$1M depending on project size
Recommendation for SWEET Analysis	Don't count on funding to justify project economics
Next steps	Continue to track / pursue if selected alternatives meet criteria

Low-Carbon Fuel Standard

Program	Low-Carbon Fuel Standard (LCFS)
Agency	California Air Resources Board
Eligible Projects	Part of AB 32 scoping plan – projects that reduce the carbon intensity of California's vehicle fuel – i.e. renewable compressed natural gas (CNG vehicle fuel)
Funding	Incentives based on fuel production, market-based values; Paid on a per-gallon basis as the project performs
Schedule	Ongoing program, recently extended through 2030
How much are we talking?	Varies could equate to ~\$0.50/DGE - \$1.00/DGE depending on market factors
Recommendation for SWEET Analysis	Include in SWEET analysis for vehicle fuel projects; Assume funding only through 2030, use conservative values
Next steps	Continue to track / pursue if vehicle fuel is recommended

Renewable Fuel Standard

Program	Renewable Fuel Standard
Agency	US Environmental Protection Agency
Eligible Projects	Renewable fuel projects - i.e. renewable compressed natural gas (CNG vehicle fuel)
Funding	Incentives based on fuel production, market-based values; Paid on a per-gallon basis as the project performs
Schedule	Ongoing program, not guaranteed beyond 2022
How much are we talking?	A lot of uncertainty: Wastewater digester gas is eligible for highest value of RINs – D3 EPA has recently stated that DG from food waste is a lower value – D5 EPA has the ability to set RIN quotas, which drive supply-and-demand, market-based pricing
Recommendation for SWEET Analysis	Include in SWEET analysis for vehicle fuel projects; Assume funding only through 2022, use conservative values
Next steps	Continue to track / pursue if vehicle fuel is recommended

Organics Grant Program

Program	Organics Grant Program
Agency	Department of Resource Recovery and Recycling (CalRecycle)
Eligible Projects	Projects that serve to divert organics (food waste) from landfill – toward anaerobic digestion or composting; recently issued with a food rescue requirement
Funding	Incentives based on project size and potential tons diverted
Schedule	Recently awarded, not expected to reissue for ~18 months
How much are we talking?	Up to \$4M per project
Recommendation for SWEET Analysis	Do not include – too competitive to count on
Next steps	Continue to track / pursue if food waste receiving is recommended

Organics Grant Program - Recent Award

Recommendation:

Staff recommends approval of 10 grant awards, as listed in Table 1 below, for \$24,000,000.

Applicant	County	Total Award
Anaerobic Digestion Projects		
County Sanitation Districts of Los Angeles County	Los Angeles	\$4,000,000
HZIU Kompogas SLO, Inc.	San Luis Obispo	\$4,000,000
Rialto Bioenergy Facility, LLC	San Bernardino	\$4,000,000
	Subtotal	\$12,000,000
Compost Projects		
City of San Diego	San Diego	\$3,000,000
Mid Valley Recycling, LLC	Fresno	\$1,875,000
Salinas Valley Solid Waste Authority	Monterey	\$1,341,865
Recology Yuba-Sutter (partially funded)	Yuba	\$2,783,135
	Subtotal	\$9,000,000
Rural Compost Projects		
Napa Recycling & Waste Services, LLC	Napa	\$541,700
South Lake Refuse Company, LLC	Lake	\$1,218,026
West Coast Waste (partially funded)	Madera	\$1,240,274
	Subtotal	\$3,000,000
	Grand Total	\$24,000,000

Table 1. Organics Grant Program Recommended Award – List A

Organics Grant Program - Recent Award

Applicant	County	Total Award Requested*
Anaerobic	Digestion Projects	
CR&R Incorporated	Riverside	\$4,000,000
Contra Costa Waste Services	Contra Costa	\$4,000,000
City of Manteca	San Joaquin	\$1,500,000
Santa Barbara County	Santa Barbara	\$4,000,000
Subtotal		\$13,500,000
Com	oost Projects	
Recology Yuba-Sutter (partially funded)	Yuba	\$216,865
Agromin OC, LLC	San Bernardino	\$600,000
Waste Management of Alameda County,	nc. Alameda	\$3,000,000
GreenWaste Recovery, Inc.	Santa Clara	\$1,700,000
Burrtec Waste Industries, Inc.	Riverside	\$3,000,000
Arakelian Enterprises Inc. DBA Athens Services	San Bernardino	\$3,000,000
Best Way Disposal Company, Inc. DBA Advance Disposal Co.	San Bernardino	\$2,481,250
Kern County	Kern	\$3,000,000
City of Oceanside	San Diego	\$1,178,351
Subtotal		\$18,176,466
Rural Co	ompost Projects	
West Coast Waste (partially funded)	Madera	\$161,326
Upper Valley Disposal Service	Napa	\$1,250,000
Subtotal	\$1,411,326	
	Grand Total	\$33,087,792

Table 2. Organics Grant Program Recommended Award - List B

Heathy Soils Program

Program	Healthy Soils Program	
Agency	California Department of Food and Agriculture	
Eligible Projects	Demonstration projects that sequester carbon and reduce GHG emiss – groups within CASA	
Funding	Incentives based on project size and potential GHG benefit	
Schedule	Currently accepting applications through September 19 Annual funding program (AB 32 funds), amounts and criteria may vary	
How much are we talking?	Up to \$3.75M total	
Recommendation for SWEET Analysis	Do not include / ancillary benefit to support end use program	
Next steps	Continue to track / connect with CASA Science and Research Group for potential partnerships	

Green Project Reserve

Program	Green Project Reserve
Agency	California Water Resources Control Board
Eligible Projects	Projects that improve energy efficiency, renewable energy generation, or recycled water production
Funding	A component of Clean Water State Revolving Funding; Green Project Reserve is a "loan forgiveness" program CWSRF is generally oversubscribed, but GPR is underutilized
Schedule	Ongoing
How much are we talking?	Up to \$4M per project, or 50% of project value, whichever is higher
Recommendation for SWEET Analysis	Do not include
Next steps	Something for EWA to keep in mind – if a larger capital project requires funding, consider CWSRF and adding an eligible GPR component



Air Permitting Discussion



EWA is actively pursuing air permit modification

- EWA (with Don King) will submit a request for permit modification within ~1 week
- Goal is to adjust the CO emission rate from 530 ppm to ~400 ppm, and thereby adjust the fuel input limit aimed at keeping CO emissions below Title V synthetic minor threshold
- If successful, this effort would increase permitted cogen capacity by ~20%
- This increase would allow EWA to meet plant electricity demand with current digester gas flows and cogen system



Look Ahead & Wrap-Up



Project Schedule

- Workshop #3 in mid-September
- Draft Analysis and Reports to Begin

Combined Project Schedule	JUL '17	AUG '17	SEP '17	OCT '17	NOV '17	DEC '17	JAN '18	FEB '18	MAR '18
TASK 1 - Baseline Energy									
TASK 2 - Biosolids Tech									
TASK 3 - Power Tech									
TASK 4 - Biogas Tech									
TASK 5 - Waste Heat Tech									1
TASK 6 - Air Emissions Evaluation									1
TASK 7 - Alternatives and Evaluation									
TASK 8 - Grants/Incentives									
TASK 9 - Management/QC									
Workshops	◆W1	🔶 W2	🔶 W3	3		◆ W4	♦ W5	1	W6
	COLOR KEY	Y:	Evaluation	Analyz	e/Report	Client R	leview	Final Repo	*

Look Ahead – September Workshop

- Consensus on mass balance/baseline
- Conceptual layouts/details of alternatives for consensus/feedback (example numbers to support including biogas production, food waste that can be imported)
- Air permitting impacts on power production alternatives
- Informational meeting with waste haulers
- Debrief on Anaergia meeting
- Grants update

Wrap-Up

QUESTIONS?



it's about connecting

Brown AND Caldwell

essential ingredients®

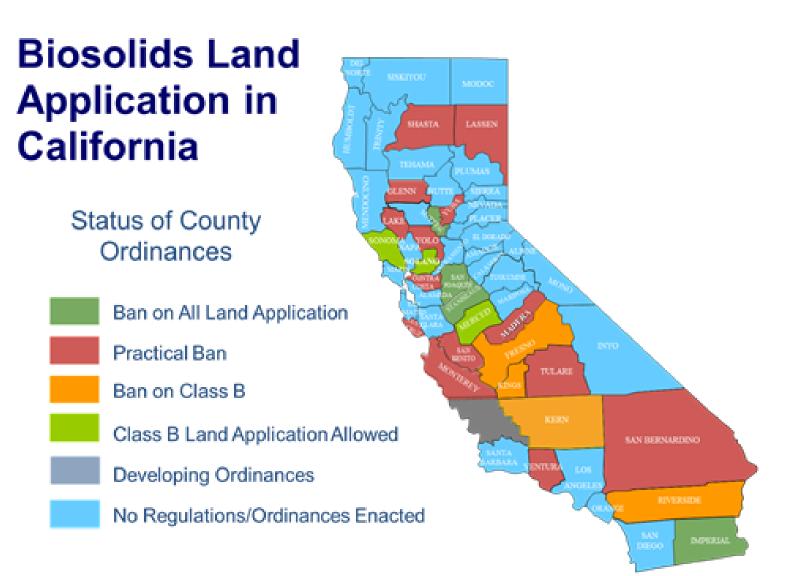
Attachment B: Map of California Land Application Ordinances

Source: California Association of Sanitation Agencies



Use of contents on this sheet is subject to the limitations specified at the beginning of this document. SC07037_Final_TM2_Tech Eval Biosolids Handling_20180108.docx

B-1



Attachment C: Digestion Volume Calculations



Use of contents on this sheet is subject to the limitations specified at the beginning of this document. SC07037_Final_TM2_Tech Eval Biosolids Handling_20180108.docx

C-1

Pre-THP Dewatering

Assumptions:

Pre-THP dewatering feed solids flows and loads are the same as the digester feed flows and loads on the Digestion tab.

Current solids flows and loads from "Peaking" tabs. 2040 flows and load provided by Tracy Chouinard.

	Current				2040			
Pre-THP Dewatering Fee	Avg	Max Month	Max 2-Week	Max Day	Avg	Max Month	Max 2-Week	Max Day
TS (lb/day)	94,380	109,731	138,681	138,681	108,100	132,000	139,500	170,800
VS (lb/day)	80,520	92,715	97,111	97,111	91,415	111,676	118,019	144,543
%TS	4.52%	4.85%	5.85%	4.15%	4.68%	4.67%	4.67%	4.67%
Flow (GPD)	250,425	271,335	284,379	400,440	277,250	338,974	358,205	438,946

Pre-THP Dewatering Cer	ntrifuge		330	gpm				
Flow (gpm)	174	188	197	278	193	235	249	305
No. of Duty Unit	0.53	0.57	0.60	0.84	0.58	0.71	0.75	0.92
No. of Standby Unit	1	1	1	1	1	1	1	1
Total No. of Unit	2	2	2	2	2	2	2	2
Solids capture rate	98%	98%	98%	98%	98%	98%	98%	98%
Solids to THP (ppd)	92,492	107,536	135,908	135,908	105,938	129,360	136,710	167,384

Centrifuge Recommendation

Recommend two 29inch bowl units

Alfa Laval G3-125 dimensions: 5' x 23'

Cambi THP Unit Capacity

	Peak Day	Other
	ton/day	ton/day
B2-1	6.5	6.2
B2-2	13	12.4
B2-3	19.5	18.5
B2-4	26.1	24.8
B6-2	46	43.7
B6-3	70	66.5
B6-4	93	88.4
B12-3	99	94.1
B12-4	119	113.1

тнр	Current				2040				
	Avg	Max Month	Max 2-Week	Max Day	Avg	Max Month	Max 2-Week	Max Day	
Solids to THP (dtpd)	46.2	53.8	68.0	68.0	53.0	64.7	68.4	8	83.7

THP Recommendation

Recommend one B6-4 unit

B6-4 dimensions: 27' x 33'

Cake Bin Recommendation

Since 1 B6-4 has sufficient capacity for 2040 peak day solids production, no cake storage is needed. Cake bins will only need to provide a working volume (~ 30 cy) to feed the THP. Recommend two cake bins (one per centrifuge), each with a capacity of 50 cy. Preliminary bin size, each, LxWxH = 14x10x14

Odor Control

SFPUC solids loads 220 dtpd, odor control (biofilter) approximately 60 x 90 Encina solids loads 84 dtpd, assume odor control will be 1/3 of SFPUC, say 60 x 30

Digester Sizing

Summary of Results

	Current	2040
Conventional Mesophilic Anaerobic Digestion (CMAD)	Existing digesters have sufficient capacity for current flows and loads	Service condition HRT is slight less than 15 days (14.7 days) with existing digesters. Probably ok.
Thermophilic Anaerobic Digestion (TAD)	Existing digesters have sufficient capacity for current flows and loads	Service condition HRT is slight less than 15 days (14.7 days) with existing digesters. Probably ok.
Class A Batch Tanks	Need 4 new batch tanks (0.48 MG each) or, 3 new batch tanks (0.3 MG each) and retrofit 3 existing small digesters (0.3 MG each)	Need 4 new batch tanks (0.48 MG each) or, 3 new batch tanks (0.3 MG each) and retrofit 3 existing small digesters (0.3 MG each)
Staged Mesophilic Anaerobic Digestion (SMAD)	One new digester is required to operate in SMAD mode. Typical operation would be three first stage and one second stage digesters. Piping configuration should allow one of the first stage digesters function as second stage digester.	One new digester is required to operate in SMAD mode. Typical operation would be three first stage and one second stage digesters. Piping configuration should allow one of the first stage digesters function as second stage digester.
Acid/Gas Anaerobic Digestion (AGAD)	Requires two acid reactors, 400,000 gallons each. Preliminary sizing: 45' dia. 34' SWD. Existing digesters have sufficent capacity to function as gas reactors.	Requires two acid reactors, 400,000 gallons each. Preliminary sizing: 45' dia. 34' SWD. Existing digesters will function as gas reactors. Service condition HRT is slightly less than 15 days (14.8 days). Should be ok.
Temperature Phased Anaerobic Digestion (TPAD)		Typical operation would be two thermophilic digesters and one mesophilic digester. Equipment and piping configuration should allow one thermophilic digester operate as a swing digester. With existing digesters, HRT at the service conditon is lower than design values. Thermophilic phase HRT is 7.4 days, the potential for microorganism washout is high. Recommend building one new thermophilic phase digester.

Current solids flows and loads from "Peaking" tabs. 2040 flows and load provided by Tracy Chouinard

		Current				2040			
Digester Feed	Avg	Max Month	Max 2-Week	Max Day	Avg	Max Month	Max 2-Week	Max Day	
TS (lb/day)	94,380	109,731	138,681	138,681	108,100	132,000	139,500	170,800	
VS (lb/day)	80,520	92,715	97,111	97,111	91,415	111,676	118,019	144,543	
%TS	4.52%	4.85%	5.85%	4.15%	4.68%	4.67%	4.67%	4.67%	
Flow (GPD)	250,425	271,335	284,379	400,440	277,250	338,974	358,205	438,946	

50 40,107 300,000 3 900,000

Existing Digesters

Digester Diameter	2@ 105, 1@95	Digester Diam
SWD	2@35, 1@42.8	SWD
Volume, cf	274,064	Volume, cf
Volume, gal	2,050,000	Volume, gal
No. of Digesters	3	No. of Digeste
Total Digester Volume, gal	6,150,000	Total Digester

Old digester 2 is working as a sludge holding tank. Digesters 1 and 3 are the same size but needs major repair

Conventional Mesophilic Anaerobic Digestion (CMAD)

Design Criteria

Digestion		Average	Service	Max 2-Week
OLR	lb VS/d/cf	0.15	0.18	0.18
HRT	day	15	15	15

Annual Average Condition: AA flows and loads, all digesters in service Service Condition: AA flows and loads, one digester out of service Max 2-Week Condition: Peak 14-d flows and loads, all digesters in service

Digester loading rates with three total digesters.

Digester Loading Rates	Current			
	Avg	Service	Max 2-Week	
No. of digesters in service	3	2	3	
Total digester capacity in service, MG	6.15	4.10	6.15	
OLR, lb VS/cf	0.10	0.15	0.12	
HRT, day	24.6	16.4	21.6	
OLR Check	OK	OK	OK	
HRT Check	OK	ОК	OK	

2040					
Avg	Service	Max 2-Week			
3	2	er)			
6.15	4.10	6.15			
0.11	0.17	0.14			
22.2	14.8	17.2			
OK	OK	OK			
OK	Overload	OK			

Thermophilic Anaerobic Digestion (TAD)

Design Criteria

Digestion		Average	Service	Max 2-Week
OLR	lb VS/d/cf	0.3	0.35	0.30
HRT	day	15	15	15

Annual Average Condition: AA flows and loads, all digesters in service Service Condition: AA flows and loads, one digester out of service Max 2-Week Condition: Peak 14-d flows and loads, all digesters in service

Digester loading rates with three total digesters.

Digester Loading Rates	Current			
	Avg	Service	Max 2-Week	
No. of digesters in service	3	2	3	
Total digester capacity in service, MG	6.15	4.10	6.15	
OLR, lb VS/cf	0.10	0.15	0.12	
HRT, day	24.6	16.4	21.6	
OLR Check	OK	OK	OK	
HRT Check	OK	OK	OK	

2040						
Avg	Service	Max 2-Week				
3	2	3				
6.15	4.10	6.15				
0.11	0.17	0.14				
22.2	14.8	17.2				
OK	OK	OK				
OK	Overload	OK				

Class A Batch Tank

Design Criteria

Digestion		Average	Service	Max 2-Week	Max Day	Annual Average Condition: AA flows and loads, all digesters in service
OLR	lb VS/d/cf	N/A	N/A	N/A	N/A	Service Condition: AA flows and loads, one digester out of service
HRT	day	1	1	1	1	Max 2-Week Condition: Peak 14-d flows and loads, all digesters in service

Digester loading rates with four total batch tanks (fill, hold, draw, redundant) (existing digesters 1-3, 0.3 MG each, plus one new the same size)

Digester Loading Rates	Current			2040				
	Avg	Service	Max 2-Week	Max Day	Avg	Service	Max 2-Week	Max Day
No. of digesters in service	1	1	1	1	1	1	1	1
Total digester capacity in service, MG	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
OLR, lb VS/cf	2.01	2.01	2.42	2.42	2.28	2.28	2.94	3.60
HRT, day	1.2	1.2	1.1	0.75	1.1	1.1	0.8	0.68
OLR Check	OK	OK	OK	ОК	OK	OK	OK	OK
HRT Check	OK	OK	OK	Overload	OK	OK	Overload	Overload

Staged Mesophilic Anaerobic Digestion (SMAD)

Design Criteria

First Stage		Average	Service	Max 2-Week
OLR	lb VS/d/cf	0.15	0.18	0.18
HRT	day	10	10	10
Second Stage		Average	Service	Max 2-Week
OLR	lb VS/d/cf	N/A	N/A	N/A
HRT	day	5	5	5

Annual Average Condition: AA flows and loads, all digesters in service Service Condition: AA flows and loads, one digester out of service Max 2-Week Condition: Peak 14-d flows and loads, all digesters in service

Digester loading rates with existing three of	digesters (two first stage and one second stage)

Digester Loading Rates	Current			
First Stage Digester	Avg	Service	Max 2-Week	
No. of digesters in service	2	1	2	
Total digester capacity in service, MG	4.10	2.05	4.10	
OLR, lb VS/cf	0.15	0.29	0.18	
HRT, day	16.4	8.2	14.4	
OLR Check	OK	Overload	OK	
HRT Check	OK	Overload	OK	
Second Stage Digester	Avg	Service	Max 2-Week	
No. of digesters in service	1	1	1	
Total digester capacity in service, MG	2.05	2.05	2.05	
OLR, Ib VS/cf	N/A	N/A	N/A	
HRT, day	8.2	8.2	7.2	
OLR Check	N/A	N/A	N/A	
HRT Check	OK	OK	OK	

	2040	
Avg	Service	Max 2-Week
2	1	2
4.10	2.05	4.10
0.17	0.33	0.22
14.8	7.4	11.4
Overload	Overload	Overload
OK	Overload	OK
Avg	Service	Max 2-Week
1	1	1
2.05	2.05	2.05
N/A	N/A	N/A
7.4	7.4	5.7
N/A	N/A	N/A
OK	OK	OK

Digester loading rates with	four digesters (three	first stage and one second stage)
-----------------------------	-----------------------	-----------------------------------

Digester Loading Rates		Current	
First Stage Digester	Avg	Service	Max 2-Week
No. of digesters in service	3	2	3
Total digester capacity in service, MG	6.15	4.10	6.15
OLR, lb VS/cf	0.10	0.15	0.12
HRT, day	24.6	16.4	21.6
OLR Check	OK	OK	OK
HRT Check	OK	OK	OK
Second Stage Digester	Avg	Service	Max 2-Week
No. of digesters in service	1	1	1
Total digester capacity in service, MG	2.05	2.05	2.05
OLR, lb VS/cf	N/A	N/A	N/A
HRT, day	8.2	8.2	7.2
OLR Check	N/A	N/A	N/A
HRT Check	OK	OK	ОК

Current					
Avg	Service	Max 2-Week			
	2	3			
6.15	4.10	6.15			
0.11	0.17	0.14			
22.2	14.8	17.2			
OK	OK	ОК			
OK	OK	OK			
Avg	Service	Max 2-Week			
1	. 1	1			
2.05	2.05	2.05			
N/A	N/A	N/A			
7.4	7.4	5.7			
N/A	N/A	N/A			
OK	OK	OK			

Acid-Gas Digestion (AGAD)

Design Criteria

Design enteria						
Acid Phase Digester		Average	Service	Max 2-Week	Max Day	Annual Average Condition: AA flows and loads, all digesters in service
OLR	lb VS/d/cf				2	Service Condition: AA flows and loads, one digester out of service
HRT	day				1	Max 2-Week Condition: Peak 14-d flows and loads, all digesters in service
Gas Phase Digester		Average	Service	Max 2-Week		Max Day Condition: For acid phase reactor sizing only
OLR	lb VS/d/cf	0.15	0.18	0.18		
HRT	day	15	15	15		

Α

Acid Phase Digester

Digester Loading Rates		Current (2012-2016)				Current (2012-2016)	
	Avg	Service	Max 2-Week	Max Day	Avg	Service	Max 2-Week	Max Day
No. of digesters in service	2	1	2	2	2	1	2	2
Total digester capacity in service, MG	0.60	0.30	0.60	0.60	0.60	0.30	0.60	0.60
OLR, lb VS/cf	1.00	2.01	1.21	1.21	1.14	2.28	1.47	1.80
HRT, day	2.40	1.20	2.11	1.50	2.16	1.08	1.68	1.37

Digester loading rates with three gas phase digesters

Digester Loading Rates	Current (2012-2016)			
	Avg	Service	Max 2-Week	
No. of digesters in service	3	2	3	
Total digester capacity in service, MG	6.15	4.10	6.15	
OLR, lb VS/cf	0.10	0.15	0.12	
HRT, day	24.6	16.4	21.6	
OLR Check	OK	ОК	OK	
HRT Check	OK	OK	OK	

Current (2012-2016)						
lvg	Service	Max 2-Week				
3	2	3				
6.15	4.10	6.15				
0.11	0.17	0.14				
22.2	14.8	17.2				
OK	OK	OK				
OK	Overload	OK				

Temperature Phased Anaerobic Digestion (TPAD)

Design Criteria

Thermophilic Digester		Average	Service	Max 2-Week
OLR	lb VS/d/cf	0.35	0.35	0.35
HRT	day	9	8	8
Mesophilic Digester		Average	Service	Max 2-Week
OLR	lb VS/d/cf	N/A	N/A	N/A
HRT	day	7	7	7

Annual Average Condition: AA flows and loads, all digesters in service Service Condition: AA flows and loads, one digester out of service Max 2-Week Condition: Peak 14-d flows and loads, all digesters in service

Digester Loading Rates		Current			
Thermophilic Digester	Avg	Service	Max 2-Week		
No. of digesters in service	2	1	2		
Total digester capacity in service, MG	4.10	2.05	4.10		
OLR, lb VS/cf	0.15	0.29	0.18		
HRT, day	16.4	8.2	14.4		
OLR Check	OK	OK	OK		
HRT Check	OK	OK	OK		
Mesophilic Digester	Avg	Service	Max 2-Week		
No. of digesters in service	1	1	1		
Total digester capacity in service, MG	2.05	2.05	2.05		
OLR, lb VS/cf	N/A	N/A	N/A		
HRT, day	8.2	8.2	7.2		
OLR Check	N/A	N/A	N/A		
HRT Check	OK	OK	OK		

Digester loading rates with existing three digesters (two thermo and one meso)

Current						
Avg	Service	Max 2-Week				
2	1	2				
4.10	2.05	4.10				
0.17	0.33	0.22				
14.8	7.4	11.4				
OK	OK	OK				
OK	Overload	OK				
Avg	Service	Max 2-Week				
1	1	1				
2.05	2.05	2.05				
N/A	N/A	N/A				
7.4	7.4	5.7				
N/A	N/A	N/A				
OK	OK	OK				



Technical Memorandum

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FINAL

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- Project No.: 150871.003.001

Technical Memorandum No. 3

- Subject: Technical Evaluation for Alternative Power Production
- Date: December 1, 2017
- To: Scott McClelland, Assistant General Manager
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Limitations:

This document was prepared solely for Encina Wastewater Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between Encina Wastewater Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by Encina Wastewater Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Encina Wastewater Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List o	of Figures	iii
List o	of Tables	iii
List o	of Abbreviations	iv
Exec	utive Summary	V
Secti	on 1: Introduction	1
1.1	TM 3 Purpose and Scope	1
1.2	Background Information	1
Secti	on 2: Identification of Technologies for Alternative Power Production and Fatal Flaw Screening	2
2.1	Internal Combustion Engine-Generators	3
2.2	Biogas Upgrading and Beneficial Use	4
2.3	Microturbines	8
2.4	Direct Use of Biogas in Drying	9
2.5	Energy Storage (Batteries)	9
2.6	Fuel Cells	10
2.7	Large-Scale Photovoltaics	11
2.8	Small-Scale Photovoltaics	13
2.9	Wind Turbines	13
2.10	Direct Sale to Adjacent Power Plant	15
2.11	Net Energy Metering	15
2.12	Fatal Flaw Conclusions	16
Sect	on 3: Ranking of Screened Technologies	17
3.1	Introduction	17
3.2	Criteria Descriptions and Weightings	17
3.3	Results and Discussion	19
	3.3.1 Internal Combustion Engines	
	3.3.2 Biogas Upgrading	
	3.3.3 Microturbines	
	3.3.4 Biosolids Drying	
	3.3.5 Energy Storage	
	3.3.6 Solar PV	25
Secti	on 4: Conclusions and Next Steps	26
Attac	hment A: Workshop Meeting Minutes	.A-1
	hment B: SDG&E Distribution Interconnection Handbook and BEE - Electrical Upgrades Required for Rule 21 Interconnection	.B-1

Brown AND Caldwell

ii

List of Figures

Figure 2-1. Existing 750 kW Caterpillar engines at EWPCF	3
Figure 2-2. Biogas upgrading system at San Mateo WWTP (CA) using Unison's BioCNG system	5
Figure 2-3. Example of ANGI high pressure compressors	7
Figure 2-4. Example of ANGI vehicle fueling equipment, including high pressure storage and fuel dispenser	7
Figure 2-5. Capstone C1000, 1000 kW microturbine package with integrated exhaust manifold	8
Figure 2-6. Napa Sanitation's Tesla Batteries	10
Figure 2-7. Fuel cell electricity generation process diagram	11
Figure 2-8. PV solar radiation intensity	12
Figure 2-9. Union Sanitary District Irvington Pump Station PV Project included 460 kW of installed solar PV in an emergency overflow basin	13
Figure 2-10. Wind Resource Map of California	14
Figure 3-1. Site layout for IC engines with gas treatment technologies	20
Figure 3-2. Potential siting of biogas upgrading equipment at EWPCF	22
Figure 3-3. Potential siting of biogas upgrading and on-site vehicle fueling equipment at EWPCF	23
Figure 3-4. Site layout of microturbine project with gas conditioning	24
Figure 3-5. Potential siting for solar PV panels at EWPCF	25

List of Tables

Table ES-1. Alternatives Scoring Evaluation	V
Table 1-1. Projected Biogas Production	2
Table 2-1. Comparison of Biogas Upgrading Pipeline Injection and Vehicle Fuel	5
Table 2-2. SDG&E Rule 21 Interconnection Electrical Upgrades	
Table 2-3. Power Production Technology Screening: Fatal Flaw Evaluation	17
Table 3-1. Criteria and Weight for Technology Screening	
Table 3-2. Alternatives Scoring Evaluation	



iii

List of Abbreviations

BC	Brown and Caldwell
BEE Plan	Biosolids Energy and Emissions Plan
Btu	British thermal units
CNG	compressed natural gas
EWA	Encina Wastewater Authority
EWPCF	Encina Water Pollution Control Facility
GHG	greenhouse gas emissions
HSW	high strength waste
IC	internal combustion
kW	kilowatt(s)
lb	pound(s)
LCFS	Low Carbon Fuel Standard
mgd	million gallons per day
MW	megawatt(s)
MWh	megawatts per hour
NEM	net energy metering
NG	natural gas
0&M	operations and maintenance
ppbv	parts per billion by volume
ppmv	parts per million by volume
psig	pounds per square inch gage
PV	photovoltaics
RIN	Renewable Identification Number
scf	standard cubic feet
scfm	standard cubic feet per minute
SCR	selective catalytic reduction
SDG&E	San Diego Gas & Electric
SWEET	Solids Water Energy Evaluation Tool
TM	Technical Memorandum
WWTP	Waste Water Treatment Plant



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Executive Summary

The Encina Water Pollution Control Facility (EWPCF) currently has four 750-kilowatt (kW) internal combustion (IC) engines that produce 83 percent of the plant's electrical power demand as well as heat for the wastewater process. The engines are primarily fueled with biogas from the plant's anaerobic digesters, but also pipeline natural gas (NG) under certain scenarios. The engine fuel input, and electric generation output, is limited by an air permit that generally restricts the plant to operation of two engines (biogas fuel), with a third engine (NG fuel) used during peak electric rate periods. Biogas production exceeds the permitted capacity, so excess biogas is directed to the plant's heat dryer or flared. Driven by a high non-coincident power demand cost and a goal to produce 95 percent of power at the plant, Encina Wastewater Authority (EWA) is evaluating alternative power production technologies to reduce costs and recover maximum value from biogas. This Technical Memorandum (TM) 3 describes the development of screening and evaluation criteria for the assessment of alternative power production technologies. Technologies evaluated include IC engines, microturbines, biogas upgrading, solar photovoltaics (PV), battery storage, fuel cells, wind turbines, and sale of biogas to the adjacent Encina Power Station. Screening and ranking of technologies was performed in a workshop with EWA staff on August 16, 2017. Technologies that did not pass the fatal flaw filter were eliminated. Those technologies that passed the fatal flaw filter moved on and were assessed using evaluation criteria developed to reflect EWA's values and project goals, and are summarized in Table ES-1. Power production alternatives that will be further refined and analyzed using Brown and Caldwell's (BC's) Solids Water Energy Evaluation Tool (SWEET) include those that received an overall score of 3 or higher in the scoring evaluation where higher scores are more favorable over low scores and scoring is specific to the EWPCF. Alternatives presented in Table ES-1 can serve as standalone alternatives or be combined to create 'hybrid' alternatives, which may provide the best of both worlds.

Table ES-1. Alternatives Scoring Evaluation										
	IC Engines - Status Quo	IC Engines - with Gas Conditioning	IC Engines - with Exhaust Treatment	Biogas Upgrading: Pipeline Injection	Biogas Upgrading: Vehicle Fueling (CNG)	Microturbines	Biosolids Drying	Energy Storage (Batteries)	Small-Scale Rooftop PV	Large-Scale PV
Proven Technology Performance	5	5	4	2	3	4	5	3	5	5
Minimize Life-Cycle Costs	3	3	4	4	4	3	3	3	4	4
Energy/Resource Recovery	4	4	5	4	4	4	2	1	5	5
0&M Impacts	3	4	3	4	4	4	3	4	5	5
Environmental Impacts	3	3	4	5	5	5	3	3	5	4
Community & Stakeholder Impacts	4	4	5	5	5	4	3	3	5	5
Project Site Compatibility	5	5	4	4	4	4	5	3	2	2
Weighted Score	3.95	4.05	4.25	3.85	4.05	4.05	3.35	2.60	4.60	4.45
Ranking	5	4	3	6	4	4	7	8	1	2

CNG = compressed NG; O&M = Operations and Maintenance; PV = photovoltaics.

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V

Section 1: Introduction

EWA has undertaken a Biosolids Energy and Emissions Plan (BEE Plan) which will be used to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan. The BEE Plan has several goals:

- 1. Provide a comprehensive analysis of all project elements including biosolids treatment, gas use, energy generation, and waste heat;
- 2. Address capacity limitations in the solids handling process at the EWPCF;
- 3. Assess which alternative is likely to be the most cost effective and sustainable solution for EWA;
- 4. Move the EWPCF toward lower energy costs, rate stability, and greater overall sustainability.; and
- 5. Reduce greenhouse gas emissions (GHGs).

The purpose of TM 3 is to conduct a technology screening for alternative power production methods that could help EWA move toward their goal of greater energy independence. Alternatives evaluated in this TM do not consider potential energy reduction measures at EWPCF; the focus is placed on power production. This TM does not provide an alternatives analysis but provides insight into the methodology and rationale used to select alternatives which will move forward for further analysis in the SWEET model development.

1.1 TM 3 Purpose and Scope

This TM is preceded by TM 1 which addressed the baseline energy profiles and projections, established a mass balance for the solids handling system, and evaluated sludge flows and loads projections performed under the Process Master Plan. Screening and evaluation of solids processing technologies is described in TMs 1 and 2, including derivation of the biogas projections used in the alternatives evaluation presented in this TM.

TM 3 summarizes the methodology for screening and evaluating alternative power production technologies, the technologies evaluated, and how these alternatives were ranked to determine which would move forward in the SWEET analysis. While an emphasis was placed on those technologies that utilize the biogas generated from sludge digestion, additional alternatives such as solar and wind power were also investigated. Non-power-producing technologies, such as biogas upgrading, are included in the evaluation – recognizing that these alternatives help EWA realize its goals of economic and environmental benefits. Recommended technologies will be advanced for further analysis and will be combined with the solids handling and waste heat alternatives presented in TMs 2 and 5. Screening and ranking of technologies were performed in a workshop with EWA staff on August 16, 2017. Meeting minutes from this workshop have been provided as Attachment A.

1.2 Background Information

The EWA cogeneration system has four Caterpillar 3516 IC engine-generators installed in the Power Building; each engine-generator can generate a maximum of 750 kW. Currently, one IC engine at the EWPCF serves as a standby unit, with the other three IC engines available for cogeneration. The existing engines are capable of operating on either biogas, NG, or blended biogas and NG. NG is blended with air at the eclipse units to reduce the British thermal units (Btu) value to biogas values, it is then introduced to the biogas header feeding both the engines and the thermal biosolids dryer. This only occurs based on header pressure during times of high biogas demand. There is no biogas conditioning upstream of the engine-generators.



During peak electrical hours, the EWA operates generators to match the plant electrical demand and allow the plant to disconnect from the electrical grid, receiving compensation from the electrical utility for this arrangement (NG EMP). During these periods, a third engine is brought on line and operates on NG to increase engine-generator output.

EWA is pursuing modifications to its air permit to increase the permitted generating capacity of the plant. Because this effort is a work in progress, this TM reflects the current air permit and the screening process presents the relative comparisons of emissions. It is assumed that exhaust treatment is required to increase permit capacity, but the ability of each technology to meet air permitting requirements needs further verification as the permit process unfolds.

The current and future biogas projections are discussed in greater detail in TM 1. These projections assume the current high strength waste (HSW) quantities will be imported for codigestion and the future increase in biogas production is a result of the increased municipal sludge loadings only. A summary of the projections is shown in Table 1-1.

Table 1-1. Projected Biogas Production					
	Current	2020	2030	2040	
scfm	501	528	619	709	
therms/year	1,581,000	1,666,000	1,951,000	2,235,000	

¹ Projected biogas production is based on current wastewater and alternative fuels loadings. Potential for additional biogas from codigestion of additional alternative fuels is presented in TM 4.

scfm = standard cubic feet per minute

Section 2: Identification of Technologies for Alternative Power Production and Fatal Flaw Screening

The BC team worked with EWA staff to identify an initial list of alternative technologies that could contribute to increasing the on-site energy production powered by renewable fuels. The initial list includes the following:

- Continued use of the existing internal combustion engines
 - With gas conditioning
 - With gas conditioning and exhaust treatment
- Biogas upgrading
 - Pipeline injection
 - On-site vehicle fueling
- Microturbines
- Biosolids drying direct use of biogas
- Energy storage (batteries only. HSW storage and biogas storage are included in TM 4)
- Fuel cells
- Large scale solar photovoltaics (PV)
- Small scale/rooftop solar photovoltaics
- Wind turbines
- Direct sale of biogas to Encina Power Station

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These technologies are discussed in subsequent sections in further detail. The alternative power production technologies were first screened using four fatal flaw criteria that were developed in conjunction with EWA staff. The fatal flaw screening criteria include the following:

- At least one successful North American installation of technology. There must be at least one full-scale installation of the technology at a wastewater treatment plant (WWTP) in North America.
- At least one successful installation and operation in a facility of similar size. The technology should be sufficiently developed that it is applicable at a facility of comparable size to EWPCF to ensure compatibility.
- Available space. The technology must be accommodated within the limited available footprint at EWPCF.
- **Compatibility with plant site and any existing equipment.** The technology must be capable of being integrated into the existing treatment plant infrastructure.

For an alternative to be considered for the ranking process, the alternative must pass all four fatal flaw criteria.

2.1 Internal Combustion Engine-Generators

This alternative assumes biogas is used as the primary fuel to the existing IC engine-generators to cogenerate heat and electricity. Current operation of the four 750 kW IC engines was discussed in Section 1.2. As mentioned, EWA is pursuing an alternative air emissions strategy via an air permit modification to increase use of available generating capacity. A revised permit strategy may require the addition of gas conditioning, exhaust treatment, or a combination of these possibilities and will be discussed in TM 4. Additionally, instead of pursuing an alternative air emissions strategy, microturbines (discussed in Section 2.3) may be paired with the IC engines to increase the electrical generating capacity of EWPCF. In this case, exhaust treatment would not be required, but upstream gas conditioning would be needed to meet inlet requirements of the microturbines. Figure 2-1 shows the existing engines located in the power generation building.



Figure 2-1. Existing 750 kW Caterpillar engines at EWPCF



In addition to the current IC engines operating at 750 kW electrical output, a second variation was considered for the evaluation in which engines would return to rich burn operation to provide 900 kW electrical output. EWPCF's original permit was for 0.5 grams of NOx per brake horsepower-hour and to achieve this level of nitrogen oxide (NOx) emissions, the original 900 kW engine was derated to 750 kW and a 750 kW generator was installed as part of the package. BC reviewed this alternative and does not recommend this alternative be carried forward since 1) the modified November 2017 air permit allows EWA to run engines at nearly plant demand; and 2) changing the engine generator output would likely require a permit modification.

With several of the IC engines' sub alternatives, in conjunction with microturbine and solar alternatives that will be discussed in Sections 2.3, 2.7 and 2.8, EWPCF may generate more power than is required to operate the plant. If power production exceeds demand, EWPCF may be able to earn revenue through exporting power to the grid. Net metering power to the grid is discussed further in Section 2.11.

IC engines have been used at EWPCF since 1983 to generate electrical power to reduce electricity costs for EWA. The engines also provide a source of emergency standby power to meet EWA's National Pollution Discharge Elimination System permit. Since the plant already operates four 750 kW IC engines, this alternative passes all fatal flaw criteria; i.e., the engines successfully generate power, they are already located at the plant, and are compatible on the existing site. The IC engines alternative passes the fatal flaw filter and will be carried forward in the evaluation screening.

2.2 Biogas Upgrading and Beneficial Use

Biogas upgrading produces biomethane, a renewable NG substitute that can also be used as vehicle fuel as compressed NG (CNG). Similar to conventional gas treatment systems that remove contaminants to improve engine performance, biogas upgrading first involves gas conditioning to remove moisture, hydrogen sulfide, and siloxanes from the raw biogas and gas compression. After contaminants are removed from the gas, the gas goes through a separation process to separate methane from carbon dioxide. The resulting product is a methane-rich process gas (biomethane or renewable NG) and a methane-lean tail gas consisting primarily of carbon dioxide with up to 25 percent of the total biogas methane depending on the selected separation system. Tail gas is typically wasted using a flare or thermal oxidizers and typically requires a supplemental NG feed to help the tail gas combust.

There are several biogas separation technologies available including membranes, pressure swing adsorption, and water solvents. Figure 2-2 shows an example biogas upgrading system provided by Unison Solutions that utilizes membrane separation. Other typical biogas separation technology manufacturers include Air Liquide, Guild, and Greenlane. These technologies will be described in greater detail in TM 4.



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Figure 2-2. Biogas upgrading system at San Mateo WWTP (CA) using Unison's BioCNG system Includes hydrogen sulfide removal, moisture removal, compression, siloxane removal, and membrane separation.

Upgraded biogas is either routed to a pipeline injection system or to on-site storage and dispensing of vehicle fuel, both described below in Table 2-1. Upgraded biogas can also be sent to a tube trailer to transport to an off-site fueling facility; in this case, the upgraded biogas must meet the on-site vehicle fueling criteria but requires less on-site storage. Southern California Gas Rule No. 30 (Transportation of Customer-owned Gas) provides requirements for gas to be injected into the utility pipeline; this rule was used to derive the values in Table 2-1. Vehicle fueling specifications are based on generally acceptable values for CNG engines, such as Cummins-Westport. Vehicle fuel standards are generally less stringent than California's NG pipeline standards.

Table 2-1. Comparison of Biogas Upgrading Pipeline Injection and Vehicle Fuel				
	Vehicle Fueling	Pipeline Injection (Rule No. 30)		
Methane, percent by volume, min	95	99		
Carbon dioxide, percent by volume, max	3.0	3.0		
Oxygen, percent by volume, max	0.1	0.2		
Sum of carbon dioxide, nitrogen, oxygen percent by volume, max	5.0	4.0		
Higher heating value, Btu/scf, min	960	990		
Water, lb / million scf, max	7	7		
Hydrogen sulfide, ppmv, max	4	4		
Mercaptan sulfur, ppmv, max		5		
Total sulfur, ppmv, max	16	12.6		
Total measurable siloxanes, ppbv, max	100			
Total ammonia, ppmv, max	10			

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Table 2-1. Comparison of Biogas Upgrading Pipeline Injection and Vehicle Fuel				
	Vehicle Fueling	Pipeline Injection (Rule No. 30)		
Other volatile organic compounds, ppbv, max	100			
Free of dust and gum, filtration to, micron, max	0.3			
Discharge Pressure, psig	4500	Depends on injection location		
Example Facilities	Janesville, WI San Mateo, CA	Point Loma, CA		

lb = pounds; ppbv = parts per billion by volume; ppmv = parts per million by volume; psig = pounds per square inch gage; scf = standard cubic feet.

Both biogas upgrading alternatives are eligible for incentives under by the Low Carbon Fuel Standard (LCFS) and Renewable Fuel Standard (RFS2). The LCFS is a state-administered program with a goal to lower greenhouse gas emissions from petroleum-based transportation fuels by requiring producers of petroleum-based fuels to reduce the carbon intensity (CI) of their products by either developing their own low-carbon fuel products or purchasing LCFS credits from other companies or producers that develop and sell low-carbon alternative fuels. Credits are a tradable environmental commodity with a monetary value and are typically managed by a third-party broker. Similarly, the RFS2 is an EPA program that requires transportation fuel to contain a minimum volume of renewable fuels. Renewable fuel sources include biomass-based diesel, cellulosic biofuel, advanced biofuel, and total renewable fuel. The RFS2 mandates that fuel refiners obtain renewable fuel credits called Renewable Identification Numbers (RINs) to meet a minimum percentage of renewable fuel production.

Sending biomethane to the existing San Diego Gas & Electric (SDG&E) pipeline would allow for more flexibility with operations by allowing biogas to be processed as it is produced rather than storing it, and requires less space at the plant than vehicle fueling. Injected biomethane can be sold to any party with a physical connection to California's NG grid. The sale is typically managed through a third-party broker. This alternative is similar to the Point Loma WWTP, a 175 million gallons per day (mgd) plant, which currently produces biomethane and injects it to the SDG&E NG pipeline through a service-provided contract with BioFuels Energy, LLC.

On-site vehicle fueling requires additional equipment for compression, storage, and dispensing of CNG. High pressure CNG compressors are required to boost the pressure of the gas up to approximately 4,500 pounds per square inch gage (psig). On-site fueling requires EWA to find a committed, local partner who can use the renewable CNG fuel. The amount of fuel produced requires an agreement with a large vehicle fleet, such as buses or solid waste collections. Identification of a partner is critical to this option moving forward. Figure 2-3 shows an installation photograph of these high pressure CNG compressors. Figure 2-4 shows high pressure CNG storage vessels and a typical fuel dispenser.



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Figure 2-3. Example of ANGI high pressure compressors



Figure 2-4. Example of ANGI vehicle fueling equipment, including high pressure storage and fuel dispenser

As an alternative to on-site vehicle fueling, vehicle fuel-quality biomethane may be transported to an off-site fueling facility via a tube trailer. This option eliminates the need for on-site storage but still requires a committed local partner. Transporting biomethane in tube trailers was discussed in a meeting with waste haulers that operate near EWPCF. These haulers were not interested in receiving tube trailers and preferred obtaining NG directly from the pipeline. Additionally, hauling costs for the significant quantity of biomethane in tube trailers is not a viable option.



Neighbors at the Point Loma WWTP currently upgrade their biogas to biomethane or renewable pipeline NG. One difference to note is that Point Loma staff do not operate or maintain the gas upgrading equipment—the gas is sold to BioFuels Energy, LLC. This private entity operates the biomethane gas purification and injects the upgraded biogas into the pipeline for use. While Point Loma WWTP is under a service type contract for sale of their biogas, the project still demonstrates that a full-scale project is feasible. Biogas upgrading equipment could fit near the existing digesters or where the old Maintenance Building is located. The biogas upgrading alternative passes the fatal flaw filter and will be carried forward in the evaluation screening.

2.3 Microturbines

Microturbines are small combustion turbines that cogenerate heat and electricity. Packaged microturbine units are available in capacities ranging from 65 to 333 kW per unit. Microturbines are a compact, easily scalable, low-emission technology for utilizing biogas. Microturbines are extremely sensitive to siloxanes and require gas conditioning to remove sulfides, moisture, and siloxanes and require compression up to 80 psig. One of the disadvantages, in comparison to IC engines, is a lower electrical efficiency; microturbines have an efficiency of 30 to 32 percent while IC engines see an efficiency of 35 to 40 percent. The two main microturbine manufacturers are Capstone and FlexEnergy, both companies with factories in the United States. Figure 2-5 shows a microturbine package installation with capability of producing 1,000 kW. Microturbines are capable of operating on the tail gas of a membrane separation biogas upgrading system where energy content is as low as 300 British thermal units per cubic foot to replace a flare or thermal oxidizer.



Figure 2-5. Capstone C1000, 1000 kW microturbine package with integrated exhaust manifold

Microturbines would not replace the existing IC engines, but would be added to increase power generation. They would run continuously and simultaneously with the existing engines and would maximize biogas utilization for combined heat and power. Because microturbines produce low emissions in comparison to an IC engine, coupling them with IC engines is a viable alternative to pursuing permit modifications and associated exhaust treatment for the IC engines.



Several treatment plants in the United States operate Capstone microturbines including Janesville, Wisconsin; Sheboygan, Wisconsin; Durango, Colorado; Persigo, Colorado; and Santa Margarita, California—all of which have reported successful operation. Microturbines would be used at EWPCF to supplement power production in conjunction with existing IC engines and multiple units could be installed. Microturbines have a relatively small footprint and would fit onto the site easily. However, because microturbines require gas treatment, the conditioning system footprint was also considered when determining space availability. The microturbine alternative passes the fatal flaw filter and will be carried forward in the evaluation screening.

2.4 Direct Use of Biogas in Drying

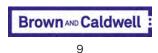
Biogas can be blended with NG and used to fuel a sludge dryer. EWA currently operates an Andritz DDS40 sludge dryer, which, according to current equipment specifications, can utilize a maximum 82 percent biogas and 18 percent NG blend. However, Andritz has stated that the DDS40 has been fueled with 100 percent biogas at certain facilities and Andritz is under contract to perform biogas optimization for the dryer at EWPCF. EWA currently uses excess biogas in typical dryer operations. Dryer fuel requirements are dependent on sludge flow; greater flows signal a greater capacity to utilize biogas. Under the current operating strategy, EWA's biogas use is lower than the maximum allowed by Andritz for biogas blending; therefore, the dryer has capacity to consume additional biogas. Biogas utilization can be further increased if Andritz determines a greater biogas blend may be used. If a second dryer is installed to accommodate increasing sludge flows, the dryer system would have even more capacity to consume excess biogas.

Since the plant already uses biogas in the solids dryer and has capacity to consume additional biogas for biogas, this alternative passes all fatal flaw criteria and will be carried forward in evaluation screening.

2.5 Energy Storage (Batteries)

Without energy storage, power that is generated at a WWTP must be utilized as it is produced. With energy storage, a WWTP can store excess power during low demand periods and use the stored power to reduce peak electricity demand, also known as energy arbitrage. Combining on-site power generation with energy storage can reduce electricity bills by decreasing both overall energy consumption and non-coincident demand charges. Battery storage is typically provided with microgrid controllers that manage the storage and deployment of power.

Lithium-ion batteries are the most common energy storage technology and have only recently been applied at a WWTP. Lithium-ion batteries are rechargeable and operate through the movement of lithium ions between negative and positive electrodes, however, there are energy losses as the battery charges and discharges. In 2016, Napa Sanitation District partnered with Tesla to install five batteries that can capture 1 megawatt (MW) and store 2 MW hours (MWh) of electricity. The Tesla batteries at Napa Sanitation District are shown in Figure 2-6. Other manufacturers, including LG, Mercedes, and Nissan, are developing their own large capacity batteries.



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Figure 2-6. Napa Sanitation's Tesla Batteries Note: Five units can store 1 MW/2 MWh of electricity.

Napa Sanitation District implemented a battery storage project in partnership with Pacific Gas & Electric and Tesla in 2016. The plant installed five Tesla batteries to capture and store 1 MW/2 MWh of electricity. Tesla has also partnered with Southern California Edison to install an 80 MWh project at the Mira Loma substation in January 2017. Additionally, Inland Empire Utilities Agency is installing batteries at several facilities in Southern California in conjunction with Advanced Microgrid Solutions. The energy storage via batteries alternative passes the fatal flaw filter and will be carried forward in the evaluation screening.

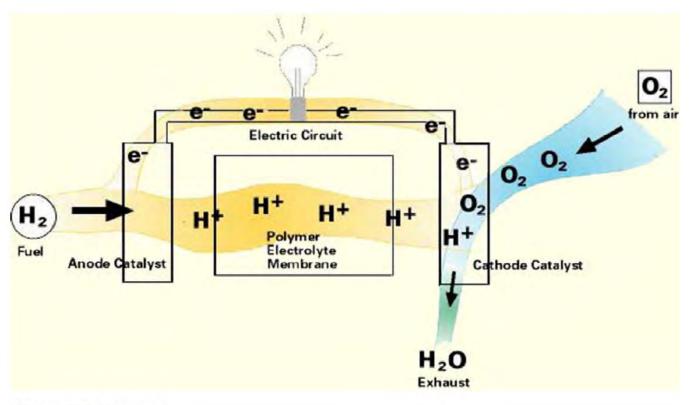
2.6 Fuel Cells

Fuel cells produce electrical power directly through an electrochemical reaction that uses hydrogen and oxygen. For application at EWA, a fuel cell would use methane as a hydrogen fuel source and air as an oxygen source. To utilize biogas in the fuel cell, the biogas would require upstream gas conditioning to remove sulfur, siloxanes, metals, and moisture. Gas quality requirements for fuel cells are higher than for IC engines, since small amounts of contaminants can ruin fuel cell stacks.

Fuel cells are not charged prior to use like batteries described in Section 2.5 and are instead fed hydrogen and oxygen continuously to provide a constant power output. The reaction does not involve combustion, has no moving parts, and has very low emissions of criteria pollutants. Figure 2-7 demonstrates the basics of how a fuel cell works—hydrogen is fed to the anode and oxygen is fed at the cathode. As hydrogen moves from the anode to the cathode through an electrolyte, electricity is created. Molten carbonate fuel cells are the most common types of fuel cells and have an electrical efficiency of roughly 45 percent.



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(Source: www.fuelcells.org)

Figure 2-7. Fuel cell electricity generation process diagram

While fuel cells are an established technology with multiple manufacturers and thousands of installations in the world, many treatment plants have reported problems with operation on biogas with numerous fuel cells abandoned. Fuel cells were a popular option for WWTPs in the 2000s due to direct subsidies; however, these subsidies have ended, making this alternative less economically attractive.

Fuel cells do not pass the fatal flaw filter on technology maturity and successful operation criteria. While fuel cell technology reportedly has air emissions benefits and high electrical efficiency, numerous treatment plants have reported poor fuel cell performance and no longer operate their units (e.g., the San Jose-Santa Clara Regional Wastewater Facility, Inland Empire, King County, and New York City). Additionally, the grants and subsidies that once made fuel cells financially attractive are no longer in place and would mean high life-cycle costs. The fuel cell alternative fails the fatal flaw filter on technology maturity and successful operation and will not be carried forward in the evaluation screening.

2.7 Large-Scale Photovoltaics

For large-scale solar projects at wastewater treatment plants, the majority are installed by third party developers who have access to federal tax credits, which are limited to private entities. Power is typically sold back to the utility at a fixed rate with inflation escalation. The third party typically pays for capital costs and operations and maintenance (O&M) of the system since the plant will continue to pay for the cost of power. This third-party arrangement is called a power purchase agreement. EWA has the option to use a power purchase agreement, or own its own system.



Use of contents on this sheet is subject to the limitations specified at the beginning of this document. SC07035_Final_TM3_Alt Pwr Production.docx EWA has identified available space for a large-scale solar project on the southeast parcel of the plant. The estimated available footprint is 13 acres, unless the plant reserves this space for future processes. Additionally, Figure 2-8 demonstrates a high amount of solar resource near the EWPCF.

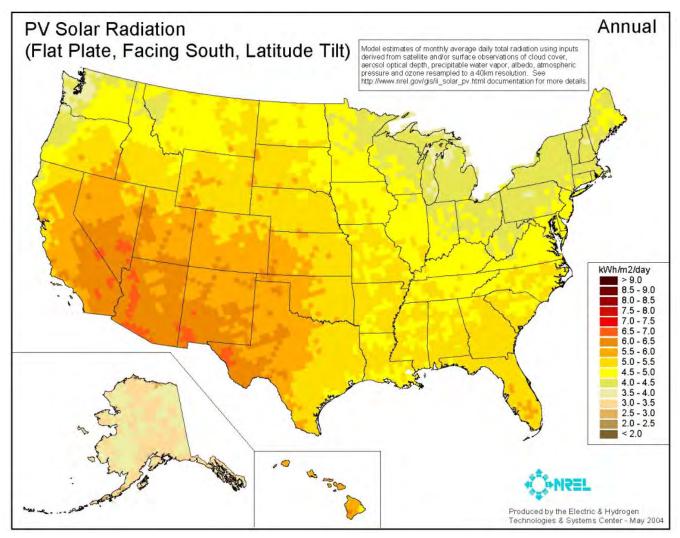


Figure 2-8. PV solar radiation intensity

A major disadvantage of PV systems is that solar power is intermittent as sunlight quantity and intensity vary greatly throughout a day. The best solar conditions occur in the middle of the day, and the power demands of WWTPs do not follow the same diurnal cycle as the rest of the electrical grid. Coupling energy storage with PV systems can increase the benefits of solar power by allowing power to be provided as needed, not as produced. This is especially true for facilities like EWA that would like to maximize renewable power consumption without exporting power to the grid during peak solar production periods.

As mentioned previously, solar PV is a mature technology with numerous successful operations. Large-scale solar PV uses the same technology as rooftop solar panels on a larger scale (greater than 1 MW). Large-scale solar PV would require approximately 5 acres of panels and could be located on the south parcel of the plant. The large-scale solar PV alternative passes the fatal flaw filter and will be carried forward in the evaluation screening.



2.8 Small-Scale Photovoltaics

Small-scale PV systems have less than 1 MW of electricity generating capacity and can range in size from a single panel used to power an instrument to a moderately sized solar array installed across a few acres of land. Smaller systems are typically more expensive per unit of power produced than large-scale systems but panels can be located using whatever space is available, including rooftops. Small-scale PV systems at EWPCF could be installed on building rooftops, such as the Solids Dryer and Power buildings. The covered aerations basins or the equalization ponds present available areas for PV installation.



Figure 2-9. Union Sanitary District Irvington Pump Station PV Project included 460 kW of installed solar PV in an emergency overflow basin

There are thousands of small-scale solar installations in North America on residential and commercial buildings, as well as at wastewater facilities such as USD Irvington Pump Station in Northern California. The small-scale solar PV alternative passes the fatal flaw filter and will be carried forward in the evaluation screening.

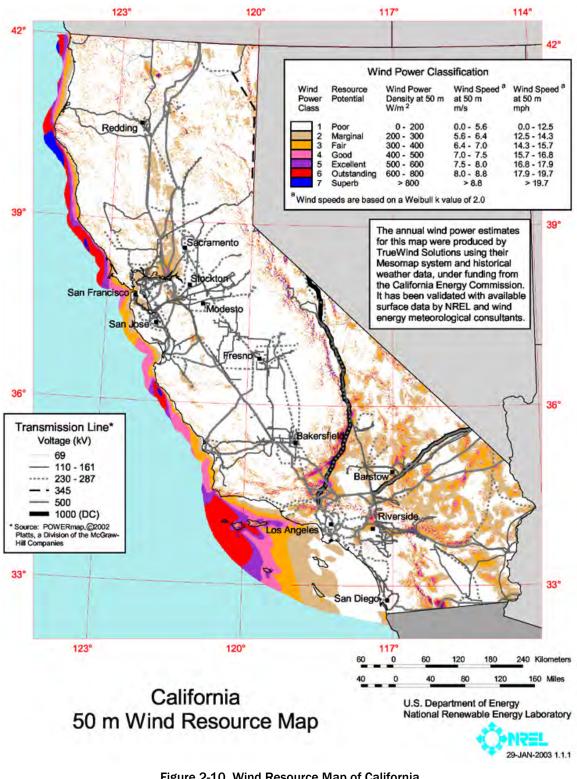
2.9 Wind Turbines

Wind turbines can be purchased in a variety of sizes; utility-scale turbines are available in 100 kW to several MW units. Unit sizing is dependent on the quantity and quality of the available wind resources and the desired power output. Smaller turbines can produce power with slower wind speeds whereas larger turbines require greater wind speeds to turn the blades and generate electricity. For example, a 100-kW turbine can produce 3.7 kW with a wind speed of 9 miles per hour, and power output increases with wind speed. Turbine height, noise limits, impacts on bird species, and aesthetics must also be considered in turbine selection and sizing.

While wind turbine technology is well established and has many successful installations around the world, it is not geographically workable with EWA's site. Wind resources are low near the coastline and would not provide a large return on investment. A wind resource map of California is provided in Figure 2-10. In addition, a large wind turbine would not meet community requirements for aesthetics on the coastline and is, therefore, not compatible with the current site layout. The wind turbine alternative fails the fatal flaw filter on available space and will not be carried forward in the evaluation screening.



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2.10 Direct Sale to Adjacent Power Plant

This alternative is a direct sale of biogas to the nearby Encina Power Station and would include a conveyance pipeline and gas treatment. Encina Power Station is a large NG and oil-fueled electricity generating plant located a couple of miles away from the EWPCF. Cleanup requirements will depend on the fuel agreement and power plant. Untreated biogas can be used in boilers and duct burners; however, higher levels of conditioning or separation would be required for fueling the generation equipment. Example treatment plants that have sold, or are currently selling their biogas to power plants include Sacramento Regional Wastewater Treatment Plant and Hyperion Water Reclamation Plant.

Ultimately, selling biogas to a nearby power plant gets EWA the lowest value for their biogas. RINs and LCFS credits do not apply to biogas sold for power production because these credits only apply to biogas used for vehicle fuel. After reviewing EWPCF's NG bills, the market value of NG is much lower than potential value from generating electricity or producing vehicle fuel to make this option economically feasible and will not be carried forward.

2.11 Net Energy Metering

A net energy metering (NEM) agreement with SDG&E can be applied to any alternative that generates electricity from a renewable fuel (e.g., biogas-fueled IC engines, biogas-fueled microturbines, and solar PV). NEM would track how much grid electricity is consumed by EWPCF and how much excess electricity is renewably generated; EWPCF would only pay for the net electricity consumption. The benefits of NEM can be maximized if most power generation occurs during high demand periods and most power consumption occurs during low demand periods. NEM eliminates costly standby charges, which is a major benefit. NEM requires interconnection to the grid, and generated power would not be used directly by EWPCF.

NEM is considered an alternative that can be combined with power generation alternatives in the SWEET analysis; however, NEM is not included in the Fatal Flaw Screening and Technology Ranking that are presented in this TM. Table 2-2 lists likely electrical upgrades that would need to be implemented if going to net metering triggers the requirements for a new Rule 21 interconnection application. Attachment B includes the SDG&E Distribution Interconnection Handbook and potential electrical upgrades specific to EWPCF's system that would be required for a Rule 21 interconnection agreement. The biggest issue, both technically and from a cost perspective, appears to be that SDG&E would require real-time metering of the net generator output completely separate from the metering at the point of interconnection. Based on the plant's record drawings, the facility was not originally set up for this. The reasoning typically given for this SDG&E requirement is that the utility is managing a large, dynamic system and they need to know how much active generation output of each type they have connected to each segment of their system to manage it. The 1 MW threshold is to prevent this from being too burdensome to small (typically solar) generators.



Table 2-2. SDG&E Rule 21 Interconnection Electrical Upgrades							
Requirement	Reference	Implementation Level of Effort					
Replace Main Utility Meters with NEM Capable Meters	SDG&E Interconnection Handbook §2.1	Easy – utility swaps these into the existing meter sockets.					
Add SDG&E Metering to measure "net generator output" and "provide real-time kW and kVAR transmitted to SDG&E grid ops."	SDG&E Interconnection Handbook §2.1 and §2.2 Figure 1	Difficult - the way the plant is currently set up, this would require cutting in new utility metering at each generator (which requires physical modification, new conduits/cables,					
[Required for generating facilities >1MW. This is not metering at the point(s) of utility connection – this is the actual net output of the generation system, regardless of plant load.]		and new SCE metering cabinets).					
Provide service to SCE's telemetering equipment (high- speed data line and 120VAC UPC circuit) at location of meters for the generators.	SDG&E Interconnection Handbook §2.6	Moderate – requires routing of conduit/cables to generator area, making physical space available for SCE's telemetering equipment.					
Add visible disconnect switches for lock-out / tag-out of generation facility. [SDG&E may allow racking out the existing breakers to meet this requirement, but this is evaluated on a case	SDG&E Interconnection Handbook §3.2	Difficult if required – requires physical modification of conduits/ductbanks, re-routing of cables, and physical location/mounting of equipment.					
by case basis.]							
Reconfigure generator controls system for continuous paralleling and export mode as opposed to load following or islanding mode.	SDG&E Interconnection Handbook §3.3	Moderate - Likely to be possible with the existing generator control system, but will require on-site time for implementation and testing by the generator control system					
Change generator control system to regulate power factor (not voltage) when connected to SCE's system (if not already implemented).		supplier.					
Modify existing main switchgear protective relays to allow sensing of ground faults on utility system (so that plant generators don't feed into it).	SDG&E Interconnection Handbook §3.3 & §3.6	Moderate - Requires main switchgear shutdown (of one side at a time) for minor internal physical modification of existing switchgear. Also reconfiguration and retesting of existing relays after new settings are approved by SDG&E.					
Witnessed "Pre-parallel testing" required for SCE signoffs.	SDG&E Interconnection Handbook §6.3	Thorough on-site testing of switchgear protective relays, generator control system, and metering interface. Usually multiple days with several different suppliers, an independent testing firm, and the utility's representative on site.					
SCE System Upgrades (transfer trip, reclose blocking, etc.) – items that SCE will have to upgrade on their side of the system.	SDG&E Interconnection Handbook §3.6	Little activity on the EWA side – this is more of a project cost issue.					
[Dependent on the overall conditions of the SCE circuit being connected to and other customers - cannot be known or obtained from SCE until an application is submitted and SCE performs an engineering study.]							

2.12 Fatal Flaw Conclusions

The results of the fatal flaw screening evaluation performed in this section are presented in Table 2-. Alternatives that passed the fatal flaw filter will each be evaluated and scored in Section 3 to determine which alternatives will be analyzed using BC's SWEET tool.



Table 2-3. Power Production Technology Screening: Fatal Flaw Evaluation								
	Technology Maturity	Successful Operation	Available Space	Compatibility				
Internal Combustion Engines	Pass	Pass	Pass	Pass				
Digester Upgrading: Pipeline Injection	Pass	Pass	Pass	Pass				
Digester Upgrading: Vehicle Fueling (CNG)	Pass	Pass	Pass	Pass				
Microturbines	Pass	Pass	Pass	Pass				
Biosolids Drying - Direct Use of Biogas	Pass	Pass	Pass	Pass				
Energy Storage	Pass	Pass	Pass	Pass				
Fuel Cells	Fail	Fail	Pass	Pass				
Wind Turbines	Pass	Pass	Fail	Fail				
Small Scale/Rooftop Solar Photovoltaics	Pass	Pass	Pass	Pass				
Large Scale Solar Photovoltaics	Pass	Pass	Pass	Pass				
Direct Sale to Adjacent Power Plant	Pass	Pass	Pass	Fail				

Ultimately, the IC engines, biogas upgrading, microturbines, biosolids drying, energy storage, and solar PV alternatives passed the fatal flaw filter and will be reviewed further in the technology screening evaluation (presented in Section 3).

Section 3: Ranking of Screened Technologies

This section describes the results of applying the evaluation criteria described in Section 2 to further screen and rank the technologies that passed the fatal flaw filter.

3.1 Introduction

Technologies that passed the fatal flaw filter were evaluated using a weighted scoring matrix. The final scores and weights were fixed in Workshop 2 with EWA staff. In this analysis, a weighted average score of 3 or less led a technology to be eliminated from further consideration. The rationale behind the scoring for each technology area is described in this section.

3.2 Criteria Descriptions and Weightings

Alternatives that passed the fatal flaw filter were further evaluated and ranked based on both economic and non-economic screening criteria. The BC team worked with EWA staff to develop a series of evaluation criteria that reflect the project goals, EWA's values, and EWA's general operational practices. Criteria weights were assigned in Workshop 2 with EWA staff. Criteria and weightings are presented in Table 3-1.



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Table 3-1. Criteria and Weight for Technology Screening					
Criterion	Description	Scoring Description	Weight		
Proven Technology Performance	Proven and reliable technology with same configuration intended at Encina. Long successful operating track record.	Low score indicates no successful large scale operating installations in North America or Europe, no successful demonstration scale installations in North America or Europe, and unknown safety or reliability record. High score indicates more than one successful operating installation in North America or Europe, more than one operating installation at a WWTP of at least 40 mgd in North America or Europe, track record duration > 5 years, and vendors in western USA.	20%		
Minimize Life-Cycle Costs	Qualitative metric of program cost. Capital and O&M costs based on existing EWA data or similar experience at other WWTPs. Potential revenues from sales.	Low score indicates high capital cost to build onsite facilities, high O&M costs, and low energy recovery efficiency. High score indicates low capital cost to build onsite facilities, low O&M costs, and potential revenue.	10%		
Energy/Resource Recovery	Recovery of renewable energy.	Low score indicates high energy requirement for onsite technology, technology does not recover, and low efficiency recovery of renewable energy. High score indicates a higher electrical efficiency.	25%		
O&M Impacts	Impacts to existing plant O&M staff levels. Complexity of new technology O&M and control systems. Reliability of new technology (potential downtime). Minimal impacts to plant safety.	Low score indicates more O&M time required, complex mechanical and control systems required compared with existing plant facilities, potential equipment downtime, and newer hazards. High score indicates reduction in O&M staff time required, new technology is simple to operate and maintain, reliable with minimal downtime, and no new hazards.	10%		
Environmental Impacts	Impacts to carbon footprint and air permitting.	Low score indicates high carbon footprint for technology, and new permitting for environmental regulatory requirements. High score indicates low carbon footprint for technology, reduced pollutant emissions, no additional permitting for environmental regulatory requirements.	15%		
Community & Stakeholder Impacts	Minimize nuisance impacts such as dust, odors, vectors, aesthetics, noise and traffic. Assess impacts to partner agency issues/values as well as local planning codes and requirements.	Low score indicates nuisance factors for on-site technology are difficult to mitigate. High score indicates nuisance factors can be mitigated at plant site.	10%		
Project Site Compatibility	Assess compatibility of technology with available plant footprint. Incorporation into existing treatment process.	Low score indicates lack of site space for new facilities, requires abandonment of existing facilities, and difficult integration with existing plant. High score indicates available footprint for new facilities and maintains space for future facilities, ease of integration with existing processes and facilities.	10%		



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3.3 Results and Discussion

Table 3-2 shows the scoring results for the alternative power production technologies that passed the fatal flaw filter. Among these, small-scale rooftop PV, IC engines with gas conditioning, IC engines with selective catalytic reduction (SCR), and biogas upgrading to vehicle fuel scored the highest. Rationale behind the scoring for each technology area is described below.

Table 3-2. Alternatives Scoring Evaluation										
	IC Engines - Status Quo	IC Engines - with Gas Conditioning	IC Engines - with Ex- haust Treatment	Biogas Upgrading: Pipeline Injection	Biogas Upgrading: Vehicle Fueling (CNG)	Microturbines	Biosolids Drying	Energy Storage (Batteries)	Small-Scale Rooftop PV	Large-Scale PV
Proven Technology Performance	5	5	4	2	3	4	5	3	5	5
Minimize Life-Cycle Costs	3	3	4	4	4	3	3	3	4	4
Energy/Resource Recovery	4	4	5	4	4	4	2	1	5	5
0&M Impacts	3	4	3	4	4	4	3	4	5	5
Environmental Impacts	3	3	4	5	5	5	3	3	5	4
Community & Stakeholder Impacts	4	4	5	5	5	4	3	3	5	5
Project Site Compatibility	5	5	4	4	4	4	5	3	2	2
Weighted Score	3.95	4.05	4.25	3.85	4.05	4.05	3.35	2.60	4.60	4.45

3.3.1 Internal Combustion Engines

IC engines received the highest score for proven technology performance and project site compatibility since they are already in operation at the plant. Gas conditioning of biogas is a common practice for many treatment plants and does not require a significant footprint. In Workshop 3, plant staff agreed that gas conditioning equipment could be located on the empty space near the digesters and existing gas blowers. Exhaust treatment, particularly SCR, is proven on natural-gas-fueled engines, but has only recently been required for biogas facilities. The addition of SCR to biogas engines is driven by air permit standards in the state's most restrictive air districts, such as the South Coast and Bay Area. Robust biogas conditioning is required to protect the SCR catalyst. Few WWTPs operate engines with SCR; however, this technology is deemed feasible and "best available" in several districts. Orange County Sanitation District recently added SCR to their central generation facility to meet permit requirements. Figure 3-1 shows a site layout for potential implementation of gas conditioning and SCR gas treatment.



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Figure 3-1. Site layout for IC engines with gas treatment technologies

Adding exhaust treatment to eliminate the permit restriction, thus allowing the plant to run more engines, would increase energy recovery and lower annual electricity costs. EWA staff are familiar with IC engines; i.e., there is no added complexity for this alternative. Adding gas conditioning reduces O&M effort on the engines, but introduces O&M required for the conditioning system. Exhaust treatment such as an oxidation catalyst and/or SCR will add a layer of complexity, especially for handling materials such as urea reactant and O&M and reporting for the continuous emission monitoring system.



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Engines produce particulate matter, carbon monoxide (CO), sulfur oxide, and NOx emissions without exhaust treatment. With exhaust treatment, CO and NOx emissions are reduced and have less of an environmental impact.

3.3.2 Biogas Upgrading

Biogas upgrading is still considered an emerging technology and has fewer large-scale installations and less established equipment manufacturers. There are more installations of on-site vehicle fueling in California that have been in successful operation in comparison to pipeline injection; therefore, vehicle fueling scored a 3 and pipeline injection scored a 2. Example projects for pipeline injection are limited to California projects due to more stringent standards compared to other states.

Biogas upgrading alternatives can bring in potential revenue from LCFS and RINs credits generated for producing renewable fuel, currently valued between \$1 and \$2 per diesel equivalent produced (1440 cubic feet of biogas produces approximately 5 diesel gallon equivalents of fuel) in addition to the value of the fuel itself. However, they have a relatively high capital cost, thus, lowering the life-cycle cost score to a 4.

Generally speaking, the electricity grid is more renewable than the NG grid in California; therefore, decreasing the amount of purchased NG has a greater environmental benefit compared to reducing purchased electricity. However, depending on how much NG is purchased for running cogeneration engines or running a boiler as part of an overall biogas upgrading operation, this alternative may end up being more equivalent to the other options.

Figure 3-2 shows where the biogas upgrading for pipeline injection could be located at the plant and Figure 3-3 shows the alternative with on-site vehicle fueling.







Figure 3-2. Potential siting of biogas upgrading equipment at EWPCF



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Figure 3-3. Potential siting of biogas upgrading and on-site vehicle fueling equipment at EWPCF

3.3.3 Microturbines

With proper biogas treatment, microturbines are a proven combined heat and power technology that is utilized at several treatment plants. While not as common as IC engines, microturbines are still a proven technology and more treatment plants, such as San Francisco Southeast Plant and Roseville Pleasant Grove WWTP, will be installing them. In addition, microturbines have very low emissions, are California Air Resources Board-certified and easy to permit; therefore, they have favorable environmental impacts.

Microturbines have a slightly lower capital cost than IC engines, similar 0&M costs, but 20 to 25 percent less electrical energy recovery than IC engines; therefore, microturbines do not offset as much electrical costs. Life-cycle costs are similar to that of an engine; consequently, microturbines received a 3 in life-cycle costs.

Microturbines are packaged in a modular enclosure and can be easily removed from the system for routine maintenance. By installing multiple smaller capacity units, maintenance can be performed simultaneously to minimize downtime. Microturbines have few moving parts and have demonstrated high reliability when installed with proper gas treatment.

Microturbines are relatively quiet devices with a published sound level of 65 A-weighted decibels at 10 meters and would not impact neighbors. There are no odors or traffic associated with microturbines. Additionally, microturbines are pre-packaged within an enclosure and are low profile, therefore, would not impact the visual quality of the plant.

Figure 3-4 shows a site map with potential location of a microturbine project with gas conditioning included. Microturbines have a compact footprint and come shipped as containerized units, making it easy to accommodate them on the site.



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Figure 3-4. Site layout of microturbine project with gas conditioning

3.3.4 Biosolids Drying

Biosolids drying received the highest score for proven technology performance and project site compatibility since this process is already in operation at the plant. However, with respect to energy recovery, using biogas in the biosolids dryer is the lowest financial value of biogas. There are no financial incentives available when biogas is used in the solids dryer, aside from offsetting NG use. Using biogas as a replacement for NG also introduces volatile organic compounds that must be treated in a regenerative thermal oxidizer.



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3.3.5 Energy Storage

Energy storage via batteries is a proven technology, but have only recently been installed on a larger scale at treatment plants. Energy storage does not provide any resource recovery of biogas or generate any additional power — batteries strictly provide storage to lower non-coincident demand costs through energy arbitrage. Battery storage will not be carried forward to the SWEET analysis since it did not achieve an overall score greater than 3. Battery storage and microgrid controls may be reevaluated as a means to stabilize engine operation and performance when disconnected from the grid.

3.3.6 Solar PV

Solar PV options require minimal effort from O&M staff to operate and have a moderate capital cost. They scored the highest in energy and resource recovery because they utilize power from the sun and still allow for biogas to be used in the engine or solids dryer. There are no emissions from solar panels; therefore, they have minimal environmental impacts.

With respect to site capability, small-scale solar would be challenging to locate since the panels would need to be located on multiple buildings and locating them on the primaries or secondaries may be a corrosive, hazardous space that reduces access to the tanks. Input from EWA staff recommended putting small-scale solar (if used) on the aeration basins, which is the location highlighted in Figure 3-5. For large-scale solar, the large open area south of the EWPCF site was identified as a potential location. However, small or large-scale solar likely isn't required at the plant since 80 percent of the power demand is generated by the engines, leaving a relatively small amount of electricity usage charges that could be offset. Large-scale solar is most applicable if biogas is upgraded instead of used for power production – this leaves more available electricity consumption for offset. Large-scale solar options may be combined with net metering or energy storage to accommodate the excess power production. Figure 3-5 shows potential locations for solar PV panels at the plant.



Figure 3-5. Potential siting for solar PV panels at EWPCF





Section 4: Conclusions and Next Steps

Screening of alternative power production resulted in a final selection of technologies to be included in endto-end alternatives and are summarized in the list below. These technologies will be combined with the results of Tasks 2, 4, and 5 for the creation of end-to-end alternatives for analysis in the SWEET model. Factors influencing power production, such as gas treatment and codigestion (TM 4), will be paired with the power production technologies to aid in selection of the best overall alternative. Development of end-to-end alternatives will be performed in cooperation with EWA staff prior to analysis.

A shortlist of alternatives to be carried forward in SWEET analysis follows:

- Continued use of the existing IC engines
 - With gas conditioning
 - With gas conditioning plus SCR
- Biogas upgrading
 - Pipeline injection
 - On-site vehicle fueling
- Microturbines
- Biosolids drying direct use of biogas
- Large-scale solar PV
- Small-scale/rooftop solar PV



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Attachment A: Workshop Meeting Minutes

August 16, 2017



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A-1



Meeting Minutes

9665 Chesapeake Drive, Suite 201 San Diego, CA 92123

T: 858.571.8822 F: 858.571.8833

Prepared for:Encina Wastewater AuthorityProject Title:Energy & Emissions Strategic Plan & Biosolids Management Plan UpdateProject No.:150871

Purpose of Meeting:	Workshop #2	Date: August 16, 2017
Meeting Location:	Encina Wastewater Authority	Time: 1:30 - 5:00 PM
Minutes Prepared by:	Hari Seshan and Jocelyn Lu, Brown and Caldwell	

Attendees:Doug Campbell, Encina, JPAAScott McClelland, Encina JPAHJimmy Kearns, Encina JPAHMike Steinlicht, Encina JPAHOctavio Navarrete, Encina JPASNathan Chase, RMCH

Adam Ross, Brown and Caldwell Hari Seshan, Brown and Caldwell Jocelyn Lu, Brown and Caldwell Natalie Sierra, Brown and Caldwell Scott Lacy, Brown and Caldwell Tom Chapman, Brown and Caldwell

Attachments:

• Workshop #2 Presentation Slides

Decisions

The following is a list of decisions made as a result of the meeting discussion:

- BC team to evaluate RDTs against the current status quo of primary clarifier and DAFT.
- Stabilization technologies that moved to the next round of evaluation: Mesophilic Digestion, Mesophilic Digestion with High Solids, Thermophilic Digestion, and Traditional CAMBI.
- Dewatering technologies that moved to the next round of evaluation: Centrifuges and Belt Presses.
- Post-dewatering technology that moved to the next round of evaluation: Thermal Drying High Quality (Drum Dryer).
- Alternative power production technologies that moved to the next round of evaluation: Internal Combustion Engines (Status Quo), Internal Combustion Engines – with Gas Conditioning, Internal Combustion Engines – with Exhaust Treatment, Digester Upgrading – Pipeline Injection, Micro-Turbines, Biosolids Drying – Direct Use of Biogas, Large Scale Photovoltaics (PV), Small Scale Rooftop PV.
- Waste heat technologies that moved to the next round of evaluation: Small-Scale Steam Turbines, and Thermo/THP.

Action Required

The following is a list of actions required as a result of the meeting discussion:

- Jimmy to send Adam maintenance schedule costs.
- Octavio to send WAS daily flow data to Hari Seshan (Hari).
- Scott L to send list of additional data/document requests over to Scott M after updating based on discussion.
- Scott M to send a list of EWA attendees for the Waste Haulers Meeting to BC.
- Adam to send a draft agenda of the Waste Haulers meeting to EWA and finalize per any EWA comments.
- Octavio to send EWA's SDG&E point of contact to Adam. EWA and BC to discuss initial contact with SDG&E regarding biomethane pipeline injection.
- Octavio to send Hari lab data on the performance of the centrifuges.
- Tom to work with Octavio on refining the solids mass balance.
- Adam to present a big picture view of the power production alternatives at the next workshop.
- BC to identify technologies that would be beneficial to visit at WEFTEC.
- BC will set up a meeting with Anaergia to discuss project goals and opportunities. This meeting will be separate from the Waste Hauler meeting.
- Scott L and Scott M will schedule Workshop 3 for mid-September aim for conducting the Waste Hauler meeting on the same day.
- EWA will take the dryer out of service in September/October. BC requests that any condition assessment results be shared with the team particularly related to the increased use of digester gas (siloxane or hydrogen sulfide issues).
- BC to check in with EWA to confirm is any support is needed related to the next board meeting on Oct 11.

Summary

Workshop #2 was held for the Encina Water Authority (EWA) Energy & Emissions Strategic Plan & Biosolids Management Plan Update. The purpose of this Workshop was to review pending administrative tasks and provide task updates. A summary of the discussion is provided below:

Introductory Items

BC started off the meeting by reviewing the schedule and goals for the meeting. The goals are to generate content and direction for the project team moving forward.

- This month, the Brown and Caldwell (BC) team will be:
 - Preparing a baseline report, to be reviewed by EWA in September.
 - o BC will also be preparing report sections of Tasks 2 and 3 by September.
 - In October and November, BC will be developing SWEET alternatives and providing more clarity on how the pieces interact.
- Adam Ross (Adam) stated that he expects to have more questions about permitting, cogeneration (cogen), electrical rates, and where to send digester gas, and would appreciate dialogue between now and the next workshop. EWA staff recommended for him to work with Octavio Navarrete (Octavio).

New Data Request Items

BC reviewed new data request items with EWA. They included:

- Trussell food waste capacity report Scott McClelland (Scott M) stated that he has the data, but not the report, on the Trussell study. Preliminary conclusions of the report indicate that EWA could accept an additional 80,000 gal/week of FOG and 25,000 gal/week of brewery waste. EWA expect it'll take about another month before the report is ready. Imported wastes are received Monday – Friday/Saturday. A constant feed to the digesters is provided until around Saturday afternoon. A potential limitation to high strength waste acceptance is truck offloading capacity. A food waste pilot program began on Monday, 9/14.
- O&M costs for cogen engines Adam asks if EWA has annual O&M costs for the engines. Jimmy Kearns (Jimmy) states that EWA has annual costs for the maintenance schedule.
 - ACTION: Jimmy to send Adam maintenance schedule costs.
- WAS flow data
 - o BC requests the WAS flow data, and Octavio indicates that EWA does have that data.
 - ACTION: Octavio to send WAS daily flow data to Hari Seshan (Hari).
- Air permitting summaries or progress
 - o Doug Campbell (Doug) sent Adam the latest email from Don King (Don).

Outstanding Data Requests

BC reviewed outstanding data requests with EWA. They included:

- Cogen drawing and cut-sheets
 - o Natalie Sierra (Natalie) points out that BC has received drawings from Andritz.
- Information on energy management
- High strength waste storage (typical day operating procedure)
- ACTION: Scott L to send list of additional data/document requests over to Scott M after updating based on discussion.

There was a subsequent discussion on wasted gas that was being flared. Octavio explains that the operators need to manually control the digester gas flow to the dryer, which results in some flaring. Operators generally try to set the digester gas flow rate to avoid drawing down the gas system and triggering natural gas blending at cogen. This typically results in a conservative offtake of digester gas to the dryer which results in some flaring. Mike Steinlicht (Mike) asks how much is being flared, and Adam calculated that about 180 kW of gas was being flared (averaged over a month) in current operation.

Cogeneration operation was discussed. EWA operates two engines on digester gas 24/7. A third engine operates on natural gas during peak power rates. EWA physically disconnects from the power grid to avoid demand and consumption charges.

FOG is fed to the digesters at a constant rate of 12 gallons per minute. FOG is fed to only one or two digesters, not all. The FOG feeding begins on Monday with first deliveries of the week, and continues into Saturday to pump down material from the last deliveries on Friday.



Meeting with Waste Haulers

BC reviewed the timing, attendees, and goals of the Waste Haulers Meeting. Below is a summary of the discussion:

- Scott L reviewed the potential list of attendees, which included: EWA representatives, BC representatives, Waste Management (WM), Republic, EDCO, and potentially LES or Anaergia.
 - ACTION: Scott M to send a list of EWA attendees for the Waste Haulers Meeting to BC.
- Scott M stated that the intent of the meeting is to develop a public-private partnership and noted increase grant eligibility by having this kind of relationship.
- Mike emphasized that the elected officials want all of the waste haulers at the table, especially those that operate within EWA's service area.
- Adam reviewed the draft Waste Hauler Agenda, which would cover background on the plant, current operation, and a discussion of potential capacity.
- Scott M stated that he would like to have an agenda finalized and sent out to each waste hauler 30 days in advance of the meeting, to give them adequate prep time.

• ACTION: Adam to send a draft agenda of the Waste Haulers meeting to EWA and finalize per any EWA comments 30-days in advance of the meeting.

• Adam stated that another discussion point for the meeting is the waste haulers potential interest in accepting compressed natural gas (CNG). Scott M stated that SDG&E should be involved in these conversations as well. A meeting should be arranged with SDG&E.

• ACTION: Octavio to send EWA's SDG&E point of contact to Adam.

Different gas delivery options, tube trailer vs. pipeline, were discussed. Adam stated that a tube trailer has less stringent standards than a pipeline, but there would be tube trucks coming in and out of the facility. However, the pipeline would have more stringent sampling/reporting requirements and the investment for an interconnection for the pipeline could cost \$1 – 2 million dollars. This will be developed as the alternatives analysis is advanced.

Other Outstanding Items

BC reviewed their understanding of the discussion with Anaergia:

Adam stated that Anaergia is promoting Omnivore as a process treatment option, which may
or may not be the right fit at EWA. However, there might be opportunity for Anaergia to work
with waste haulers for pre-processing food waste.

Review of Mass Balance and Project Flows and Loads

BC presented the project flows and loads:

- Mass Balance
 - Hari reviewed the assumptions made to calculated WAS. Octavio responded that the actual WAS flow is around 0.75 MGD, and that he could send that data to BC (ACTION above).
 - Adam stated that the VSR value of 65% seemed suspiciously high. Octavio stated that EWA's VSR value was closer to 55%.
 - Hari stated that the centrifuge % capture right now is 78%. Octavio responded that the capture rate for the centrifuges is consistently 95%, and that the calculated value is probably lower because of values during start-up and shut-down.
 - ACTION: Octavio to send Hari lab data on the performance of the centrifuges.

- Tom requested that the BC team review the data with Octavio after he send is to BC.
 - ACTION: Tom to send up conference call with Octavio after reviewing the data.
- Solids Mass Balance Comparison
 - Tom presented a graph that shows that BC's calculated solids loading was higher than the calculated values in the Process Master Plan (2016).
 - Octavio stated that one reason for the increase might be a 2015 change in how EWA sampled the influent flow.
 - ACTION: Tom to work with Octavio on refining the solids mass balance.
- Power Loads and Gas Usage
 - Adam reviewed the gas usage graphs with EWA.
 - Digester Gas Usage Summary Total gas production is trending up, probably due to the increase in high strength waste deliveries. Adam pointed out that the yellow "Total Gas Production" line didn't match up with the top of the bars, which is normal. Scott M pointed out that the important part is that the yellow line followed the same trend as the bars.
 - Natural Gas Usage Summary Most of the natural gas is being used for the heat dryer and cogen, which is expected.
 - Power Production and Import Currently, EWA is making about 80% of their electricity needs. This means that EWA could potentially export power. A look into the SDG&E power bills also showed that the actual kWh power that EWA is purchasing only constitutes \$10,000 out of a \$70,000 bill. The majority of the bill is non-coincident and standby power.
 - Mike stated that he had talked to SDG&E about the standby charges and haven't been able to get around them.
- Engine Fuel Use
 - Octavio explained that the increase in natural gas in November 2015 was because they needed to switch to natural gas to stay below emission limits.

Screening of Technologies

BC the fatal flaw filter and evaluation criteria, and then evaluated each process technology against that criteria. The results of the evaluation are summarized below and more details are included in the attached Workshop #2 PowerPoint slides.

- There were four fatal flaw filters:
 - o At least one successful North American installation of the technology
 - o At least one successful installation in a facility of similar size
 - o There is available space to implement that technology
 - Compatibility with plant size and any existing equipment
- The technologies that passed the fatal flaw filter were then scored for each evaluation criteria, which included: end use market compatibility, proven technology performance, life cycle costs, energy/resource recovery, O&M impacts, environmental impacts, community and stakeholder impacts, and project site combability.
 - Each evaluation criteria was then weighted to reflect EWA's priorities.

- Technologies that scored lower than a 3 were eliminated, and technologies that scored greater than a 3 would be evaluated through the SWEET model.
- O&M impacts criteria will be clarified to describe reduction in O&M staff time.
- Thickening Technologies
 - Prior planning efforts recommended evaluating rotary drum thickeners (RDTs) against the existing primary clarifier and dissolved air flotation thickeners (DAFTs). EWA concurred with that recommendation.
 - Natalie asked if the team should add Anaergia's Omnivore to the list of technologies to evaluate. Scott L proposed that that decision to be made after a meeting with Anaergia takes place.
 - DECISION: BC team to evaluate RDTs against the current status quo of primary clarifier and DAFT.
- Stabilization Technologies
 - Technologies that failed the fatal filter: Staged Digestion, Acid/Gas Phased Digestion, Temperature Phased Anaerobic Digesion, Enzymatic Hydrolysis, Chemical Hydrolysis, THP – DLD, and Solid Stream CAMBI.
 - Technologies that scored lower than a 3 in the evaluation criteria: Lystek.
 - (DECISION) Stabilization technologies that moved to the next round of evaluation: Mesophilic Digestion, Mesophilic Digestion with High Solids, Thermophilic Digestion, and Traditional CAMBI.
- Dewatering Technologies
 - Technologies that failed the fatal filter: Bucher Press.
 - Technologies that scored lower than a 3 in the evaluation criteria: Screw Press, Rotary Press, and Volute Press.
 - (DECISION) Dewatering technologies that moved to the next round of evaluation: Centrifuges and Belt Press.
- Post-Dewatering Technologies
 - Technologies that failed the fatal filter: Thermal Drying: Low Quality (Indirect Dryer), Gasification, and Pyrolysis.
 - o Technologies that scored lower than a 3 in the evaluation criteria: N/A
 - (DECISION) Post-dewatering technologies that moved to the next round of evaluation: Thermal Drying: High Quality (Drum Dryer).
- Alternative Power Production Technologies
 - Technologies that failed the fatal filter: Fuel Cells and Wind Turbines.
 - Technologies that scored lower than a 3 in the evaluation criteria: Energy Storage (Batteries), Large Scale Solar Photovoltaics
 - (DECISION) Alternative power production technologies that moved to the next round of evaluation: Internal Combustion Engines (Status Quo), Internal Combustion Engines – with Gas Conditioning, Internal Combustion Engines – with Exhaust Treatment, Digester Upgrading – Pipeline Injection, Micro-Turbines, Biosolids Drying – Direct Use of Biogas, Large-Scale Solar Photovoltaics (PV), and Small Scale Rooftop PV.
- Waste Heat Technologies
 - Technologies that failed the fatal filter: Absorption and Adsorption Chillers, Organic Rankine Cycle, and Gasification of Biosolids.

- o Technologies that scored lower than a 3 in the evaluation criteria: N/A
- (DECISION) Waste heat technologies that moved to the next round of evaluation: Small-Scale Steam Turbines, and Thermo/THP.

Creation of End to End Alternatives

The BC team reviewed initial alternatives that were to be evaluated, as well as different power production alternatives. The power production alternatives included:

- Baseline: existing cogen and drying
- Baseline with gas conditioning
- Existing cogen with vehicle fuel (via pipeline injection or tube trailer)
- Existing cogen with microtubines
- Existing cogen with steam boiler/turbine
- New cogen permit, CO catalyst and selective catalytic reduction (SCR), with gas conditioning
- Vehicle fuel (primary use of digestive gas) with existing cogen
- ACTION: Adam to present a big picture view of the power production alternatives at the next workshop.

Grant Updates

BC provided an overview of different grant programs, and explained how the program would fit into the SWEET model. The programs included:

- Self-Generation Incentives Program
- Low Carbon Fuel Standard
- Renewable Fuel Standard
- Organics Grant Program
- Healthy Soils Program
- Green Project Reserve

Air Permitting Discussion

BC and EWA discussed the current efforts of the air permit modification. EWA is submitting a request for permit modification in one week. If successful, it would increase the permitted cogen capacity by \sim 20%.

Look Ahead & Wrap-Up

The meeting ended with a look ahead and reviewing pending action items.

- Workshop #3 will take place in mid-September, and the team will try to schedule the Waste Hauler Meeting on the same day.
- The team will present the following in Workshop #3:
 - Baseline SWEET model
 - o Conceptual layouts and details of alternatives for consensus and feedback
 - o Air permitting impacts on power production alternatives
 - o Grant updates
- WEFTEC is also taking place in early-October. Mike stated that it would be beneficial to walk the floor together with BC to look at potential technologies.
 - ACTION: BC to identify technologies that would be beneficial to visit at WEFTEC.

• ACTION: BC to check in with EWA to confirm is any support is needed related to the next board meeting on Oct 11.





Energy & Emissions Strategic Plan & Biosolids Management Plan Update



Workshop #2 – August 16, 2017 &

Encina Water Pollution Control Facility



Project Schedule

- Progress On Schedule
- Task 1 Energy Baseline Complete
- Other Tasks (except 7) are Under Way,
- Workshop #2 Today

 Task 1 Energy Base 	eline	Comp	lete						
 Other Tasks (exception) 	ot 7) a	re Un	der V	Vay					
 Workshop #2 Toda 	у								
 Task 1 Energy Base Other Tasks (exception) Workshop #2 Toda Q.EX Combined Project Schedule TASK 1 - Baseline Energy 				ent h					
Combined Project Schedule	JUL '17	AUG '17	SEP '17	OCT '17	NOV '17	DEC '17	JAN '18	FEB '18	MAR '18
TASK 1 - Baseline Energy			-	1000					8
TASK 2 - Biosolids Tech	ler-	_			L				
TASK 3 - Power Tech									-
TASK 4 - Biogas Tech									
TASK 5 - Waste Heat Tech					-				
TASK 6 - Air Emissions Evaluation		-		-	-			-	I
TASK 7 - Alternatives and Evaluation TASK 8 - Grants/Incentives		-		-		-			-
TASK 9 - Management/QC		-				-	1		
Workshops	W 1	♦ W2	🔶 W:	3		W 4	◆ W5	-	W6
	COLOR KEY	/:	Evaluation	Analyze	Report	Client R	leview	Final Repo	*

Agenda

- Administrative (20 min)
 - Status of data requests
 - Comments on waste hauler agenda
 - Discussion with Anaergia
- Review Mass Balance and Projected Flows and Loads (45 min)
- Review Fatal Flaw and Screening Criteria (30 min)
- Screen Technologies (1 hr)
- Discussion of Preliminary End to End Alternatives (30 minutes)
- Grants Update (10 min)
- Air Emissions Review (5 min)
- Wrap-Up/Review Action Items (10 min)

New Data Requests

- Trussell food waste capacity report
- O+M costs for the engines (have costs for electricity for the system, but not for gas treatment, upkeep, general maintenance, etc.)
- WAS daily flow data (back-calculated for mass balance)
- FOG TS and VS data (used assumptions from 2016 PMP for mass balance)
- Any air permitting summaries or progress between EWA and Don King

Outstanding Data Requests

- Cogen and solids systems drawings, engine cut sheets
- Dryer system drawings and cut sheets
- Recent air permitting efforts progress, memos, contact info
- Copies of current air permits (SDAPCD and Title V)
- Energy Management typical day operating procedure:
 - Cogen strategy
 - Peak period disconnect from utility
 - HSW storage and feed strategy

Waste Hauler Agenda

- Timing: September (coordinate with Workshop 3) nissions Strategic Plan & Nagement Plan Update
- Attendees:
 - EWA Scott, Jimmy
 - BC Adam, Ari
 - WM
 - Republic
 - EDCO
 - LES?
 - ids Mana Anaergia?
- Goals:
- and Caldwell Workshop #2 Provide background info to haulers about EWA's goals and BEE effort
 - Determine availability of pre-processed food waste, market demand for an EWA initiative to receive more material, tipping fee range for SWEET analysis
 - Gauge interest in a renewable CNG partnership
 - Discuss "next steps" such as letter of intent, future coordination

Other Outstanding Items

- Discussion with Anaergia
 - Omnivore as an alternative
 - plan & Orex or Biorex for food waste pre-processing
 - Just with Republy Just dried product? Status of food waste receiving project(s) with Republic
 - Capacity at Rialto facility for dried product? Riosolids N

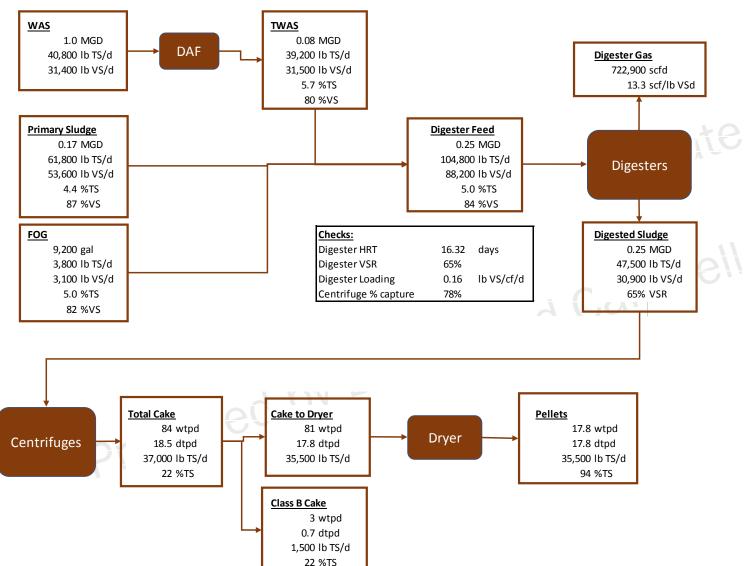


Review of Mass Balance and Projected Flows and Loads



Mass Balance

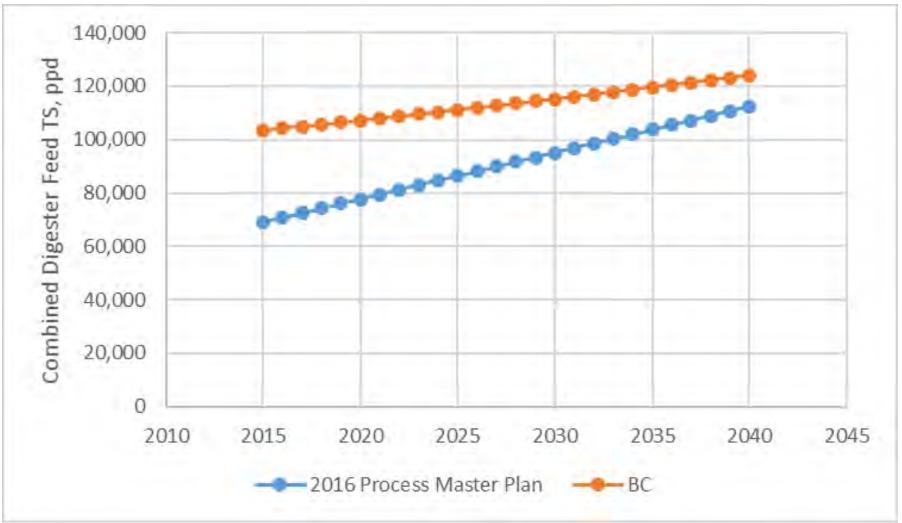




Mass Balance Assumptions

- TWAS flows that were zero and subsequent loads when TWAS flow was zero were excluded. Assumed percent capture rate for the DAFTs is 95%.
- TWAS flows were taken from DAFT totalizer data and digester feed meters.
- The digester feed flow from July 1, 2016 to June 2017 were subtracted daily to obtain a daily digester feed volume. This was based on the assumption that the flow values were cumulative from a meter reading starting 7/1/16.
- The Class B cake data were averaged with zero data to obtain an annualized daily average.
- FOG data were a daily average of the volumes received. This assumes FOG is fed 24/7/365. Assumes %TS and %VS are 5% and 82%, respectively.
- To calibrate the mass balance as shown, 2,300 lbs TS/d and 1,900 lbs VS/d were added to Primary Sludge.

Solids Mass Balance Comparison



Brown and Caldwel

Sludge Production Peaking Factors

	Max Month	Peak 2-Week	Peak Week	Peak Day
Primary Sludge	1.23	1.3	1.4	1.60
WAS	1.23	1.3	1.4	1.60
Combined Sludge	1.23	1.3	1.4	1.60

Notes:

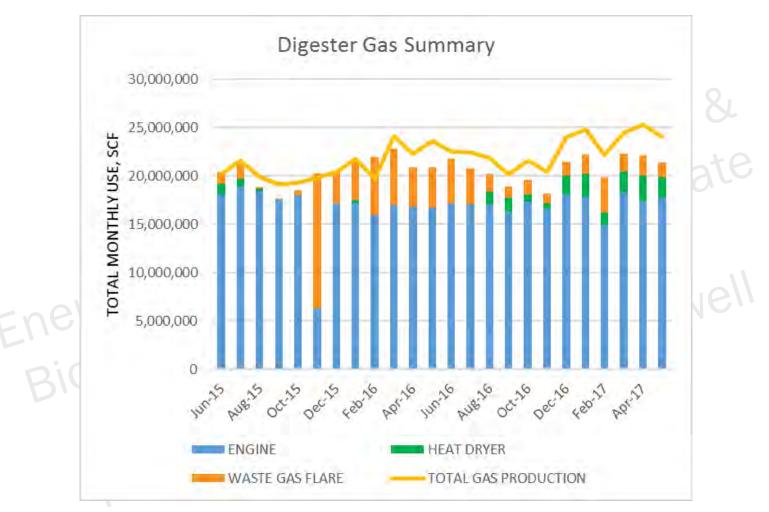
- us rkchon # Peaking factors for maximum month and peak day conditions are developed based • on 2016 PMP solids projections.
- Peaking factors for maximum 2-week and maximum week conditions are proposed ٠ based on historical data.

Power Loads and Gas Usage

• Power:

- Monthly production: 1,500 kW (2, 750 kW engines full output) - 80% of total electrical demand)
- Monthly import: 385 kW equivalent (1,390 MWh per year)
- Digester gas:
 - Average production: 1,645,000 therms per year Caldwell
 - Engines: 1,263,000 therms per year
 - Waste gas: 229,000 therms per year
 - Heat dryer: 57,000 therms per year
- Natural gas: 856,000 therms per year
 - Engines: 156,000 therms/year
 - Other plant use: 700,000 therms/year

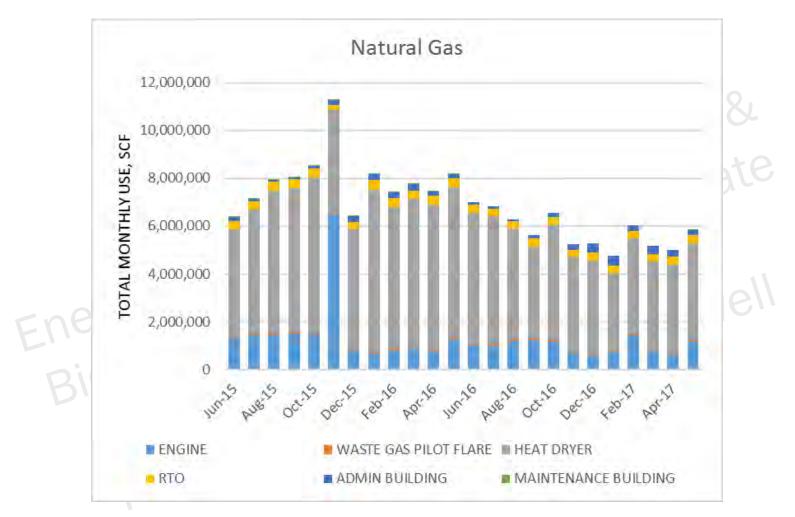
Digester Gas Usage Summary – Last 2 years



1) What happened November 2015? DG outage?

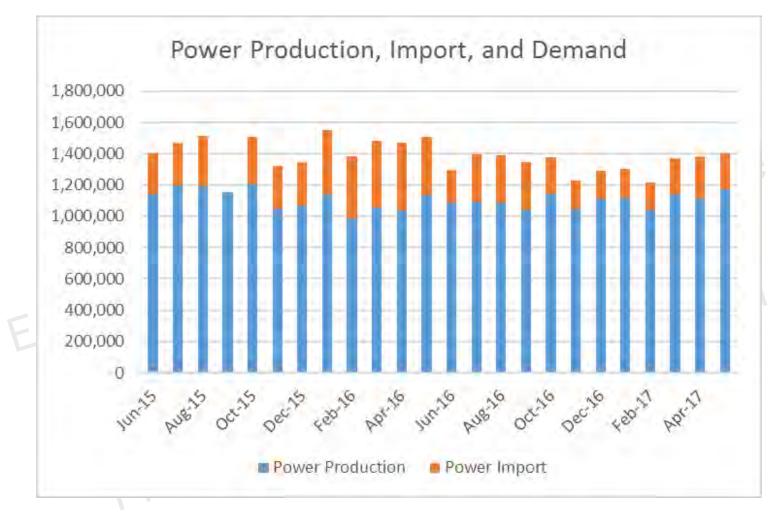
- 2) Divergence of "total gas production" from sum of other meters
- 3) When DG is sent to the heat dryer, what contributes to flaring?
- 4) Flared gas, over the course of the last year, represents 179 kW of "potential" power production

Natural Gas Usage Summary – Last 2 years



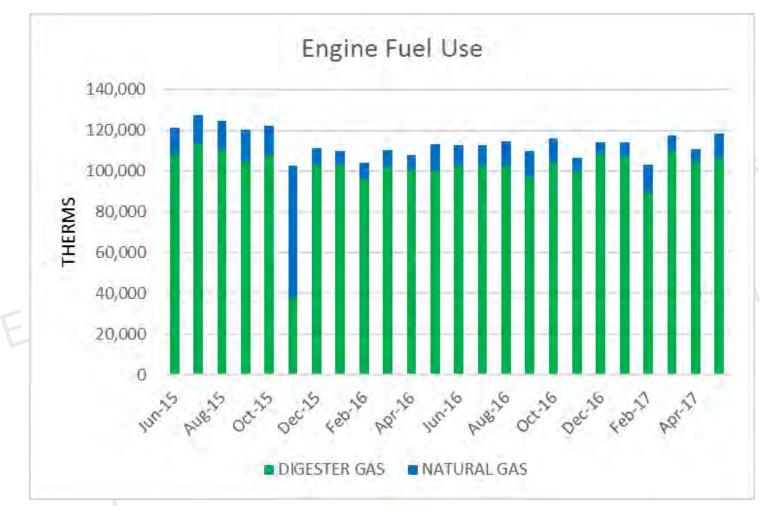
1) What is the NG control strategy to cogen? Why is there NG contribution to cogen in months where DG is being sent to dryer or flare?

Power Production and Import – Last 2 years



- 1) Consistently operating at 2-engine output
- 2) Operating a third engine at full output (if DG production increases and/or permit is modified) would result in power export

Engine Fuel Use – Last 2 years



- 1) Consistent operation
- 2) What is NG blending strategy?



Screening of Technologies



Fatal Flaw Filter

- Applied uniformly across all technologies
- Four criteria:
 - At least one successful North American installation of technology
 - At least one successful installation in a facility of similar size
 - Available space
 - Compatibility with plant size and any existing equipment
 Bio
 Bio

Evaluation Criteria

Criterion	Criterion Description	Scoring Description
End Use Market Compatibility	 Onsite technology directly produces one of the recommended product alternatives. Alternately, onsite technology product is compatible with product alternatives. 	 Low score indicates technology product that has not been identified as part of the product list nor compatible with the product list. High score indicates technology product that is compatible with Class B cake, Class A cake, Class A THP cake, and dried Class A pellet.
Proven Technology Performance	 Proven and reliable technology with same configuration intended at Encina. Long successful operating track record. 	 Low score indicates no successful large scale operating installations in North America or Europe, no successful demonstration scale installations in North America or Europe, and unknown safety or reliability record. High score indicates more than one successful operating installation in North America or Europe, more than one operating installation at a WWTP of at least 40 mgd in North America or Europe, track record duration > 5 years, and vendors in Western USA.
Minimize Life Cycle Costs	 Qualitative metric of program cost. Capital and O&M costs based on existing Encina data or similar experience at other WWTPs. Potential revenues from sales. Product/market geographic proximity. 	 Low score indicates high capital cost to build onsite facilities, high 0&M costs, expensive end use market, and high transportation costs. High score indicates low capital cost to build onsite facilities, low 0&M costs, potential product revenue, and product destination within 100 miles.

Evaluation Criteria (cont.)

Criterion	Criterion Description	Scoring Description
Energy/Resource Recovery	 Increases biogas production through advanced digestion. Supports co-digestion of organic waste. Recovery of renewable energy. Beneficial use of biosolids product. 	 Low score indicates high energy requirement for onsite technology, no increase in biogas production, technology does not recover energy as biogas, no recovery of renewable energy in biosolids, and no biosolids resource recovery. High score indicates a higher biogas production, compatible with co-digestion of organic waste, and biosolids resource recovery.
O&M Impacts	 levels. Complexity of new technology O&M and control systems. Reliability of new technology (potential downtime). 	 Low score indicates more O&M time required, complex mechanical and control systems required compared with existing plant facilities, potential equipment downtime, and new chemicals or hazards. High score indicates reduction in O&M staff time required, new technology is simple to operate and maintain, reliable with minimal downtime, and no new chemicals or hazards.
	Minimal impacts to plant safety.	

Evaluation Criteria (cont.)

Criterion	Criterion Description	Scoring Description
Environmental Impacts	 Impacts to carbon footprint and air permitting. 	 Low score indicates high carbon footprint for technology, high travel distance to end use, difficult to treat side-streams or impacts to GWRS, and new permitting for environmental regulatory requirements. High score indicates low carbon footprint for technology, low travel distance to end use, minimal side-stream generation or impacts, no additional permitting for environmental regulatory requirements.
Community & Stakeholder Impacts	 Minimize nuisance impacts such as dust, odors, vectors, aesthetics, noise and traffic. Assess impacts to partner agency issues/values as well as local planning codes and requirements. 	 Low score indicates nuisance factors for onsite technology are difficult to mitigate. High score indicates nuisance factors can be mitigated at plant site.
Project Site Compatibility	 Assess compatibility of technology with available plant footprint. Incorporation into existing treatment process. Ability to accept co-digestion substrates. 	 Low score indicates lack of site space for new facilities, requires abandonment of existing facilities, and difficult integration with existing plant. High score indicates available footprint for new facilities and maintains space for future facilities, easy of integration with existing processes and facilities.

Evaluation Criteria Weighting

Criterion	Weight Stabilization	Weight Dewatering	Weight Biogas Use and Waste Heat
End Use Market Compatibility	15%	15%	NA
Proven Technology Performance	15%	25%	20%
Minimize Life Cycle Costs	10%	20%	10%
Energy/Resource Recovery	20%	NA	25%
O&M Impacts	10%	15%	10%
Environmental Impacts	10%	5%	15%
Community & Stakeholder Impacts	10%	5%	10%
Project Site Compatibility	10%	15%	10%

Thickening Technologies

- Primary Clarifier (Existing)

- Rotary Drum Thickener (RDT)
 Recommendation from prior planet status quo Brown and Calower Prepared by Brown evaluate RDTs compared to status quo

Starting with the End in Mind – Market Compatibility

- Class B Cake Land application (Arizona) or contract composting
- Class A Cake Land application in CA and AZ (soil blending and land reclamation possible)
- Class A THP Cake Land application and soil blending (land reclamation possible)
- Class A granules (high quality) Land application, horticulture, fertilizer blending, soil blending (land reclamation possible)
- Class A granules (low quality) Land application (land reclamation possible)
- Class A Lystegro Land application

Options to produce end-use product alternatives

Product Alternatives	Technology Options
Class B Cake	Class B digestion
Class A Cake	Class A digestion (thermophilic or TPAD)
Class A THP Cake	THP/digestion
Class A Dried Granule (high quality)	Class A or B digestion + two dryer trains
Class A Dried Granule (low quality)	Class A or B digestion + maximize existing dryer
Class A Lystegro	Class A or B digestion + Lystek
Class A Lystegro Prepared by Bro	

Stabilization Technologies

- Mesophilic Digestion

- Brown and Caldwell

 - Chemical Hydrolysis
 - Lystek
 - Thermal Hydrolysis Process (THP) Traditional CAMBI
 - THP Digestion-Lysis-Digestion (DLD)
 - THP Solid Stream CAMBI

Stabilization Technologies – Fatal Flaw

	Technology Maturity	Successful Operation of Comparable Size	Available Space	Compatibility
Mesophilic Digestion	Pass	Pass	Pass	Pass
Mesophilic with High Solids	Pass	Pass	Pass	Pass
Staged Digestion	Pass	Pass	Fail	Pass
Acid/Gas Phased Digestion	Pass	Pass	Fail	Pass
Thermophilic Digestion	Pass	Pass	Pass	Pass
Temperature Phased Anaerobic Digestion	Pass	Pass	Fail	Pass
Enzymatic Hydrolysis	Fail	Fail	Pass	Pass
Chemical Hydrolysis	Pass	Fail	Pass	Pass
Lystek	Pass	Pass	Pass	Pass
Traditional CAMBI	Pass	Pass	Pass	Pass
THP - DLD	Fail	Fail	Fail	Pass
Solid Stream CAMBI	Fail	Fail	Pass	Pass

Stabilization Technologies - Screening

	Mesophilic Digestion	Mesophilic Digestion with High Solids	Thermophilic Digestion	Lystek	Traditional CAMBI
End Use Market Compatibility	3	3	3	2	5
Proven Technology Performance	5	2	5	2	4
Minimize Life Cycle Costs	3	3	4	2	2
Energy/Resource Recovery	3	4	5	3	4
O&M Impacts	4	3	4	3	3
Environmental Impacts	4	4	4	3	4
Community & Stakeholder Impacts	4	4	4	2	4
Project Site Compatibility	5	3	5	3	2
Weighted Score	3.80	3.25	4.30	2.50	3.65

Dewatering Technologies

- Centrifuge

- volute press Bucher press
 - Prepared by Brown and Caldwell

Dewatering Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility	
Centrifuges	Pass	Pass	Pass	Pass	
Belt Press	Pass	Pass	Pass	Pass	
Screw Press	Pass	Pass	Pass	Pass	
Rotary Press	Pass	Pass	Pass	Pass	
Volute Press	Pass	Pass	Pass	Pass	
Bucher Press	Fail	Fail	Pass	Pass	
Volute PressPassPassPassBucher PressFailPassPass					

Dewatering Technologies - Screening

	Centrifuges	Belt Press	Screw Press	Rotary Press	Volute Press
End Use Market Compatibility	3	5	4	3	3
Proven Technology Performance	5	5	3	2	2
Minimize Life Cycle Costs	4	4	3	3	3
0&M Impacts	5	5	2	2	2
Environmental Impacts	3	2	3	3	3
Community & Stakeholder Impacts	4	4	4	4	4
Project Site Compatibility	5	4	2	3	3
Weighted Score	4.35	4.45	2.90	2.65	2.65
Prepared by prepared by					

Post-Dewatering Technologies

- Thermal drying high quality granules
- Thermal drying low quality granules (indirect dryer) nt Plan Update

- Junyons
 Partial solar drying
 Deep well injection
 Dehydration
 Incineration Julon Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell

 - Incineration

Post-Dewatering Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility
Thermal Drying: Low Quality (Indirect Dryer)	Pass	Pass	Pass	Fail
Thermal Drying: High Quality (Drum Dryer)	Pass	Pass	Pass	Pass
Gasification	Fail	Fail	Pass	Pass
Pyrolysis	Fail	Fail	Pass	Pass
	ids Main Wo epared b		Pass Pass	

Alternative Power Production Technologies

- Internal Combustion Engines
- Digester gas upgrading
 - For pipeline injection
 - For vehicle fueling (CNG)
- Microturbines
- Biosolids Drying direct use of biogas and Caldwell
- Energy Storage (Batteries)
- Fuel Cells
- Large Scale Solar Photovoltaics (PV)
- Small Scale/Rooftop Solar Photovoltaics
- Wind Turbines
- Direct sale to adjacent power plant

Alternative Power Production – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility
Internal Combustion Engines	Pass	Pass	Pass	Pass
Digester Upgrading: Pipeline Injection	Pass	Pass	Pass	Pass
Digester Upgrading: Vehicle Fueling (CNG)	Pass	Pass	Pass	Pass
Microturbines	Pass	Pass	Pass	Pass
Biosolids Drying - Direct Use Of Biogas	Pass	Pass	Pass	Pass
Energy Storage	Pass	Pass	Pass	Pass
Fuel Cells	Fail	Fail	Pass	Pass
Large Scale Solar Photovoltaics	Pass	Pass	Pass	Pass
Small Scale/Rooftop Solar Photovoltaics	Pass	Pass	Pass	Pass
Wind Turbines	Pass	Pass	Fail	Fail

Alternative Power Production – Screening

	Internal Combustio n Engines - Status Quo	Engines - With Gas	Engines - With Exhaust	Digester Upgrading: Pipeline Injection	Digester Upgrading: Vehicle Fueling (CNG)	Micro- turbines	Biosolids Drying - Direct Use Of Biogas	Energy Storage (Batteries)	Small Scale Rooftop PV	Large Scale Photovoltaics
Proven Technology Performance	5	5	4	2	3	4	5	3	5	5
Minimize Life Cycle Costs	3	3	4	4	4	3	3	3	4	4
Energy/Resourc e Recovery	4	4	5	4	4	4	2	1	5	5
O&M Impacts	3	4	3	4	4	4	3	4	5	5
Environmental Impacts	3	3	4	5	5	5	3	3	5	4
Community & Stakeholder Impacts	4	4	5	5	5	4	3	3	5	5
Project Site Compatibility	5	5	4	4	4	4	5	3	2	2
Weighted Score	3.95	4.05	4.25	3.85	4.05	4.05	3.35	2.60	4.60	4.45

Waste Heat Technologies

- Small Scale Steam Turbines
- Absorption and Adsorption Chillers
 Organic Rankine Cycle (ORC)
 Gasification of Biosolids
- Workshop #2 Workshop #2 Prepared by Brown and Caldwell
- Biosolids

Waste Heat Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility			
Small Scale Steam Turbines	Pass	Pass	Pass	Pass			
Use For Thermo/THP	Pass	Pass	Pass	Pass			
Absorption And Adsorption Chillers	Pass	Pass	Pass	Fail			
Organic Rankine Cycle	Fail	Fail	Pass	Pass			
Gasification Of Biosolids	Fail	Fail	Pass	Pass			
Gasification Of BiosolidsFailPass							

Waste Heat Technologies – Screening

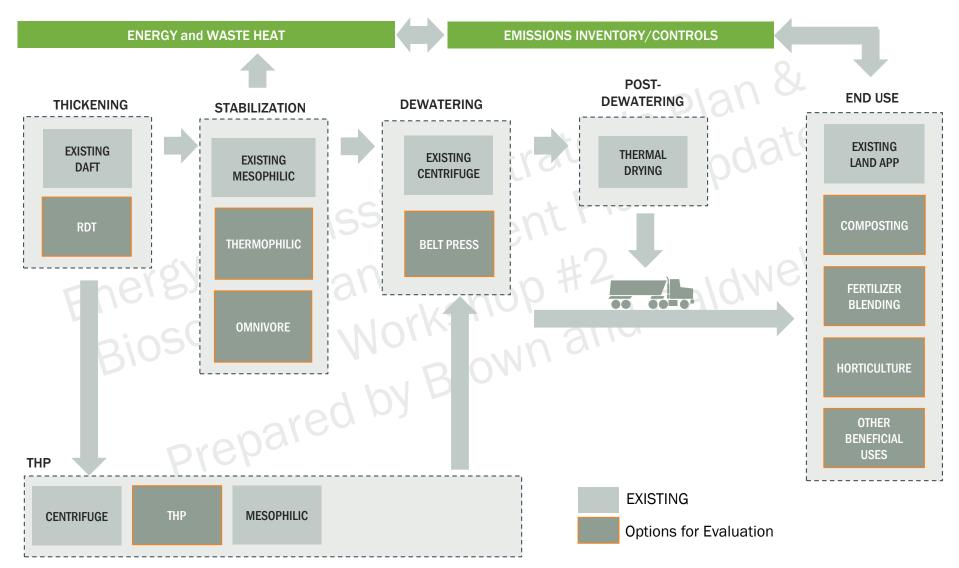
	Small-Scale Steam Turbines	Thermo/THP	
Proven Technology Performance	2	5	
Minimize Life Cycle Costs	3	5	
Energy/Resource Recovery	4	4	
O&M Impacts	3	3	
Environmental Impacts	3	4	
Community & Stakeholder Impacts	3	4	
Project Site Compatibility	3	4	
Weighted Score	3.05	4.2	
Weighted Score Prepare			



Creation of End to End Alternatives



Evaluating Technologies and Markets Together



Brown and Caldwel

Initial Alternatives

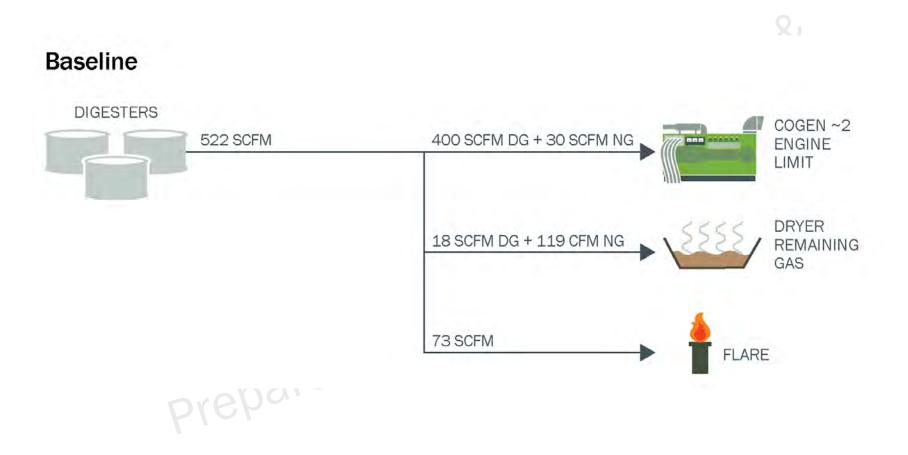
- Meso plus second dryer
- Meso plus Class B hauling
- Thermophilic
 - Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell With and without second dryer
- Cambi (traditional)
 - With and without second dryer

- Additional Layers
 - Thickening
 - Dewatering
 - Energy alternatives
 - End use markets

Alternatives: Power Production

- Baseline: Existing cogen + drying
- Baseline + gas conditioning
 - Gas conditioning serves to reduce O&M costs associated with engines and dryer
- Existing cogen + vehicle fuel (via pipeline injection or tube trailer)
 - No permit modification to cogen / no DG to dryer
 - Continue to operate two engines
 - Additional gas routed to vehicle fuel
- Existing cogen + microturbines
 - Includes gas conditioning
 - No permit modification to cogen / no DG to dryer
- Existing cogen + steam boiler/turbine
 - No permit modification to cogen / no DG to dryer
 - Additional gas routed to steam boiler; steam used in small turbine
- New cogen permit, CO catalyst and SCR, gas conditioning
 - Need to consider plant demand as a limit on power production
- Vehicle Fuel (primary use of DG) + existing cogen (natural gas + tail gas)
 - "All in" on vehicle fuel

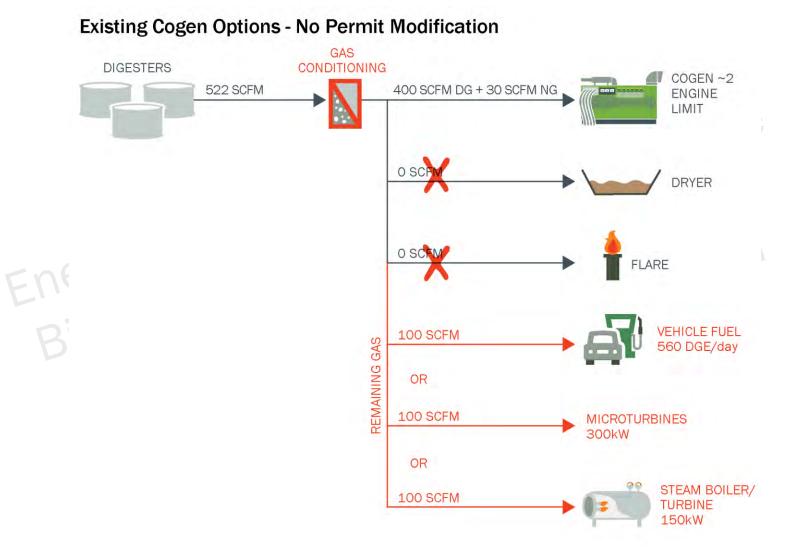
Baseline includes cogeneration (permit limited), dryer and some flaring



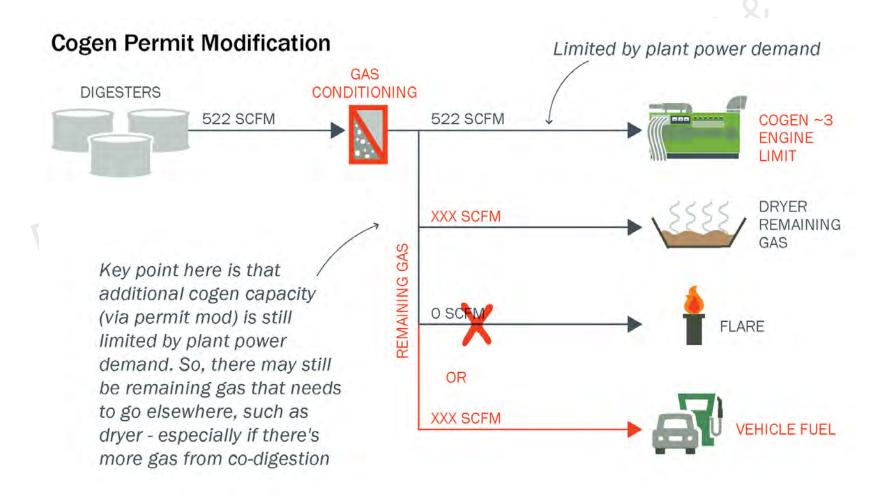
Gas conditioning could reduce engine and dryer O&M costs associated with siloxanes

Baseline with Gas Conditioning GAS DIGESTERS CONDITIONING COGEN~2 522 SCFM 400 SCFM DG + 30 SCFM NG 000 -ENGINE LIMIT DRYER 18 SCFM DG + 119 CFM NG REMAINING GAS 73 SCFM FLARE

With the existing permit in place, where else can we send digester gas to get highest value?

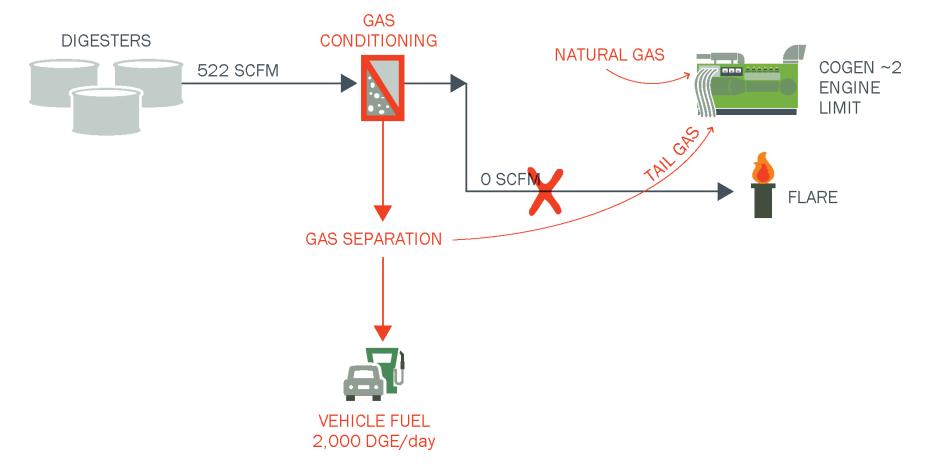


A permit modification allows EWA to meet plant electricity demand, but any additional gas would need to go to a non-generating use



An all-vehicle-fuel option may deliver the best economics

Vehicle Fuel



Alternatives to be presented at next workshop

- Process schematic
- sprint Potential locations solons for plan agend to the plan

 - Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell



Grant Updates



Self Generation Incentive Program

Program	Self-Generation Incentive Program (SGIP)		
Agency	California Energy Commission / administered by SDG&E		
Eligible Projects	Self-generation projects such as new engines, microturbines, or steam turbines – increased incentives for renewable/biogas projects; Energy storage / batteries		
Funding	Incentives based on anticipated power output – based on fuel availability, not nameplate capacity; 50% paid upfront / 50% paid over 5 years based on performance		
Schedule	Funding available each year / first-come, first-served Battery funding decreases as tiers fill up Projects must be operational within 18 months of award		
How much are we talking?	~\$500k - \$1M depending on project size		
Recommendation for SWEET Analysis	Don't count on funding to justify project economics		
Next steps	Continue to track / pursue if selected alternatives meet criteria		

Low-Carbon Fuel Standard

Program	Low-Carbon Fuel Standard (LCFS)			
Agency	California Air Resources Board			
Eligible Projects	Part of AB 32 scoping plan – projects that reduce the carbon intensity California's vehicle fuel – i.e. renewable compressed natural gas (CNG vehicle fuel)			
Funding	Incentives based on fuel production, market-based values; Paid on a per-gallon basis as the project performs			
Schedule	Ongoing program, recently extended through 2030			
How much are we talking?	Varies could equate to ~\$0.50/DGE - \$1.00/DGE depending on market factors			
Recommendation for SWEET Analysis	Include in SWEET analysis for vehicle fuel projects; Assume funding only through 2030, use conservative values			
Next steps	Continue to track / pursue if vehicle fuel is recommended			

Renewable Fuel Standard

Program	Renewable Fuel Standard		
Agency	US Environmental Protection Agency		
Eligible Projects	Renewable fuel projects - i.e. renewable compressed natural gas (CNG vehicle fuel)		
Funding	Incentives based on fuel production, market-based values; Paid on a per-gallon basis as the project performs		
Schedule	Ongoing program, not guaranteed beyond 2022		
How much are we talking?	A lot of uncertainty: Wastewater digester gas is eligible for highest value of RINs – D3 EPA has recently stated that DG from food waste is a lower value – D5 EPA has the ability to set RIN quotas, which drive supply-and-demand, market-based pricing		
Recommendation for SWEET Analysis	Include in SWEET analysis for vehicle fuel projects; Assume funding only through 2022, use conservative values		
Next steps	Continue to track / pursue if vehicle fuel is recommended		

Organics Grant Program

Program	Organics Grant Program		
Agency	Department of Resource Recovery and Recycling (CalRecycle)		
Eligible Projects	Projects that serve to divert organics (food waste) from landfill – toward anaerobic digestion or composting; recently issued with a food rescue requirement		
Funding	Incentives based on project size and potential tons diverted		
Schedule	Recently awarded, not expected to reissue for ~18 months		
How much are we talking?	Up to \$4M per project		
Recommendation for SWEET Analysis	Do not include – too competitive to count on		
Next steps	Continue to track / pursue if food waste receiving is recommended		

Organics Grant Program - Recent Award

Recommendation:

Staff recommends approval of 10 grant awards, as listed in Table 1 below, for \$24,000,000.

Applicant	County	Total Award
Anaerobic Digestion Projects		
County Sanitation Districts of Los Angeles County	Los Angeles	\$4,000,000
HZIU Kompogas SLO, Inc.	San Luis Obispo	\$4,000,000
Rialto Bioenergy Facility, LLC	San Bernardino	\$4,000,000
	Subtotal	\$12,000,000
Compost Projects		
City of San Diego	San Diego	\$3,000,000
Mid Valley Recycling, LLC	Fresno	\$1,875,000
Salinas Valley Solid Waste Authority	Monterey	\$1,341,865
Recology Yuba-Sutter (partially funded)	Yuba	\$2,783,135
	Subtotal	\$9,000,000
Rural Compost Projects		
Napa Recycling & Waste Services, LLC	Napa	\$541,700
South Lake Refuse Company, LLC	Lake	\$1,218,026
West Coast Waste (partially funded)	Madera	\$1,240,274
	Subtotal	\$3,000,000
	Grand Total	\$24,000,000

Table 1. Organics Grant Program Recommended Award – List A

Organics Grant Program - Recent Award

Applicant	County	Total Award Requested*
Anaerobic	Digestion Projects	
CR&R Incorporated	Riverside	\$4,000,000
Contra Costa Waste Services	Contra Costa	\$4,000,000
City of Manteca	San Joaquin	\$1,500,000
Santa Barbara County	Santa Barbara	\$4,000,000
Subtotal		\$13,500,000
Com	oost Projects	
Recology Yuba-Sutter (partially funded)	Yuba	\$216,865
Agromin OC, LLC	San Bernardino	\$600,000
Waste Management of Alameda County,	nc. Alameda	\$3,000,000
GreenWaste Recovery, Inc.	Santa Clara	\$1,700,000
Burrtec Waste Industries, Inc.	Riverside	\$3,000,000
Arakelian Enterprises Inc. DBA Athens Services	San Bernardino	\$3,000,000
Best Way Disposal Company, Inc. DBA Advance Disposal Co.	San Bernardino	\$2,481,250
Kern County	Kern	\$3,000,000
City of Oceanside	San Diego	\$1,178,351
Subtotal		\$18,176,466
Rural Co	ompost Projects	
West Coast Waste (partially funded)	Madera	\$161,326
Upper Valley Disposal Service	Napa	\$1,250,000
Subtotal		\$1,411,326
	Grand Total	\$33,087,792

Table 2. Organics Grant Program Recommended Award - List B

Heathy Soils Program

Program	Healthy Soils Program		
Agency	California Department of Food and Agriculture		
Eligible Projects	Demonstration projects that sequester carbon and reduce GHG emissions – groups within CASA		
Funding	Incentives based on project size and potential GHG benefit		
Schedule	Currently accepting applications through September 19 Annual funding program (AB 32 funds), amounts and criteria may vary		
How much are we talking?	Up to \$3.75M total		
Recommendation for SWEET Analysis	Do not include / ancillary benefit to support end use program		
Next steps	Continue to track / connect with CASA Science and Research Group for potential partnerships		

Green Project Reserve

Program	Green Project Reserve		
Agency	California Water Resources Control Board		
Eligible Projects	Projects that improve energy efficiency, renewable energy generation, or recycled water production		
Funding	A component of Clean Water State Revolving Funding; Green Project Reserve is a "loan forgiveness" program CWSRF is generally oversubscribed, but GPR is underutilized		
Schedule	Ongoing		
How much are we talking?	Up to \$4M per project, or 50% of project value, whichever is higher		
Recommendation for SWEET Analysis	Do not include		
Next steps	Something for EWA to keep in mind – if a larger capital project requires funding, consider CWSRF and adding an eligible GPR component		



Air Permitting Discussion



EWA is actively pursuing air permit modification

- EWA (with Don King) will submit a request for permit modification within ~1 week
- Goal is to adjust the CO emission rate from 530 ppm to ~400 ppm, and thereby adjust the fuel input limit aimed at keeping CO emissions below Title V synthetic minor threshold
- If successful, this effort would increase permitted cogen capacity by ~20%
- This increase would allow EWA to meet plant electricity demand with current digester gas flows and cogen system



Look Ahead & Wrap-Up



Project Schedule

- Workshop #3 in mid-September
- Draft Analysis and Reports to Begin

Combined Project Schedule	JUL '17	AUG '17	SEP '17	OCT '17	NOV '17	DEC '17	JAN '18	FEB '18	MAR '18
TASK 1 - Baseline Energy									
TASK 2 - Biosolids Tech									
TASK 3 - Power Tech									
TASK 4 - Biogas Tech									
TASK 5 - Waste Heat Tech									1
TASK 6 - Air Emissions Evaluation									1
TASK 7 - Alternatives and Evaluation									
TASK 8 - Grants/Incentives									
TASK 9 - Management/QC									
Workshops	◆W1	🔶 W2	🔶 W3	3		◆ W4	♦ W5	1	W6
	COLOR KEY	Y:	Evaluation	Analyz	e/Report	Client R	leview	Final Repo	*

Look Ahead – September Workshop

- Consensus on mass balance/baseline
- Conceptual layouts/details of alternatives for consensus/feedback (example numbers to support including biogas production, food waste that can be imported)
- Air permitting impacts on power production alternatives
- Informational meeting with waste haulers
- Debrief on Anaergia meeting
- Grants update

Wrap-Up

QUESTIONS?



it's about connecting

Brown AND Caldwell

essential ingredients®

Attachment B: SDG&E Distribution Interconnection Handbook and BEE - Electrical Upgrades Required for Rule 21 Interconnection



Use of contents on this sheet is subject to the limitations specified at the beginning of this document. SC07035_Final_TM3_Alt Pwr Production.docx

B-1

SDG&E Electric Distribution System Interconnection Handbook

<Revised as of 10/21/2015>



TABLE OF CONTENTS

1	Introduction	1
	1.1 Purposes	1
	1.2 Applicability and Related Tariffs	1
	1.3 Interconnection Agreement Required	1
	1.4 Technical Requirement	1
2	Metering Requirements	
	2.1 Basic Metering Requirements	
	2.2 Metering Equipment Layout	
	2.3 Metering Sections	
	2.4 Other Metering Requirements	
	2.5 Metering Equipment Installation	
	2.6 Telemetering Equipment	
	2.7 Meter Reading/Maintenance/Testing	
3	Protection and Control Requirements	
-	3.1 Purpose	
	3.2 General Interconnection and Protective Function Requirements	
	3.3 Prevention of Interference	
	3.4 Technology Specific Requirements	
	3.5 Inverter Specifications	
	3.6 Supplemental Generating Facility Requirements	
4	Operating Requirements	
	4.1 Generator Step-up Transformer	
	4.2 Power Quality Requirements	
	4.3 Under-frequency Operation	
5	Operating Procedures	
-	5.1 CVR Standards	
	5.2 Voltage Control Operation and Other Service Requirements	
	5.3 Unusual or System Emergency Conditions	
6	Energization and Synchronization Requirements	
-	6.1 Purpose	
	6.2 Design Review and Interconnection Facilities Inspection	
	6.3 Pre-parallel Testing	
	1 0	28
	6.3.2 Non-Certified Equipment	
	6.3.3 Verification of Settings	
	6.4 Requirements for Commercial (Parallel) Operation	
	6.4.1 Trip Tests	
	6.4.2 In-service Tests	
	6.4.3 Periodic Testing	
7	Attachments	
-	7.1 Tariffs	
	7.2 Interconnection Applications	
	·	~ 1

1 Introduction

1.1 Purposes

This handbook has been prepared to provide an overview of the technical requirements to interconnect Generating Facilities (includes all generators located at an interconnection point) to operate in parallel with SDG&E's distribution system. The requirements are necessary to ensure safe and reliable operation of SDG&E's electric system. The handbook shall serve as a guideline to SDG&E personnel and customer generation owners in completing generation to distribution interconnections that conform to SDG&E reliability requirements.

The interconnections include facility additions and modifications on generation and distribution systems necessary to accommodate the interconnection of generation to SDG&E distribution system. For generation interconnection to the transmission system, refer to **SDG&E Generation Interconnection Handbook,** which can be found on the SDG&E website, link below.

http://www.sdge.com/generation-interconnection-handbook

1.2 Applicability and Related Tariffs

All generators connected to the distribution system must meet the technical requirements of this handbook. The handbook is not intended to supersede

Interconnection Agreements required by SDG&E's Electric Rule 21 and/or the Wholesale Distribution Open Access Tariff (WDAT), particularly the Large Generator Interconnection Agreement (LGIA) and Small Generator Interconnection Agreement (SGIA).

1.3 Interconnection Agreement Required

The Owner/Operator must execute an Interconnection Agreement with SDG&E, and receive SDG&E's express written permission before parallel operation of its generating facility with SDG&E's Distribution System. SDG&E shall treat all requests in a non-discriminatory manner and shall not unreasonably withhold its permission for Parallel Operation of Owner/Operator's Generating Facility with SDG&E's Distribution System.

1.4 **Technical Requirement**

The technical requirements are organized in five (5) categories:

- Metering
- Protection and Control

- Operating Requirements
- Operating Procedures
- Energization and Synchronization

2 Metering Requirements

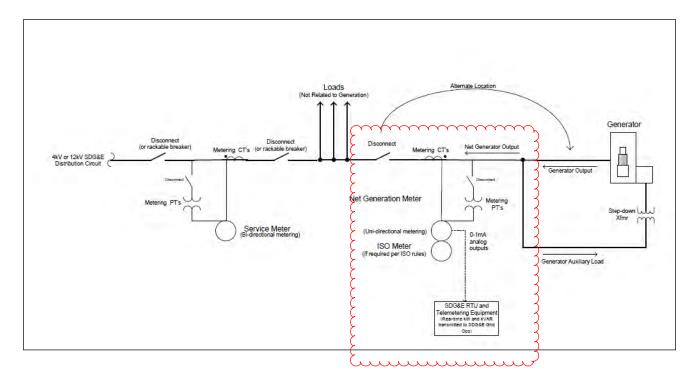
2.1 Basic Metering Requirements

- On generating facilities < 1 MW, it is recommended that SDG&E metering be installed to measure net generator output (generator output minus auxiliary loads associated with the generator) per SDG&E metering standards and requirements.
- On generating facilities >= 1MW, SDG&E metering shall be installed to measure net generator output (generator output minus auxiliary loads associated with the generator) in addition to SDG&E telemetering.
- SDG&E metering shall be installed to meter import and export at the SDG&E service point(s) regardless of Generating Facility size.
- If the facility is a generating facility serving only auxiliary load with one SDG&E service point, the SDG&E service point is also considered to be the net generator output point, so no additional net generation output meter is required or recommended.
- For a generating facility that requires CAISO (California Independent System Operator) metering, a CAISO meter(s) shall be installed at the SDG&E service point or at the net-generation point(s) per CAISO requirements and policies.

2.2 Metering Equipment Layout

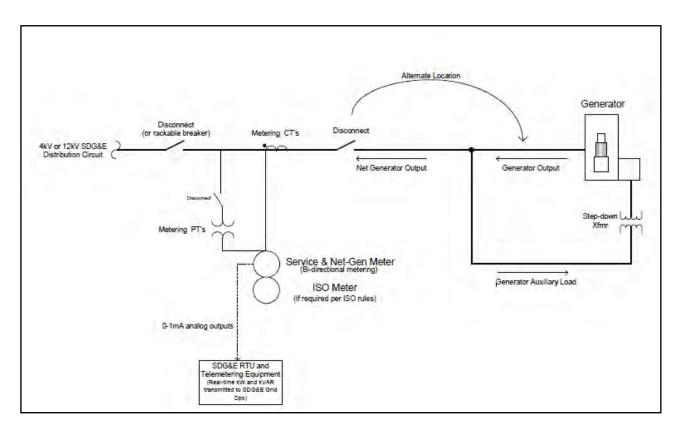
A typical metering layout of a generating facility containing load that is not directly associated with generation is illustrated in Figure 1.





A typical metering layout of a generating facility with only loads associated with generation is illustrated in Figure 2.

Figure 2: Typical Generation Facility Metering Layout (w/ <u>only</u> loads associated with generation)



2.3 Metering Sections

- At all points where SDG&E meters are to be installed, the Owner/Operator shall acquire and install a metering section. The metering section includes cable pull sections, bus bars for metering CT/PT insertion; disconnect switches, a metering panel, a meter socket(s), and accommodations for test switches/test blocks. Please refer to pages 676 and 677 of SDG&E's Electric Service Standards & Guide Manual for a typical metering section.
- Detailed information on all new proposed metering sections for the project shall be provided to SDG&E as part of the review and approval process described in the applicable tariff. This includes (but is not limited to) clearances from the metering section and details of the standing surface of the metering section.
- A set of disconnect switches or a rackable breaker shall be placed directly on the line side of each metering section as well as a set of disconnect switches for the metering PT's (accessible by SDG&E personnel only) per SDG&E service requirements. In addition, a set of disconnect switches shall be placed on the load side of the meter or at the point of generator output.
- Locations of these disconnect switches (or rackable breakers) are illustrated in Figures 1 and 2 above.
- The required disconnect switches (or rackable breakers) shall allow visible verification that separation has occurred.
- Disconnect switches are required to be gang operated.
- Disconnect switches and rack-out breakers must accommodate locking devices to allow SDG&E to lock-out services or net-generation points when necessary.
- Suitable locations shall be selected for all SDG&E metering sections per requirement outlined on page 602 of SDG&E's Electric Service Standards & Guide Manual.
- CAISO meters shall be located on the same metering panel plate as SDG&E meters that serve to meter the same point (e.g. net-generation point, SDG&E service point). Both meters will tap off the same metering PT's/CT's with the enclosure/panel having two sockets and test switches. See page 678 of SDG&E's Electric Service Standards & Guide Manual for a typical layout of this panel configuration.
- Any load that precedes point of service metering must be metered by an SDG&E self-contained meter on the same meter panel as that of the SDG&E meter. Typically, this load consists of customer owned PT's feeding control, protection, and monitoring devices. A typical panel layout showing this self-contained metering is shown on pages 679 and 680 of SDG&E's Electric Service Standards & Guide Manual.
- For self-contained meters, the Owner/Operator is required to acquire and install test blocks that meet SDG&E service requirements.

• The Electric Service Standards & Guide Manual can be found at:

http://www.sdge.com/electric-service-standards-guide-manual

2.4 Other Metering Requirements

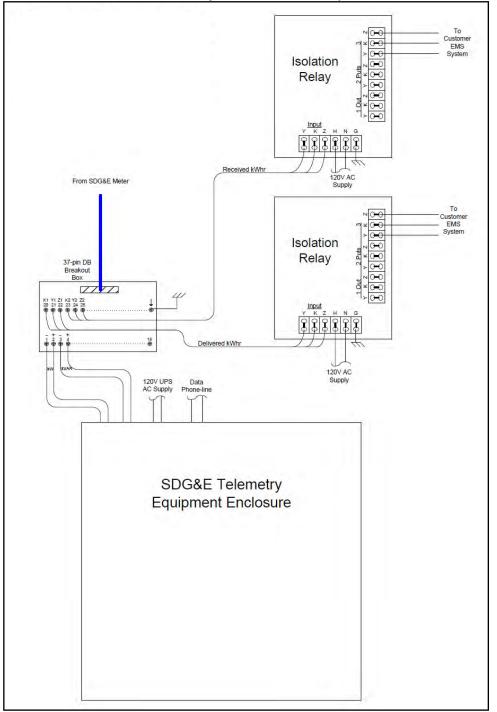
- An activated dial-up phone line shall be provided to each SDG&E meter.
- This phone line shall be routed to the associated meter panel with the SDG&E meter where SDG&E can plug an RJ-11 connector to obtain phone service to the meter. The RJ-11 connection point shall be within 12" of the meter socket.
- Monthly costs and maintenance of the phone lines to SDG&E meters are the responsibly of the Owner/Operator.
- At all SDG&E metering locations where voltage potential may be lost (except in the event of a planned or forced SDG&E outage), the Owner/Operator shall supply each SDG&E meter with a 120VAC uninterruptible power supply (UPS).
- A dedicated breaker position in the UPS breaker panel shall be utilized to supply each meter with UPS power and shall be clearly marked as feeding an SDG&E meter.
- The Owner/Operator may request KYZ outputs from any SDG&E meter for a one-time cost. See Figure 3 shown in Section 2.6 of this handbook for a typical KYZ output configuration.

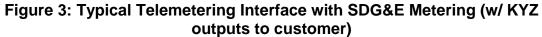
2.5 Metering Equipment Installation

- All metering sections shall be installed by the Owner/Operator.
- Upon final approval of the metering sections, layout, and overall facility, SDG&E personnel will provide, install and wire the metering CT's/PT's, telemetry equipment (if applicable), and test switches in preparation for the installation of SDG&E meters.
- If a CAISO meter is required, SDG&E will wire all CAISO metering. However, an ISO certified contractor is required to perform installs of CAISO meters per arrangements made by the Owner/Operator with the CAISO.

2.6 **Telemetering Equipment**

 SDG&E telemetering equipment located at net generation output metering points for generators >= 1MW utilize outputs from SDG&E meters located at the same metering points. See Figure 3 below for typical telemetering configuration.





- Telemetering requires a dedicated 120VAC UPS source. The telemetering equipment enclosure should be placed on or close to the meter panel but is not required to be on the meter panel. A suitable conduit can be used to interconnect the telemetering equipment with the SDG&E meter.
- The telemetering requires a high speed dedicated data line to SDG&E's Grid Operations center.
- Costs associated with the set-up requirements of telemetering equipment (e.g., conduit runs, activated data line) are borne by the Owner/Operator. There is a one-time cost to the Owner/Operator for the SDG&E telemetering equipment.

2.7 Meter Reading/Maintenance/Testing

- SDG&E will own, install, maintain, read, and test all SDG&E meters, telemetry equipment, metering PT's/CT's, and associated wiring installed at the facility.
- 24hr/7day unrestricted and unescorted access to all metering equipment and metering associated devices shall be provided to SDG&E metering personnel. All locked doors and gates SDG&E metering personnel must pass through to gain access shall each contain a SDG&E Schlage restricted VTQP quad lock supplied and installed by the Owner/Operator. A list of locksmiths authorized by SDG&E to sell Schlage restricted VTQP quad locks is listed on page 005.1 of SDG&E's Electric Service Standards & Guide Manual.
- If required, the Owner/Operator shall be responsible for installing, maintaining, reading, and testing the CAISO meter(s) per CAISO requirements. It is the responsibility of the facility Owner/Operator to comply with all applicable CAISO metering standards and requirements.
- Per SDG&E request, the Owner/Operator of the Generating Facility shall make all necessary arrangements with the CAISO for SDG&E to obtain all 5 min interval data reads from the CAISO meter. SDG&E will in-turn, upon reasonable notification, supply the CAISO with meter data from the SDG&E meter in the event of a CASIO meter failure within a reasonable time-frame, and with the understanding that most SDG&E meters only record IDR data on a 15min basis per SDG&E tariffs.
- The format of these reads must be compatible with SDG&E's meter reading system (MV90) using a Hand-Held Files (HHF) format. SDG&E shall supply the CAISO with meter data in this same HHF format.
- All metering sections and associated equipment are maintained by the Owner/Operator. In the event of a failure or malfunction of this equipment, the Owner/Operator is responsible for all replacements and repairs.
- The metering PT's/CT's, SDG&E meters, and SDG&E telemetry equipment is owned and therefore maintained by SDG&E.
- Repairs and replacements of CAISO meters are the Owner/Operator's responsibility and not the responsibility of SDG&E.

- Upon reasonable advanced notification by SDG&E, the Owner/Operator shall operate disconnect switches and/or rack-out breakers in order for SDG&E to perform maintenance on metering CT/PT's, telemetering equipment, or inspection of the metering section.
- Upon a failure or malfunction of a metering section or SDG&E equipment, the Owner/Operator shall accommodate immediate arrangements with SDG&E to operate disconnects or rack-out breakers.

3 Protection and Control Requirements

3.1 Purpose

This section specifies the requirements for protection and control devices for Generating Facilities interconnecting to the SDG&E Distribution System.

The applicable protective standards of this section apply to all Generating Facilities interconnecting to any portion of SDG&E's Distribution System. These standards, which govern the design, construction, inspection and testing of protective devices, have been developed to be consistent with SDG&E's Rule 21, *Interconnection Standards for Non-Utility Owned Generation*, and IEEE 1547, *IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems*.

3.2 General Interconnection and Protective Function Requirements

The Protective Functions and requirements of this Section are designed to protect SDG&E's Distribution System and not the Generating Facility. An Owner/Operator shall be solely responsible for providing adequate protection for its Generating Facility and Interconnection Facilities. The Owner/Operator's protective equipment shall not impact the operation of other protective equipment utilized on SDG&E's Distribution System in a manner that would affect SDG&E's capability of providing reliable service to its Customers.

Protective Equipment Required - Generating Facilities operating in parallel with SDG&E's Distribution System shall be equipped with protective devices that will sense abnormal conditions on SDG&E's Distribution System and will: cause the Generating Facility to automatically disconnect from SDG&E's Distribution System, or will prevent the Generating Facility from being connected to SDG&E's Distribution System inappropriately. These protective functions include:

- 1) Over and under voltage trip functions and over and under frequency trip functions;
- 2) A voltage and frequency sensing and time-delay function that will prevent the Generating Facility from energizing a de-energized Distribution System circuit, and will prevent the Generating Facility from reconnecting with SDG&E's Distribution System unless SDG&E's Distribution System service voltage and frequency is: a) within the ANSI C84.1-1995 Table 1 Range B Voltage Range of 106V to 127V (on a 120V basis), inclusive, and b) within a frequency range of 59.7 Hz to 60.5 Hz inclusive, and is stable for at least 60 seconds.
- 3) A function to prevent the Generating Facility from contributing to the formation of an Unintended Island, and cease to energize SDG&E's Distribution System within two seconds of the formation of an Unintended Island.

The Generating Facility shall cease to energize SDG&E's Distribution System for faults on SDG&E's Distribution System circuit to which it is connected (IEEE1547-4.2.1). The Generating Facility shall cease to energize SDG&E's Distribution circuit prior to reclosure by SDG&E's Distribution System equipment (IEEE1547-4.2.2).

Momentary Paralleling Generating Facilities - With SDG&E's approval, the transfer switch or scheme used to transfer the Owner/Operator's loads from SDG&E's Distribution System to Owner/Operator's Generating Facility may be used in lieu of the protective functions required for Parallel Operation.

Suitable Equipment Required - Circuit breakers or other interrupting equipment located at the Point of Common Coupling (PCC) must be Certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. Owner/Operator's Generating Facility and Interconnection Facilities shall be designed so that the failure of any single device or component shall not potentially compromise the safety and reliability of SDG&E's Distribution System. The Generating Facility paralleling-device shall be capable of withstanding 220% of the Interconnection Facility rated voltage (IEEE1547-4.1.8.3). The Interconnection Facility shall have the capability to withstand voltage and current surges in accordance with the environments defined in IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002 as applicable and as described in Rule 21 Section J.3.e (IEEE1547-4.1.8.2).

Visible Disconnect Required - When required by SDG&E's operating practices, the Owner/Operator shall furnish and install a ganged, manually-operated isolating switch (or a comparable device mutually agreed upon by SDG&E and the Owner/Operator) near the Point of Interconnection to isolate the Generating Facility from SDG&E's Distribution System. The device does not have to be rated for load break nor provide over-current protection. The device must:

- 1) Allow visible verification that separation has been accomplished. (This requirement may be met by opening the enclosure to observe contact separation.)
- 2) Include markings or signage that clearly indicates open and closed positions.
- 3) Be capable of being reached quickly and conveniently 24 hours a day by SDG&E personnel for construction, operation, maintenance, inspection, and testing or reading without: a) obstacles, b) a requirement to seek access to climb over or remove obstacles, or c) a requirement to obtain keys, special permission, or security clearances.
- 4) Be capable of being locked in the open position.
- 5) Be clearly marked on the submitted single line diagram and its type and location approved by SDG&E prior to installation. If the device is not

adjacent to the PCC, permanent signage must be installed at an SDG&E approved location providing a clear description of the location of the device.

Generating Facilities with Non-Islanding inverters totaling one (1) kilovolt-ampere (kVA) or less are exempt from this requirement.

Drawings Required - Prior to Parallel Operation or Momentary Parallel Operation of the Generating Facility, SDG&E shall approve the Owner/Operator's protective function and control diagrams. Generating Facilities equipped with protective functions and a control scheme previously approved by SDG&E for system-wide application or only Certified Equipment may satisfy this requirement by reference to previously approved drawings and diagrams.

3.3 *Prevention of Interference*

The Owner/Operator shall not operate Generating or Interconnection Facilities that superimpose a voltage or current upon SDG&E's Distribution System, or that interferes with SDG&E operations, service to SDG&E customers, or communication facilities. If such interference occurs, the Owner/Operator must diligently pursue and take corrective action at its own expense after being given notice and reasonable time to do so by SDG&E. If the Owner/Operator does not take corrective action in a timely manner, or continues to operate the facilities causing interference without restriction or limit, SDG&E may, without liability, disconnect the Owner/Operator's facilities from SDG&E's Distribution System, in accordance with Section 3.4 of the Wholesale Open Access Distribution Tariff Small Generator Interconnection Agreement (WDAT SGIA). Below is a link to the WDAT SGIA:

http://www.sdge.com/generation-interconnections/wholesale-generator-transmission-interconnections

To eliminate undesirable interference caused by its operation, each Generating Facility (GF) shall meet the following criteria:

Voltage Regulation - The GF shall not actively regulate the voltage at the PCC while in parallel with SDG&E's Distribution System. The GF shall not cause the service voltage at other customers to go outside the requirements of ANSI C84.1-1995, Range A (IEEE1547-4.1.1).

Operating Voltage Range - The voltage ranges in Table 1 below define protective trip limits for the protective function and are not intended to define or imply a voltage regulation function. Generating Facilities shall cease to energize SDG&E's Distribution System within the prescribed trip time whenever the voltage at the PCC deviates from the allowable voltage operating range. The protective function shall detect and respond to voltage on all phases to which the Generating Facility is connected.

1) **Generating Facilities (30 kVA or less**) - Generating Facilities with a Gross Nameplate Rating of 30 kVA or less shall be capable of operating within the

voltage range normally experienced on SDG&E's Distribution System from 114V to 126V on a 120V base, at the service panel or PCC. The trip settings at the generator terminals may be selected in a manner that minimizes nuisance tripping between 106 volts and 132 volts on a 120-volt base (88%-110% of nominal voltage) to compensate for voltage drop between the generator terminals and the PCC. Voltage may be detected at either the PCC or the Point of Interconnection. However, the normal operating voltage range at the PCC, with the generator on-line, shall stay within +/- 5% of nominal voltage.

- 2) Generating Facilities (greater than 30 kVA) SDG&E may have specific operating voltage ranges for Generating Facilities with Gross Nameplate Ratings greater than 30 kVA, and may require adjustable operating voltage settings. In the absence of such requirements, the Generating Facility shall operate at a range between 88% and 110% of the applicable interconnection voltage. Voltage shall be detected at either the PCC or the Point of Interconnection, with settings compensated to account for the voltage at the PCC. However, the normal operating voltage range at the PCC, with the generator on-line, shall stay within +/- 5% of nominal voltage.
- 3) **Voltage Disturbances -** Whenever SDG&E's Distribution System voltage at the Point of Common Coupling varies from and remains outside normal (nominally 120 volts) by the predetermined amounts set forth in Table 1, the Generating Facility's protective functions shall cause the Generator(s) to become isolated from SDG&E's Distribution System.

Common Coupling (t used to trip the gener	r Terminal or Point of the ranges below are rator during abnormal tions)	Maximum Trip Time [1]		
Assuming 120 V Base	% of Nominal Voltage	# of Cycles (Assuming 60Hz Nominal)	Seconds	
Less than 60 Volts	Less than 50%	10 Cycles	0.16 Seconds	
Greater than or equal to 60 Volts but less than 106 Volts	Greater than or equal to 50% but less than 88%	120 Cycles	2 Seconds	
Greater than 132 Volts but less than or equal to 144 Volts	Greater than 110% but less than or equal to 120%	60 Cycles	1 Second	
Greater than 144 Volts	Greater than 120%	10 Cycles	0.16 Seconds	

Table 1:	Voltage	Trip	Settings
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[1] -"Maximum Trip time" refers to the time between the onset of the abnormal condition and the Generating Facility ceasing to energize SDG&E's Distribution System. Protective function sensing equipment and circuits may remain connected to SDG&E's Distribution System to allow sensing of electrical conditions for use by the "reconnect" feature. The purpose of the allowed time delay is to allow a Generating Facility to "ride through" short-term disturbances to avoid nuisance tripping. Set points shall not be user adjustable (though they may be field adjustable by qualified personnel). For Generating Facilities with a Gross Nameplate Rating greater than 30 kVA, set points shall be field adjustable and different voltage set points and trip times from those in Table 1 may be negotiated with SDG&E.

Paralleling - The Generating Facility shall parallel with SDG&E's Distribution System without causing a voltage fluctuation at the PCC greater than $\pm 5\%$ of the prevailing voltage level of SDG&E's Distribution System, and meet the flicker requirements of this section. (IEEE1547-4.1.3)

Flicker - The Generating Facility shall not create objectionable flicker for other customers on SDG&E's Distribution System. To minimize the adverse voltage effects experienced by other customers (IEEE1547-4.3.2), flicker at the Point of Common Coupling caused by the Generating Facility should not exceed the limits defined by the "Maximum Borderline of Irritation Curve" identified in IEEE 519-1992 (IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, IEEE STD 519-1992, Institute of Electrical and Electronic Engineers, Piscataway, NJ). This requirement is necessary to minimize the adverse voltage affects experienced by other customers on SDG&E's Distribution System. Generators may be connected and brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded.

Integration with SDG&E's Distribution System Grounding - The grounding scheme of the Generating Facility interconnection shall not cause overvoltages that exceed the rating of the equipment connected to SDG&E's Distribution System, and shall not disrupt the coordination of the ground fault protection on the SDG&E's Distribution System (IEEE1547-4.1.2) (See Section I.3.h). The gas standard must be followed where electrical equipment is in the vicinity of the gas meter assembly. Any electrical connection to SDG&E's gas equipment is a violation of the Code and is unsafe. Electric bonding to SDG&E's gas service pipes, gas riser, or gas meter assembly is <u>not permitted</u> (Gas Standard page 1003).

Frequency - SDG&E controls system frequency, and the Generating Facility shall operate in synchronism with the SDG&E's Distribution System. Whenever SDG&E's Distribution System frequency at the Point of Common Coupling varies from and remains outside normal (nominally 60 Hz) by the predetermined amounts set forth in Table 2 below, the Generating Facility's protective functions shall cease to energize SDG&E's Distribution System within the stated maximum trip time.

Generating Facility Rating:	Frequency Rating (60Hz Nominal)	Maximum Trip Time [1] (Assuming 60 Cycles per Second)
	Less than 59.3 Hz	10 Cycles
Less or equal to 30kW	Greater than 60.5 Hz 10 Cycles	
	Less than 57.0 Hz	10 cycles
Greater than 30kW	Less than an adjustable value between 59.8 Hz and 57 Hz but greater than 57 Hz. [2]	Adjustable between 10 and 18,000 Cycles. [2, 3]
	Greater than 60.5 Hz	10 Cycles

Table 2: Frequency Trip Settings

- [1] -"Maximum Trip time" refers to the time between the onset of the abnormal condition and the Generating Facility ceasing to energize SDG&E's Distribution System. Protective function sensing equipment and circuits may remain connected to SDG&E's Distribution System to allow sensing of electrical conditions for use by the "reconnect" feature. The purpose of the allowed time delay is to allow a Generating Facility to "ride through" short-term disturbances to avoid nuisance tripping. Set points shall not be user adjustable (though they may be field adjustable by qualified personnel). For Generating Facilities with a Gross Nameplate Rating greater than 30 kVA, set points shall be field adjustable and different voltage set points and trip times from those in Table 2 may be negotiated with SDG&E.
- times from those in Table 2 may be negotiated with SDG&E. [2] - Unless otherwise required by SDG&E, a trip frequency of 59.3 Hz and a maximum trip time of 10 cycles shall be used.
- [3] When a 10 cycle Maximum trip time is used, a second under frequency trip setting is not required.

Harmonics - When the Generating Facility is serving balanced linear loads, harmonic current injection into SDG&E's Distribution System at the PCC shall not exceed the limits stated below in Table 3 below. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in SDG&E's Distribution System without the Generating Facility connected (IEEE1547-4.3.3). The harmonic distortion of a Generating Facility located at a Customer's site shall be evaluated using the same criteria as for the Host Loads.

Individual harmonic order, h (odd harmonics) [1]	h < 11	11 ≤ h < 17	17 ≤ h < 23	$23 \le h < 35$	35 ≤ h	Total demand distortion (TDD)
Max Distortion (%)	4.0	2.0	1.5	0.6	0.3	5.0

Table O. Marshause	the second secon	
Table 3: Maximum	harmonic current distortion in	percent of current (I) [1,2]

[1] - Even harmonics are limited to 25% of the odd harmonic limits above.

Direct Current Injection - Generating Facilities should not inject direct current greater than 0.5% of rated output current into SDG&E's Distribution System.

Power Factor - Each Generator in a Generating Facility shall be capable of operating at some point within a power factor range from 0.90 leading to 0.90 lagging. Operation outside this range is acceptable provided the reactive power of the Generating Facility is used to meet the reactive power needs of the Host Loads, or that reactive power is otherwise provided under tariff by SDG&E. The Owner/Operator shall notify SDG&E if it is using the Generating Facility for power factor correction. Unless otherwise agreed upon by the Owner/Operator and SDG&E, Generating Facilities shall automatically regulate power factor, not voltage, while operating in parallel with SDG&E's Distribution System.

3.4 **Technology Specific Requirements**

Three-Phase Synchronous Generators - For three-phase Generators, the Generating Facility circuit breakers shall be three-phase devices with electronic or electromechanical control. The Owner/Operator shall be responsible for properly synchronizing its Generating Facility with SDG&E's Distribution System by means of either manual or automatic synchronizing equipment. Automatic synchronizing is required for all synchronous Generators that have a Short Circuit Contribution Ratio (SCCR) exceeding 0.05. Loss of synchronism protection is not required except as may be necessary to meet flicker requirements (IEEE1547-4.2.5). Unless otherwise agreed upon by the Owner/Operator and SDG&E, synchronous Generators shall automatically regulate power factor, not voltage, while operating in parallel with SDG&E's Distribution System. A power system stabilization function is

specifically not required for Generating Facilities under 10 MW Net Nameplate Rating.

Induction Generators - Induction Generators (except self-excited Induction Generators) do not require a synchronizing function. Starting or rapid load fluctuations on induction generators can adversely impact SDG&E's Distribution System's voltage. Corrective step-switched capacitors or other techniques may be necessary and may cause undesirable ferro-resonance. When these counter measures (e.g., additional capacitors) are installed on the Owner/Operator's side of the Point of Common Coupling, SDG&E must review these measures. Additional equipment may be required as determined in an interconnection review or an Interconnection Study.

Inverters - Utility-interactive inverters do not require separate synchronizing equipment. Non-utility-interactive or "stand-alone" inverters shall not be used for Parallel Operation with SDG&E's Distribution System.

Single-Phase Generators - For single-phase Generators connected to a shared single-phase secondary system, the maximum Net Nameplate Rating of the Generating Facilities shall be 20 kVA. Generators connected to a center-tapped neutral 240-volt service must be installed such that no more than 6 kVA of imbalanced power is applied to the two "legs" of the 240-volt service. For Dedicated Distribution Transformer services, the maximum Net Nameplate Rating of a single-phase Generating Facility shall be the transformer nameplate rating.

3.5 Inverter Specifications

Reactive Power - The inverter shall be capable of operating in the following reactive power modes:

Dynamic power factor: Inverter shall be capable of operating dynamically at a minimum power factor range of +/- .85 PF for larger systems (>15 kW), +/- 0.90 PF for smaller systems (≤15 kW), and a preferred power factor range of +/- 0.10 PF. Figure 4 below illustrates the preferred power factor range of +/- 0.10 PF.

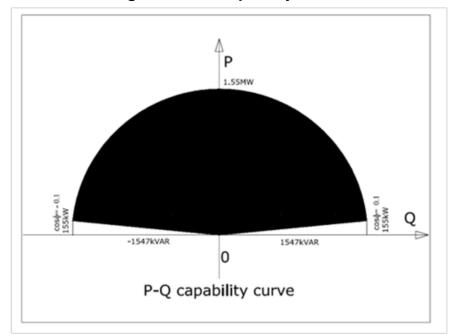


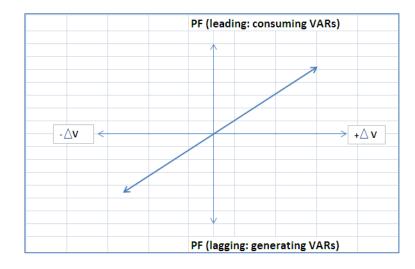
Figure 4: P-Q Capability Curve

- Dynamic VAR output or input:
 - Inverter shall autonomously prevent line voltage changes from exceeding 2% at the point of common coupling (PCC) due to a loss of generation, or due to an increase in generation output. Inverter output shall not cause the line voltage at the point of common coupling to go outside the requirements of the latest version of ANSI C84.1, Range A.
 - Dynamic VAR output/input function shall not operate within a total deadband of 2% (i.e. a range of +/-1%) of line voltage at the PCC.
- Autonomous operations described above may be superseded by an external signal issued by distribution system operator.

The reactive power output of the inverter must be dynamic and adjustable. It must be possible to provide the prescribed reactive power compensation within the following time constraints:

- Within 10 seconds if reactive power setting is prescribed by autonomous control
- Within 5 seconds if reactive power setting is prescribed by external signal which will supersede autonomous settings.
- No change in reactive compensation shall occur unless the voltage changes outside the deadband range of 2% (+/-1%)

The inverter shall consume reactive power in response to an increase in line voltage, and generate reactive power in response to a decrease in line voltage. An example of the desired correlation between reactive power output and changes in line voltage is shown below.



Low Voltage Ride-Through:

Inverters shall stay connected to the electric grid, and shall disconnect from the electric grid during a high or low voltage event, in compliance with the parameters shown in the following table and graph:

Voltage Level	Stay Connected Until	Voltage level	Disconnect by
>1.17	0.1 sec	>1.2	0.16
1.07-1.17	12 sec.	1.1 - 1.2	13 sec
0.92-1.07	Indefinite	0.6 - 0.88	21 sec
0.7 - 0.92	20 sec	0.45 - 0.6	11 sec
0.5 - 0.7	10 sec	0 - 0.45	0.16 sec
0 - 0.5	0.1 sec		

Table 4: Low Voltage Ride-Through Percent of Nominal



Randomization of Inverter Disconnect and Reconnect

If voltage limits are exceeded and inverter disconnection is imminent, disconnection shall employ timing randomization so that multiple inverters do not disconnect simultaneously for the same system voltage disturbance. And after such disconnection, inverters shall reconnect using timing randomization to avoid multiple inverters connecting simultaneously after a system disturbance. The randomization of timing for disconnection and reconnection scenarios shall be:

- Disconnection: If voltage limits are exceeded, inverters shall disconnect at a random time during a window of an additional 0 to 10% beyond the elapsed time from initial fault.
- Reconnection: After an inverter has disconnected due to a system disturbance, it will reconnect at a random time during a window of an additional 0 to 10 seconds beyond the earliest allowable reconnection time.

Extended Frequency Ride-Through:

Inverters shall accommodate, at a minimum, underfrequency and overfrequency operation in compliance with the WECC Off Nominal Frequency Load Shedding Plan, as provided in the table below. In general the inverter would not trip off line at any frequency greater than 57 Hz or less than 60.3 Hz.

Underfrequency Limit	Overfrequency Limit	nit Minimum Time*	
>59.4 Hz	< 60.6 Hz	N/A (continuous operation)	
≤59.4 Hz	≥60.6 Hz	3 minutes	
≤58.4 Hz	≥61.6 Hz	30 seconds	
≤57.8 Hz		7.5 seconds	
≤57.3 Hz		45 cycles	
≤57.0 Hz	≥61.7 Hz	Instantaneous trip	

WECC Off Nominal Frequency Load Shedding Limits

* Minimum Time is the time the inverter should stay interconnected with the PV generator power being supplied to the grid.

Communications:

Inverters will have communications capabilities and security control mechanism that will comply with all applicable System Requirements (SRs) of standard ISA 99.03.03 for Security for Industrial Automation and Control Systems: System Security Requirements and Security Assurance Levels, Draft 2, Edit 30, published September 2010. It is also desirable (but not required) that the inverter and its associated computing components shall be ISA-099 certified/accredited.

3.6 Supplemental Generating Facility Requirements

Fault Detection - A Generating Facility with an SCCR exceeding 0.1 or one that does not cease to energize SDG&E's Distribution System within two seconds of the formation of an Unintended Island shall be equipped with protective functions designed to detect Distribution System faults, both line-to-line and line-to-ground, and shall cease to energize SDG&E's Distribution System within two seconds of the initiation of a fault.

Will have to implement directional overcurrent and line ground fault detection in the existing relays. Requires replacement of existing open delta VTs with wye-wye VTs. **Transfer Trip** - For a Generating Facility that cannot detect Distribution System faults (both line-to-line and line-to-ground) or the formation of an Unintended Island, the facility must cease to energize SDG&E's Distribution System within two seconds. SDG&E may require a Transfer Trip system or an equivalent Protective Function.

Reclose Blocking - Where the aggregate Generating Facility capacity exceeds 15% of the maximum rating of any automatic reclosing device, SDG&E may require additional protective functions, including, but not limited to, reclose-blocking on some of the automatic reclosing devices.

Unknown if required until SDG&E performs interconnection study.

4 Operating Requirements

4.1 Generator Step-up Transformer

The available voltage taps of a Generating Unit's step-up transformer must be reviewed by SDG&E for their suitability with SDG&E's system. The Generator is to request this review before acquiring the transformer.

SDG&E shall determine which voltage taps would be suitable for a step-up transformer for the Generator's proposed project. Suitable taps are required to give the transformer the essential capacity for the generator to:

- Deliver maximum reactive power to SDG&E's system at the point of interconnection (generator operating at 90 percent lagging power factor) and,
- Absorb maximum reactive power from SDG&E's system (generator operating at 95 percent leading power factor).

The Generating Unit's transformer, with correct voltage taps, helps maintain a specified voltage profile on SDG&E's system for varying operating conditions. Actual voltage tap settings can be different for transformers connected at the same voltage level, depending upon their geographic location.

4.2 **Power Quality Requirements**

Voltage Fluctuation Limits - A generator connected to the SDG&E system must not cause harmful voltage fluctuations or interference with service and communication facilities. Any generating facility that does so is subject to being disconnected from the SDG&E system until the condition has been corrected.

Harmonics Limits - All generators shall comply with the voltage and current harmonic limits specified in IEEE Standard 519-1992, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems".

- The harmonic content of the voltage and current waveforms in the SDG&E system must be restricted to levels which do not cause interference or equipment-operating problems for SDG&E or its customers.
- Many methods may be used to restrict harmonics. The preferred method is to install a transformer with at least one delta connection between the generator and the SDG&E system. This method significantly limits the amount of voltage and current harmonics entering the SDG&E system. Generation system configuration with a wye-grounded generator and a two-winding (both wye-grounded) transformer shall not be allowed.
- When the Generating Facility is serving balanced linear loads, harmonic current injection into SDG&E's Distribution System at the PCC shall not exceed the limits stated in Table 3 shown in Section 3.3 of this handbook. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in SDG&E's Distribution System

without the Generating Facility connected (IEEE 1547-4.3.3). The harmonic distortion of a Generating Facility located at a Customer's site shall be evaluated using the same criteria as for the Host Loads.

4.3 Under-frequency Operation

SDG&E controls system frequency, and the Generating Facility shall operate in synchronism with SDG&E's Distribution System. Whenever SDG&E's Distribution System frequency at the PCC varies from and remains outside of the normal (nominally 60 Hz) by the predetermined amounts set forth in Table 2 shown in Section3.3, the Generating Facility's Protective Functions shall cease to energize SDG&E's Distribution System within the stated maximum trip time.

5 Operating Procedures

5.1 **CVR Standards**

In 1977, the CPUC mandated the Conservation Voltage Reduction (CVR) standards. Approximately 95% of SDG&E substations are CVR and the remaining are NON-CVR. For CVR substations, the voltage maximum limit is 12.3kV and the adjustable voltage range shall be 11.9kV to 12.3kV. For NON-CVR substations, the voltage maximum limit is 12.6kV and the adjustable voltage range shall be 12.1kV to 12.6kV. The specific voltage set point will be provided to the interconnect customer after completion of load flow modeling with the generator on the distribution circuit.

5.2 Voltage Control Operation and Other Service Requirements

The Generating facility operator shall operate any voltage control (i.e., generator controls, shunt capacitors) at the direction of the SDG&E Designated Control Center and in accordance with applicable provisions of applicable agreements, applicable tariff(s), CAISO requirements if required and other electric service schedules. The facility operator shall insure the orders are understood and passed on to subsequent shift operator as appropriate to insure that any relief or backup operator is aware of the current SDG&E voltage instruction. The Generator is responsible for the safe operation and interruption and de-energization of the customer-owned voltage control devices when required.

Whenever primary relays or protective devices are out of service, backup or secondary relays must be available to clear faults. When restoring any relays that have been out of service, the Generator's designated representative shall verify that the contacts of any such relays, which are normally open, are in fact open. The Generator must ensure that relays do not have standing trip output.

5.3 Unusual or System Emergency Conditions

SDG&E is responsible for complying with all directions from the CAISO regarding management and alleviation of the System Emergency, unless such compliance would impair the Health and Safety of personnel or the general public. As directed by the CAISO, SDG&E will be responsible for communicating with Generating Facilities regarding emergencies. Unusual operating conditions or other factors that have affected or may affect SDG&E's electric system (e.g., abnormal voltages or loading or unbalanced loading) must be reported to the SDG&E Designated Control Center as soon as possible. Conditions imperiling life or property shall be reported to the SDG&E Designated Control Center immediately.

6 Energization and Synchronization Requirements

6.1 Purpose

The following is SDG&E's procedure for performing pre-parallel inspections and preparing to energize and synchronize the generator to SDG&E's Distribution System. All time requirements must be met for SDG&E to provide the Generating Units with timely service.

Any inspections required by local government agencies must be completed and permits signed off prior to the pre-parallel date. Failure to meet the succeeding requirements within the timeframes specified may result in a delay to successful operations parallel to the SDG&E system.

6.2 **Design Review and Interconnection Facilities Inspection**

SDG&E shall have the right to review the design of an Owner/Operator's Generating and Interconnection Facilities and to inspect an Owner/Operator's Generating and/or Interconnection Facilities prior to the commencement of Parallel Operation with SDG&E's Distribution System. SDG&E may require an Owner/Operator to make modifications as necessary to comply with the requirements of this Handbook. SDG&E's review and authorization for Parallel Operation shall not be construed as confirming or endorsing the Owner/Operator's design, nor as warranting the Generating and/or Interconnection Facility's safety, durability or reliability. SDG&E shall not, by reason of such review or lack of review, be responsible for the strength, adequacy, or capacity of such equipment.

6.3 Pre-parallel Testing

Commissioning Testing, where required, will be performed on-site to verify protective settings and functionality. Upon initial Parallel Operation of a Generating Facility, or any time interface hardware or software is changed that may affect the functions listed below, a Commissioning Test must be performed. An individual qualified in testing protective equipment (professional engineer, factory-certified technician, or licensed electrician with experience in testing protective equipment) must perform Commissioning Testing in accordance with the manufacturer's recommended test procedure to verify the settings and requirements per this handbook.

SDG&E may require that a written commissioning test procedure be submitted at least 10 working days prior to the performance of the commissioning test. SDG&E has the right to witness Commissioning Tests. SDG&E may also require written Certification by the installer describing which tests were performed and their results. Protective Functions to be tested during commissioning, particularly with respect to non-Certified Equipment, may consist of the following:

- Over and under voltage
- Over and under frequency

- Anti-Islanding Function (if applicable)
- Non-Export Function (if applicable)
- Inability to energize dead line
- Time delay on restart after utility source is stable
- Utility system fault detection (if used)
- Synchronizing controls (if applicable)
- Other Interconnection Protective Functions that may be required as part of the Interconnection Agreement

Commissioning Test shall include visual inspections of the interconnection equipment and protective settings to confirm compliance with the interconnection requirements.

Other checks and tests that may need to be performed include:

- Verifying final Protective Function settings
- Trip test
- In-service test

6.3.1 Certified Equipment

Generating Facilities qualifying for Simplified Interconnection must incorporate Certified Equipment that has, at a minimum, passed the Type Tests and Production Tests described in this handbook and are judged to have little or no potential impact on SDG&E's Distribution System. For such Generating Facilities, it is necessary to perform the following tests:

- Protective function settings that have been changed after Production Testing will require field verification. Tests shall be performed using injected secondary frequencies, voltages and currents, applied waveforms, a test connection using a Generator to simulate abnormal utility voltage or frequency, or varying the set points to show that the device trips at the measured (actual) utility voltage or frequency.
- 2) The Non-Islanding Function will be checked by operating a load break disconnect switch to verify the Interconnection equipment ceases to energize SDG&E's Distribution System and does not re-energize it for the required time delay after the switch is closed.
- 3) The Non-Exporting Function shall be checked using secondary injection techniques. This function may also be tested by adjusting the Generating

Facility output and local loads to verify that the applicable Non-Exporting criteria (i.e., reverse power or under power) are met.

The Supplemental Review or an Interconnection Study may impose additional components or additional testing.

6.3.2 Non-Certified Equipment

Non-Certified Equipment shall be subjected to the appropriate tests described in Rule 21 under Type Testing (Section J.3.) as well as those described in Certified Equipment Commissioning Tests (Section J.5.c.). With SDG&E's approval, these tests may be performed in the factory, in the field as part of commissioning, or a combination of both. SDG&E, at its discretion, may also approve a reduced set of tests for a particular Generating Facility or, for example, if it determines it has sufficient experience with the equipment.

6.3.3 Verification of Settings

At the completion of Commissioning testing, the Owner/Operator shall confirm all devices are set to SDG&E-approved settings. Verification shall be documented in the Commissioning Test Certification.

6.4 Requirements for Commercial (Parallel) Operation

An Owner/Operator's Generating Facility and Interconnection Facilities shall be reasonably accessible to SDG&E personnel as necessary for SDG&E to perform its duties and exercise its rights under its tariffs approved by the Commission, and any Interconnection Agreement between SDG&E and the Owner/Operator.

An Owner/Operator shall operate and maintain its Generating Facility and Interconnection Facilities in accordance with Prudent Electrical Practices and shall maintain compliance with this Handbook.

SDG&E may limit the operation, disconnect, or require the disconnection of an Owner/Operator's Generating Facility from SDG&E's Distribution System at any time, with or without notice, in the event of an Emergency, or to correct Unsafe Operating Conditions. SDG&E may also limit the operation, disconnect, or require the disconnection of an Owner/Operator's Generating Facility from SDG&E's Distribution System upon the provision of reasonable written notice: 1) to allow for routine maintenance, repairs or modifications to SDG&E's Distribution System; 2) upon SDG&E's determination that a Owner/Operator's Generating Facility is not in compliance with this Handbook and any applicable tariffs or rules that apply to the interconnection; or 3) upon termination of the Interconnection Agreement. Upon the Owner/Operator's written request, SDG&E shall provide a written explanation of the reason for such curtailment or disconnection.

6.4.1 Trip Tests

Interconnection Protective Functions and devices (e.g., reverse power relays) that have not previously been tested as part of the Interconnection Facilities with their associated interrupting devices (e.g. contactor or circuit breaker) shall be trip tested during commissioning. The trip test shall be adequate to prove that the associated interrupting devices open when the protective devices operate. Interlocking circuits between Protective Function devices or between interrupting devices shall be similarly tested unless they are part of a system that has been tested and approved during manufacturing.

6.4.2 In-service Tests

Interconnection Protective Functions and devices that have not previously been tested as part of the Interconnection Facilities with their associated instrument transformers or that are wired in the field shall be given an in-service test during commissioning. This test will verify proper wiring, polarity, CT/PT ratios, and proper operation of the measuring circuits. The in-service test shall be made with the power system energized and carrying a known level of current. A measurement of the magnitude and phase angle of each Alternating Current (AC) voltage and current connected to the protective device shall be made and the results shall be compared to expected values. For protective devices with built-in Metering Functions that report current and voltage magnitudes and phase angles, or magnitudes of current, voltage, and real and reactive power, the metered values may be used for in-service testing. Otherwise, portable ammeters, voltmeters, and phase-angle meters shall be used.

6.4.3 Periodic Testing

Periodic Testing of Interconnection-related Protective Functions shall be performed as specified by the manufacturer, or at least every four years. All periodic tests prescribed by the manufacturer shall be performed. The Owner/Operator shall maintain periodic test reports or a log for inspection by SDG&E. Periodic Testing conforming to SDG&E test intervals for the particular Line Section may be specified by SDG&E under special circumstances, such as high fire hazard areas. Batteries used to activate any Protective Function shall be checked and logged once per month for proper voltage. Once every four years, these batteries must be replaced or a discharge test must be performed.

7 Attachments

7.1 Tariffs

SDG&E offers open access, wholesale distribution service to eligible customers, under the rates, terms and conditions set forth by the CPUC, California Public Utilities Commission. Below is the link to the SDG&E Wholesale Distribution Open Access Tariff (WDAT) outlining integration of Distribution SGIP, Small Generator Interconnection Procedures, and Distribution LGIP, Large Generator Interconnection Procedures, to the WDAT.

http://www.sdge.com/rates-regulations/tariff-information/open-access-ferc-tariffs

7.2 Interconnection Applications

For an interconnection to the distribution system for a project that *does not* intend to resell the power generated back to the market, a Rule 21 Interconnection Application is required to be completed and issued to SDG&E. Upon receipt of the application, SDG&E will review the request as outlined in Rule 21. Below is an internet link to the application document and other information about interconnection.

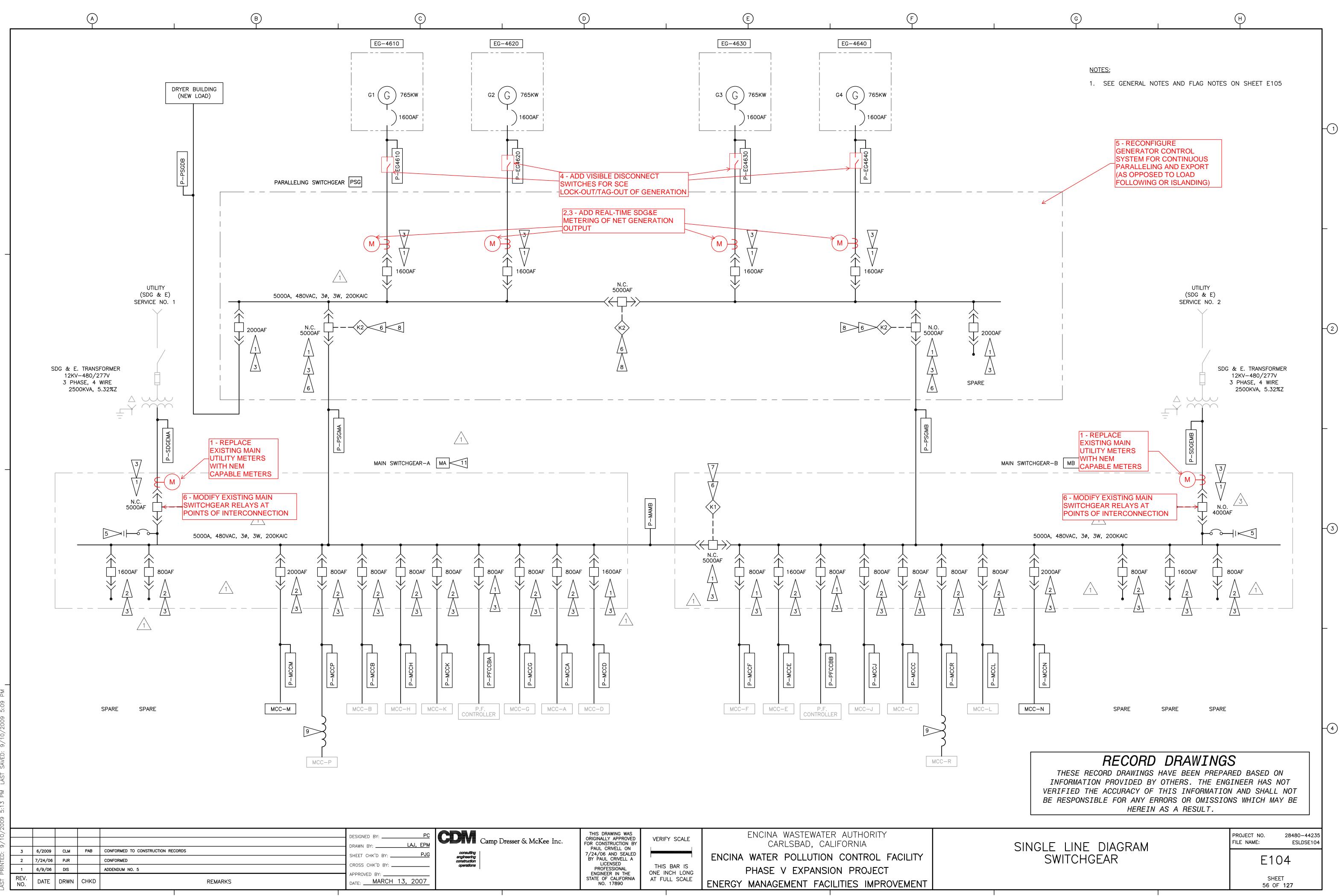
http://www.sdge.com/rates-regulations/tariff-information/open-access-ferc-tariffs

For an interconnection to the distribution system that intends to resell the power generated back to the market and the project is no larger than 20 MW in size, a Small Generation Interconnection Procedures (SGIP) Interconnection Application from SDG&E's Wholesale Distribution Open Access Tariff (WDAT) is required to be completed and submitted to SDG&E. Upon receipt of the application, SDG&E will review the request as outlined in the SGIP WDAT tariff.

For an interconnection to the distribution system for a project that intends to resell the power generated back to the market and is larger than 20 MW in size, a Large Generation Interconnection Procedures (LGIP) Interconnection Application from SDG&E's Wholesale Distribution Open Access Tariff (WDAT) is required to be completed and submitted to SDG&E. Upon receipt of the application, SDG&E will review the request as outlined in the LGIP WDAT tariff.

Below, and as shown in section 7.1, is an internet link that contains the WDAT application documents and summaries as well as other information about generation interconnections to SDG&E's system.

http://www.sdge.com/rates-regulations/tariff-information/open-access-ferc-tariffs





Technical Memorandum

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FINAL

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- Project title: Biosolids, Energy, and Emissions
- Project no.: 150871.004

Technical Memorandum 4

- Subject: Technology Evaluations for Biogas Production
- Date: February 14, 2018
- To: Scott McClelland, Assistant General Manager
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Limitations:

This document was prepared solely for Encina Wastewater Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between Encina Wastewater Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by Encina Wastewater Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Encina Wastewater Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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- Tracy Chouinard, Ph.D.
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- William Pevec, Staff Engineer



Table of Contents

List of Figures	ii
List of Tables	iii
List of Abbreviations	iv
Executive Summary	v
Section 1: Introduction	1-1
1.1 TM 4 Purpose and Scope	1-1
1.2 Background Information	1-1
Section 2: Identification and Screening of Technologies for Gas Treatment	2-1
2.1 Gas Treatment for Internal-Combustion Engines	
2.1.1 Gas Conditioning	
2.1.2 Gas Conditioning and Exhaust Treatment	
2.2 Biogas Upgrades for Pipeline Injection or Vehicle Fuel	
2.3 Fatal-Flaw Screening and Evaluation of Gas Treatment	
Section 3: Identification and Screening of Technologies for Gas Storage	
3.1 Identification of Applicable Technologies	
3.1.1 Piston-Type Gas Holder	
3.1.2 Dual-Membrane Gas Storage	
3.2 Fatal-Flaw Screening and Evaluation of Gas Storage	
Section 4: Increased Gas Production: WAS Pretreatment	
4.1 Identification of Treatment Technologies for WAS Pretreatment	
4.1.1 Ultrasonic Pretreatment4.1.2 Electrokinetic Disintegration	
4.1.2 Electrokinetic Disintegration4.1.3 Thermal Hydrolysis	
4.1.3 Mechanical Pretreatment	
4.2 Fatal-Flaw Screening of WAS Pretreatment Technologies	
4.3 Conclusions	
Section 5: Increased Gas Production: Co-digestion	
5.1 Co-digestion Feedstocks and Typical Characteristics	
5.2 Initial Estimation of Acceptable Co-Digestion Volumes	
5.3 Results of Initial Outreach to Feedstock Providers	
Section 6: Digester Gas Management and Dryer Control	6-1
Section 7: Conclusions and Next Steps	
ReferencesF	

Brown AND Caldwell

Attachment A: Workshop Meeting Minutes	. A-1
Attachment B: Evaluation of Alternative Fuel Digester Loading Strategy	.B-1
Attachment C: Pre-Processed SSO Characteristics	.C-1
Attachment D: Co-digestion Capacity Calculations	.D-1

List of Figures

Figure 2-1. Gas conditioning system at the Santa Rosa Laguna Treatment Plant, including H ₂ S removal vessels, siloxane removal vessels, and chillers	. 2-2
Figure 2-2. Process flow diagram for a typical gas conditioning system. Configurations may vary, depending on equipment suppliers and treatment needs	. 2-2
Figure 2-3. Biogas upgrading system at San Mateo WWTP (California) using Unison's BioCNG system, which includes H ₂ S removal, moisture removal, compression, siloxane removal, and membrane separation	. 2-4
Figure 3-1. Piston-type gas holder installed at SJSCRWF with 50,000 cubic feet of active storage	.3-1
Figure 3-2. Dystor® gas holder system from Evoqua Water Technologies example installation	. 3-2
Figure 4-1. Schematic of key components of a Sonolyzer™ unit	.4-1
Figure 4-2. Section view of a BioCrack® module	. 4-2
Figure 4-3. Schematic of LysoTherm™ process	. 4-3
Figure 4-4. Crown™ disintegration system at Rosedale WWTP, North Shore, New Zealand	. 4-4



ii

List of Tables

Table ES-1. Biogas Train Enhancements	V
Table 2-1. Raw Biogas Quality at EWPCF	2-1
Table 2-2. Gas Treatment Fatal-Flaw Evaluation	2-5
Table 2-3. Criteria and Weight for Technology Screening	2-5
Table 2-4. Gas Treatment Technologies Scoring Evaluation	2-6
Table 2-5. Biogas Upgrading Potential Assuming Existing Baseline Biogas Production a	2-7
Table 3-1. Advantages and Disadvantages of Piston-Type Gas Holder	3-2
Table 3-2. Advantages and Disadvantages of Dual-Membrane Gas Holder	3-3
Table 3-3. Gas Storage Fatal-Flaw Evaluation	3-3
Table 4-1. WAS Pretreatment Technologies Fatal-Flaw Evaluation	4-4
Table 5-1. Summary of Annual Average Solids Conditions	5-2
Table 5-2. Process Data for Each Solids Stabilization Scenario	5-2
Table 5-3. Results of Capacity Analysis Under Service Conditions a	5-3
Table 5-4. Results of Capacity Analysis Under Full Operational Conditions a	5-4



List of Abbreviations

°C	degree(s) Celsius	Ν	nitrogen
BC	Brown and Caldwell	N/A	not applicable
BEE	Biosolids Energy and Emissions	NG	natural gas
CCR	California Code of Regulations	NH₃	ammonia
CH ₄	methane	NH ₄₊	ammonium
cm	centimeter(s)	NOx	nitrogen oxides
CNG	compressed natural gas	OLR	organic loading rate
CO	carbon monoxide	0&M	operations and maintenance
CO ₂	carbon dioxide	PM _{2.5}	particulate matter with a diameter of less
d	day(s)		than 2.5 micrometers
DG	digester gas		particulate matter with a diameter of less than 10 micrometers
DGE	diesel gallon equivalent	PMP	Process Master Plan
EWA	Encina Wastewater Authority	ppbv	parts per billion by volume
EWPCF	Encina Water Pollution Control Facility	ppmb	parts per million by volume
FOG	fats, oil, and grease	RIN	Renewable Identification Number
ft ³	cubic foot/feet	SB	Senate Bill
GHG	greenhouse gas	scfd	standard cubic foot/feet per day
gpd	gallon(s) per day	scfm	standard cubic foot/feet per minute
H ₂ S	hydrogen sulfide	SCR	selective catalytic reduction
HLR	hydraulic loading rate	SJSCRWF	San José-Santa Clara Regional
HSW	high-strength waste		Wastewater Facility
IC	internal combustion	SOx	sulfur oxides
kHz	kilohertz	SSO	source-separated organics
kV	kilovolt(s)	SWEET	Solids Water Energy Evaluation Tool
kW	kilowatt(s)	THP	thermal hydrolysis process
L	liter(s)	TM	technical memorandum
LACSD	Sanitation Districts of Los Angeles County	TS	total solids
lb	pound(s)	TWAS	thickened waste activated sludge
lb-VS/day	pounds per volatile solids per day	VOC	volatile organic compound
lb-VS/ft ³	pounds per volatile solids per cubic feet	VS	volatile solids
LCFS	Low Carbon Fuel Standard	WAS	waste activated sludge
mg	milligram(s)	WM	Waste Management
MG	million gallons	WWTP	wastewater treatment plant
mgd	million gallons per day		



iv

Executive Summary

The Encina Water Pollution Control Facility (EWPCF) operates an Alternative Fuels Receiving Facility to accept high-strength waste (HSW) that is co-digested with municipal solids to increase biogas production. This Technical Memorandum (TM) 4 provides an evaluation of enhancements to the biogas train including alternative technologies for increasing biogas production, increasing the utilization and recovery of the biogas, and improving the treatment and management of the biogas. Biogas train enhancements include biogas treatment (conditioning), biogas storage, and waste activated sludge (WAS) pretreatment to improve volatile solids reduction and increase biogas production. Screening and ranking of technologies was performed in a workshop on August 16, 2017, with Encina Wastewater Authority (EWA) staff. The technologies that passed the fatal-flaw filter are summarized in Table ES-1. Technologies that did not pass the fatal-flaw filter were eliminated. Those technologies that passed the fatal-flaw filter moved on and were assessed using evaluation criteria developed to reflect EWA's values and goals for the project, which are summarized in Table 2-3.

Table ES-1. Biogas Train Enhancements						
Gas Treatment Technology	Gas Storage Technology	WAS Pretreatment Technology				
Gas conditioning	Piston-type gas holder	WAS-only Cambi THP				
Gas conditioning + exhaust treatment	Dual-membrane gas storage					
Biogas upgrading						

THP = thermal hydrolysis process

In addition, the Brown and Caldwell (BC) team evaluated the possibility of increasing co-digestion of HSW at EWPCF to increase biogas production for use in the alternative power production technologies.



V

Section 1: Introduction

EWA has undertaken a Biosolids Energy and Emissions (BEE) Plan, which will serve to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan (PMP). The BEE Plan has several goals:

- Provide a comprehensive analysis of all project elements, including biosolids treatment, gas use, energy generation, and waste heat
- Address capacity limitations in the solids-handling process at EWPCF
- Assess which alternative is likely to be the most cost-effective and sustainable solution for EWA
- Move EWPCF toward greater energy independence
- Reduce greenhouse gas (GHG) emissions

The purpose of TM 4 is to document the technology screening for co-digestion opportunities, sludge pretreatment technologies, and biogas treatment and storage alternatives. This TM does not provide an alternatives analysis, but provides insight to the methodology and rationale that were used to select alternatives that will move forward for further analysis in the Solids Water Energy Evaluation Tool (SWEET) model development.

1.1 TM 4 Purpose and Scope

TM 4 summarizes the methodology for screening and evaluating biogas train enhancements, the technologies evaluated, and how these alternatives were ranked to determine which would move forward in the SWEET analysis. Biogas train enhancements generally fall into three categories: gas treatment, gas storage, and increased gas production. Those alternatives for gas treatment and storage are necessarily linked to the alternative power production options selected under Task 3 and summarized in TM 3. Co-digestion is compatible with the stabilization alternatives selected under Task 2 and summarized in TM 2, but a range of co-digestion possibilities were explored under Task 4 and are described herein. Recommended technologies and co-digestion operating schemes selected under this task will be advanced for further analysis and will be combined with the solids-handling and waste heat alternatives developed under Tasks 2, 3, and 5. Screening and ranking of technologies was performed in a workshop on September 19, 2017, with EWA staff. Meeting minutes from this workshop are provided as Attachment A.

1.2 Background Information

This TM is based on the conclusions developed in TM 1, which addressed the baseline energy profiles and projections, established a mass balance for the solids-handling system, and evaluated sludge flows and loads projections performed under the PMP. Where preliminary calculations were performed, the baseline data were used in evaluation. As described in Section 1.1, screening and evaluation of solids-processing technologies is described in TM 2, while screening and evaluation of alternative power production technologies is described in TM 3. Only those alternatives for biogas train enhancement that are compatible with technologies selected under Tasks 2 and 3 were evaluated under Task 4.

Additional information regarding EWA's experience with co-digestion is included in a TM written by Trussel Tech (Attachment B) that summarizes EWA's experience with alternative fuels codigestion to date, includes a literature review of alternative fuels codigestion, and presents process monitoring recommendations (Noelte 2017).



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Section 2: Identification and Screening of Technologies for Gas Treatment

This section describes potential gas treatment technologies, including gas treatment for internal-combustion (IC) engines and biogas upgrading for pipeline injection or vehicle fuel, followed by a fatal-flaw screening of gas treatment and rankings of gas treatment technologies.

2.1 Gas Treatment for Internal-Combustion Engines

Four 750-kilowatt (kW) IC engines are currently operated on raw biogas; however, EWPCF typically only runs two engines at a time due to air permit restrictions (discussed in TM 6). When excess biogas is available, it can be sent to the thermal dryer, where it is blended with natural gas (NG). This section discusses gas treatment options that could improve IC engine lifespan and reduce the frequency of maintenance activities for both the engines and thermal dryer.

2.1.1 Gas Conditioning

Biogas typically contains methane (CH₄), carbon dioxide (CO₂), water vapor, hydrogen sulfide (H₂S), ammonia (NH₃), nitrogen (N), volatile organic compounds (VOCs), siloxanes, and trace amounts of other components. Some of these compounds can harm an IC engine and must be removed before combustion. For example, H₂S can cause engine corrosion, and siloxanes oxidize during combustion to form silica particles that can damage an engine. Additionally, the combustion of some compounds, such as H₂S, produces harmful and regulated air pollutants.

Gas treatment system design is driven by raw biogas flowrate, raw biogas quality, and post-treatment requirements. Post treatment requirements are dependent on fuel end use (IC engines, IC engines combined with exhaust treatment, pipeline injection, and direct vehicle fueling); however, all options require low H₂S and siloxane concentrations and minimal water content. Raw biogas quality characteristics at EWPCF are presented in Table 2-1. Components included in the table are H₂S and three of the most common siloxane species (D3, D4, and D5). The data presented in Table 2-1 are from two gas samples taken in 2011 and 2012.

Table 2-1. Raw Biogas Quality at EWPCF						
Sample Date H ₂ S (ppmv) D3 Siloxanes (ppbv) D4 Siloxanes (ppbv) D5 Siloxanes (ppbv)						
December 15, 2011	139	18.4	115	734		
January 23, 2012	125	20.5	433	4,480		
Average	132	19.5	274	2,607		

ppbv = parts per billion by volume; ppmv = parts per million by volume.

The H₂S concentrations are relatively low for biogas, but the observed concentrations still exceed most IC engine inlet specifications, the recommended value for compressed NG (CNG) vehicle fuel (SAE J1616), or the California Rule 30 H₂S limit for pipeline injection. Additionally, even though total siloxane concentrations are relatively moderate for biogas, the raw biogas does not meet most IC engine fuel specifications, siloxane inlet requirements for selective catalytic reduction (SCR), or the California Rule 30 siloxane limit for pipeline injection.



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It should also be noted that modifications to upstream biogas-producing systems may alter raw biogas quality. For example, thermophilic digestion may increase siloxane concentrations, and additional high strength waste quantities may increase H₂S and NH₃ concentrations. If a Cambi thermal hydrolysis processing system is added upstream, significant concentrations of NH₃ may be present in the biogas.

A biogas conditioning system should be designed to meet all the fuel quality requirements for the selected alternative for biogas utilization; partial biogas treatment is not recommended. Typically, biogas conditioning systems include H₂S, moisture, and siloxane removal and compression. Gas conditioning systems can either be engineered in separate components or provided as a whole system by a single equipment vendor, such as Unison Solutions or DMT Clear Gas Solutions. Individually specifying components often allows the design engineer to provide a more flexible layout that can be tailored to space requirements and maintenance access. Packaged systems can be desirable since treatment steps are highly codependent. Figure 2-1 shows an example of a gas conditioning system located at the Santa Rosa Laguna Treatment Plant. A process flow diagram for a sample gas conditioning system is presented in Figure 2-2.



Figure 2-1. Gas conditioning system at the Santa Rosa Laguna Treatment Plant, including H₂S removal vessels, siloxane removal vessels, and chillers

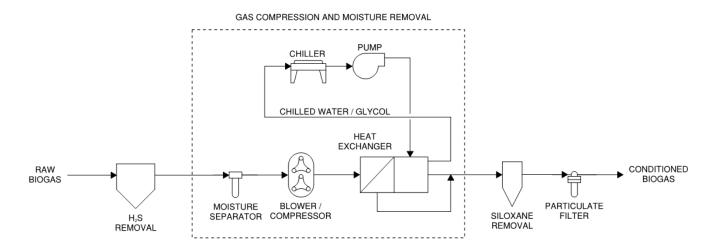


Figure 2-2. Process flow diagram for a typical gas conditioning system. Configurations may vary, depending on equipment suppliers and treatment needs.



H₂S removal is typically the first step in a biogas conditioning system. H₂S is removed using an iron-oxide media, which operates best at ambient temperatures and high moisture content (saturated gas). Thus, raw biogas can be sent through H₂S removal vessels before moisture removal or compression. Multiple types of H₂S removal media are currently available, including iron sponge, SulfaTreat, and granular iron hydroxide. H₂S removal media must be replaced regularly, which incurs additional operating and maintenance costs. Lifespan and maintenance requirements vary among the different media types. H₂S removal systems are sized based on biogas flow rate and the biogas H₂S concentration. At least two vessels are recommended so that one vessel can be taken offline during media removal or maintenance. Multiple vessels may be placed in series to treat biogas with high H₂S concentrations.

NH₃ removal may be required if significant quantities of NH₃ are detected consistently in the biogas. In this case, NH₃ removal vessels would be placed downstream of the H₂S removal vessels. NH₃ concentrations are often not high enough to warrant specialized removal vessels, and NH₃ can be effectively removed via carbon adsorption in the downstream siloxane removal vessels. NH₃ in the biogas increases nitrogen oxide (NO_x) emissions in IC engines. After passing through the H₂S removal vessels, the biogas pressure must be increased and moisture must be removed because siloxane removal systems require a dry gas. Gas pressure must also meet the inlet requirements of the selected utilization alternative. Water is removed from the wet biogas through a moisture removal system that cools the biogas to condense water vapor; liquid water can then be drained and mist can be removed through a moisture separator. Gas pressure can be increased with blowers or compressors, depending on the desired outlet pressure. Compression increases the biogas temperature above the allowable inlet temperature for the downstream activated carbon media. A gas cooling heat exchanger is required after the pressure is boosted; the cooled biogas must then be reheated slightly before entering the siloxane removal system. The reheat step aims to return the biogas to ambient temperature and raise the temperature approximately 20 degrees Fahrenheit above the dew point to prevent condensation. Cooling and reheating can be achieved through a series of heat exchangers or via a single dual-core heat exchanger.

The most common siloxane removal method is adsorption via activated carbon media, which has microscopic pore spaces and a resulting high surface area to particle size ratio. This high ratio makes activated carbon an effective media for adsorbing molecular contaminants. The media typically becomes exhausted after 3 to 6 months and must be replaced regularly, incurring additional operating and maintenance costs. Like H₂S removal, at least two vessels are recommended so that one vessel can be taken offline during media removal or maintenance. Multiple vessels may be placed in series to treat biogas with high siloxane concentrations and to avoid siloxane breakthrough that can harm downstream equipment. Particulate filters are usually installed downstream to capture any activated carbon particles that become suspended in the biogas.

2.1.2 Gas Conditioning and Exhaust Treatment

If modifications to the existing IC engine operation are made, such as increased fuel usage or output above the current air permit limitations, an oxidation catalyst may be required to meet regulatory exhaust limits for carbon monoxide, which are discussed in greater detail in TM 6.A survey of several leading manufacturers of exhaust treatment equipment indicates that to meet exhaust emission requirements, biogas fuel must be treated prior to combustion to limit sulfur species to no more than 20 ppmv and siloxanes to no more than 20 ppbv or non-detect limits. These values are much lower than the raw biogas concentrations presented in Table 2-1.

Prior to reviewing the air permit, SCR systems to meet NO_x limits were previously considered; however, they are not necessary to meet the permit requirements. In addition, installing an SCR system for exhaust treatment would be cost prohibitive as the Power Building would need to be replaced due to space



constraints and a relatively large footprint. On the fatal flaw criteria of compatibility and available space, SCR exhaust treatment fails the fatal flaw filter and will not be carried forward as an alternative.

2.2 Biogas Upgrades for Pipeline Injection or Vehicle Fuel

Biogas upgrading produces biomethane, a renewable NG substitute, which can be used as vehicle fuel in place of CNG or can be injected into a utility NG pipeline. These two biomethane end uses are described further in TM 3. Biogas upgrading first involves gas compression and gas conditioning to remove moisture, H₂S, and siloxanes from the raw biogas, similar to conventional gas conditioning processes described in Section 2.1.1. After contaminants are removed from the gas, the gas goes through a separation process to remove CO₂. The resulting product is a CH₄-rich process gas commonly referred to as biomethane, or renewable NG. Separation systems can be designed to achieve various levels of biomethane purity, up to 99+ percent CH₄. The CO₂ leaves the system in a CH₄-lean tail gas consisting of primarily CO₂ with up to 30 percent of the total biogas CH₄ depending on the gas separation technology used. Tail gas is typically wasted using a flare or thermal oxidizers and may require a supplemental NG feed to help the tail gas combust.

Several biogas separation technologies are available, including membranes, pressure swing adsorption, and water solvents. Figure 2-3 shows an example biogas upgrading system provided by Unison Solutions that utilizes membrane separation. Other typical biogas separation technology manufacturers include Air Liquide, Guild Associates, Greenlane Biogas, and DMT Clear Gas Solutions. These manufacturers typically supply flange-to-flange packaged solutions and design and fabricate the systems in-house. For one of these flange-to-flange systems, the client and design engineer provide a performance specification in which the inlet gas and desired product gas characteristics are described. At EWPCF, a biogas upgrading system specification in a pipeline injection application would include the product gas requirements to meet the standards of California Rule 30. EWA and BC have identified a San Diego Gas & Electric NG pipeline that runs to the north of the plant to potentially tie into if a pipeline injection alternative is selected. TM 3 provides more information on product gas requirements for pipeline injection and direct vehicle fueling.



Figure 2-3. Biogas upgrading system at San Mateo WWTP (California) using Unison's BioCNG system, which includes H₂S removal, moisture removal, compression, siloxane removal, and membrane separation



2.3 Fatal-Flaw Screening and Evaluation of Gas Treatment

The power production alternatives presented in Section 2 were first screened using four fatal-flaw criteria, which were applied uniformly across all technologies. The four criteria developed in conjunction with EWA staff include the following:

- At least one successful North American installation of technology: There must be at least one full-scale installation of the technology at a wastewater treatment plant (WWTP) in North America.
- At least one successful installation and operation in a facility of similar size: The technology should be sufficiently developed that it is applicable at a facility of comparable size to EWPCF to ensure compatibility.
- Available space: The technology must be accommodated within the limited available footprint at EWPCF.
- Compatibility with plant site and any existing equipment: The technology must be capable of being
 integrated into the existing EWPCF infrastructure.

For an alternative to be considered for the ranking process, the alternative must pass all four fatal-flaw criteria. The results of the fatal flaw screening exercise are presented in Table 2-2 and discussed in Section 2.3.

Table 2-2. Gas Treatment Fatal-Flaw Evaluation						
Technology Technology Maturity Successful Operation Available Space Compatibility						
Gas conditioning	Pass	Pass	Pass	Pass		
Gas conditioning + exhaust treatment	Pass	Pass	Fail	Fail		
Biogas upgrading	Pass	Pass	Pass	Pass		

Alternatives that passed the fatal-flaw filter were further evaluated and ranked based on both economic and non-economic screening criteria. The BC team worked with EWA staff to develop a series of evaluation criteria that reflect the project goals, EWA's values, and EWA's general operational practices. Criteria weights were assigned in Workshop 2 with EWA staff. Criteria and weightings are presented in Table 2-3.

Table 2-3. Criteria and Weight for Technology Screening			
Criterion	Description	Scoring Description	Weight
Proven technology performance	Proven and reliable technology with same configuration intended at Encina Long successful operating track record	Low score indicates no successful large-scale operating installations in North America or Europe, no successful demonstration-scale installations in North America or Europe, and unknown safety or reliability record High score indicates more than one successful operating installation in North America or Europe, more than one operating installation at a WWTP of at least 40 mgd in North America or Europe, track record duration > 5 years, and vendors in western United States	20%
Minimize life-cycle costs	Qualitative metric of program cost Capital and O&M costs based on existing EWA data or similar experience at other WWTPs Potential revenues from sales	Low score indicates high capital cost to build onsite facilities, high O&M costs, and low energy recovery efficiency High score indicates low capital cost to build onsite facilities, low O&M costs, and potential revenue	10%



Table 2-3. Criteria and Weight for Technology Screening			
Criterion	Description	Scoring Description	Weight
Energy/resource recovery	Recovery of renewable energy	Low score indicates high energy requirement for onsite technology, technology does not recover energy as biogas, and low-efficiency recovery of renewable energy High score indicates a higher electrical efficiency	25%
O&M impacts	Impacts to existing plant O&M staff levels Complexity of new technology O&M and control systems Reliability of new technology (potential downtime) Minimal impacts to plant safety	Low score indicates more 0&M time required, complex mechanical and control systems required compared with existing plant facilities, potential equipment downtime, and newer hazards High score indicates reduction in 0&M staff time required, new technology is simple to operate and maintain, reliable with minimal downtime, and no new hazards	10%
Environmental impacts	Impacts to carbon footprint and air permitting	Low score indicates high carbon footprint for technology, and new permitting for environmental regulatory requirements High score indicates low carbon footprint for technology, reduced pollutant emissions, and no additional permitting for environmental regulatory requirements	15%
Community and stakeholder impacts	Minimize nuisance impacts such as dust, odors, vectors, aesthetics, noise, and traffic Assess impacts to partner agency issues/values as well as local planning codes and requirements	Low score indicates nuisance factors for onsite technology are difficult to mitigate High score indicates nuisance factors can be mitigated at plant site	10%
Project site compatibility	Assess compatibility of technology with available plant footprint Incorporation into existing treatment process	Low score indicates lack of site space for new facilities, requires abandonment of existing facilities, and difficult integration with existing plant High score indicates available footprint for new facilities and maintains space for future facilities, ease of integration with existing processes and facilities	10%

Table 2-4 shows the scoring results for the gas treatment technologies that passed the fatal-flaw filter. The scores for each alternative were also developed with EWA staff in Workshop 2. All alternatives passed the fatal-flaw filter. The rationale behind the scoring for each technology area is described below.

Table 2-4. Gas Treatment Technologies Scoring Evaluation			
Criterion	Gas Conditioning	Gas Conditioning + Exhaust Treatment	Biogas Upgrading
Proven technology performance	5	4	2
Minimize life-cycle costs	3	4	4
Energy/resource recovery	4	5	4
O&M impacts	4	3	4
Environmental impacts	3	4	5
Community and stakeholder impacts	4	5	5
Project site compatibility	5	4	4
Weighted score	4.05	4.25	3.85



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Biogas upgrading is still considered an emerging technology and has fewer large-scale installations and less established equipment manufacturers. Biogas upgrading alternatives can bring in potential revenue from Low Carbon Fuel Standard (LCFS) and Renewable Identification Number (RIN) credits generated for producing renewable fuel, currently valued between \$1 and \$3 per diesel gallon equivalent produced (every 1 standard cubic foot per minute [scfm] of biogas produces approximately 5 diesel gallon equivalents of fuel per day) in addition to the value of the fuel itself. However, the biogas upgrading alternatives have relatively high capital costs when compared with an engine project, thus, lowering the life-cycle cost score to a 4. The approximate biogas production during the baseline period, potential quantity of renewable NG that can be generated, and potential RINs values associated with biogas upgrading are presented in Table 2-5.

Table 2-5. Biogas Upgrading Potential Assuming Existing Baseline Biogas Production ^a			
Characteristic	Value		
Biogas Production, cfm	500		
Methane recovery, %	99.5		
DGE/day	3,000		
RINs/day	5,000		
\$Revenue/day	12,000		
\$Revenue/year 4.4M			

 Assumes 95% biogas upgrading uptime, RINs value of \$2/RIN and LCFS value of \$0.70/DGE.

DGE = diesel gallon equivalent

Biogas upgrading received the highest score for environmental impacts because biomethane replaces anthropogenic fuels with a biogenic, fully renewable fuel.



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Section 3: Identification and Screening of Technologies for Gas Storage

Biogas storage is used to buffer or control variations in biogas production and maintain steady output from IC engines or other biogas uses. EWPCF has no dedicated biogas storage equipment; however, differences between biogas production and utilization in the existing IC engines are controlled by NG blending. The primary benefit of biogas storage at EWPCF is reducing the need for NG blending and the associated utility costs. Stored biogas from periods of excess production can be used to replace NG in times of low biogas production.

Because EWPCF's current gas management system and NG blending strategy provides effective control of the IC engines and helps utilize nearly all produced biogas, gas storage alternatives do not offer significant savings. It is noted that although NG blending increases NG costs, it provides a greater decrease in power costs due to increased IC engine output.

3.1 Identification of Applicable Technologies

This section identifies two biogas storage options—a piston-type gas holder and a dual-membrane type gas holder on the top of a digester. Both types have been in service for many years.

3.1.1 Piston-Type Gas Holder

The piston-type gas holder has a simple and linear relationship between piston height and stored gas volume. These types of gas holders are proven in the industry and provide reliable and robust storage. Figure 3-1 shows a piston-type gas holder that was installed at the San José-Santa Clara Regional Wastewater Facility (SJSCRWF) and Table 3-1 presents the pros and cons of this type of gas holder.



Figure 3-1. Piston-type gas holder installed at SJSCRWF with 50,000 cubic feet of active storage



Table 3-1. Advantages and Disadvantages of Piston-Type Gas Holder			
Advantages	Disadvantages		
30-year life	High capital cost		
Fixed storage pressure	Dry seal replacement at 15 years a		
Direct/visual measurement of stored volume	Recoat at 15 years		
Reliable operation/signal for blending control			

a. Industry experience shows that dry seal service life can be as long as 29 years, but replacement is recommended after 15 years.

Typically, dedicated gas storage tanks are sized for 10 to 60 minutes of biogas storage. Based on the plant's biogas production, this could result in a new 30- to 50-foot-diameter tank for gas storage, which is not compatible with the plant's available space and, therefore, does not pass the fatal-flaw filter.

3.1.2 Dual-Membrane Gas Storage

Gas storage can also be accomplished by installing a dual membrane above the concrete walls of a digester or on a slab on grade. With a dual-membrane storage system, the outer air membrane remains inflated in a fixed position while the inner membrane moves freely as biogas is stored or removed for use downstream. Figure 3-2 shows an example of a dual-membrane gas holder.



Figure 3-2. Dystor® gas holder system from Evoqua Water Technologies example installation

The dual-membrane type gas holders first came on the market in about 1987. However, dual-membrane gas holders with control signals that represent the gas production/consumption relationship are relatively new and have been in service for only about the last 5 years.

A dual-membrane gas storage system can be installed on top of one of the smaller digesters at EWPCF and can provide a feasible solution if gas storage and a digester cover are required. When installed as a digester cover, the dual-membrane system can double or triple the existing biogas storage space of one of the smaller digesters. Table 3-2 presents the pros and cons of this type of gas holder.



Table 3-2. Advantages and Disadvantages of Dual-Membrane Gas Holder		
Advantages Disadvantages		
Low capital cost	Membrane replacement at 10–20 years a	
Adjustable operating pressure	Level detection is unproven, developing, and different for each manufacturer	
Greater volume, if needed	Less robust than piston-type gas holder	
	Limited fill/draw rates	
	Requires continuous electric blower operation	
	Digester-mounted membranes are difficult to access for repairs	

a. Industry experience shows that membrane service life can be as short as 7 years.

One of the smaller existing EWPCF digesters can be retrofitted to a dual membrane gas holder, which meets the available space and compatibility requirements of the fatal-flaw filter. Dual membrane gas holders have been employed as digester covers at multiple moderate-sized WWTPs, including Yakima Regional WWTP in Washington and the City of Mansfield WWTP in Ohio. As a result, dual membrane gas holders also meet the successful installation requirements of the fatal-flaw filter. Economics will ultimately determine whether a dual membrane gas holder is a feasible gas storage option at EWPCF. If NG savings from better metering of stored biogas can be shown to exceed the capital and operating costs of dual membrane storage, this alternative may be feasible moving forward. Dual membrane gas holders will be further considered in the SWEET analysis.

3.2 Fatal-Flaw Screening and Evaluation of Gas Storage

The same four fatal-flaw criteria presented in Section 2 were applied to the gas storage alternatives. These results are presented in Table 3-3. If gas storage is required, one of the smaller digesters would be retrofitted to serve for the base tank of a dual membrane gas holder.

Table 3-3. Gas Storage Fatal-Flaw Evaluation				
Technology	Technology Maturity	Successful Operation	Available Space	Compatibility
Piston-type gas holder	Pass	Pass	Fail	Fail
Dual membrane gas holder	Pass	Pass	Pass	Pass



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Section 4: Increased Gas Production: WAS Pretreatment

One way to increase biogas production from anaerobic digestion is to condition WAS to make it more readily biodegradable with WAS pretreatment technologies. WAS pretreatment technologies work on different principles to disintegrated cell walls. Some of these technologies have been discussed in TM 2. Technologies screened out in TM 2 were not considered further in this evaluation unless they presented a unique application. Many WAS pretreatment technologies are in research stage and are not commercially available. Those technologies were not included in this evaluation.

WAS pretreatment technologies evaluated in this section include:

- Ultrasonic pretreatment
- Electro kinetic disintegration
- Thermal hydrolysis
- Mechanical pretreatment

Brief introductions and a fatal-flaw screening evaluation of the WAS pretreatment technologies are provided in the following subsections.

4.1 Identification of Treatment Technologies for WAS Pretreatment

The BC team first identified possible WAS pretreatment technologies for incorporation at EWPCF. These are discussed below.

4.1.1 Ultrasonic Pretreatment

The principle of ultrasonic treatment relies on the cavitation generated by probes to disintegrate cell walls and reduce particle size, making WAS easier to digest during the anaerobic digestion process. There are a few commercial ultrasonic pretreatment technologies available, such as Sonix[™] by Sonico and Sonolyzer[™] by Ovivo.

The key components of these ultrasonic pretreatment technologies are similar, typically include a reactor, probes, and a control unit. A schematic depicting the key components of a Sonolyzer[™] unit is shown in Figure 4-1.

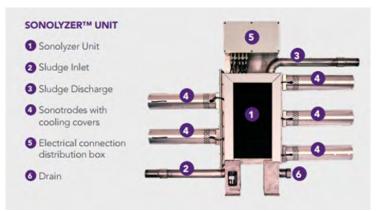


Figure 4-1. Schematic of key components of a Sonolyzer™ unit Courtesy of Ovivo

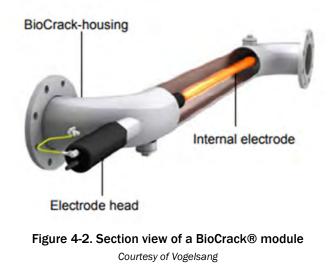


Ultrasonic pretreatment technologies have been tested at bench scale and pilot scale and shown to increase volatile solids (VS) reduction and increase biogas production. However, no full-scale installation has been reported at the time of this evaluation.

4.1.2 Electrokinetic Disintegration

Electrokinetic disintegration technology uses high-voltage of electricity to rupture the cell membranes. Two electrokinetic disintegration technologies have been developed, including BioCrak® and OpenCEL[™]. The OpenCEL[™] system is currently not available as the company filed for bankruptcy a few years ago.

BioCrack® is an electrokinetic disintegration process offered by Vogelsang. During the process, a highvoltage field is generated in the reactor, which breaks up organic matter and bacteria in WAS and makes it easier to digest during the anaerobic digestion process. A BioCrack® system consists of several modules. Each module is made up of three major components, including a housing, electrode, and electrode head, as shown in Figure 4-2. The number of modules in each system is determined by the characteristics of the sludge and digestion process.



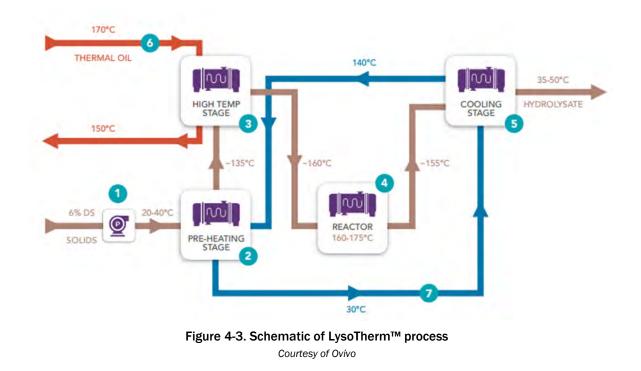
BioCrack® has more than 40 installations, most of which are in biogas plants for silage digestion in Europe. There is no reported municipal WWTP BioCrack® installation in North America.

4.1.3 Thermal Hydrolysis

The thermal hydrolysis process (THP) solubilizes the organic fraction of the sludge and break the cell membranes by submitting it to elevated temperature and pressure. Manufacturers of thermal hydrolysis systems include Cambi, Veolia (BioThelys[™] and Exelys[™]), and Ovivo (LysoTherm[™]). Cambi, Biothelys, and Exelys were evaluated for processing both WAS and primary sludge, which is discussed in TM 2. Within this task, these technologies were evaluated for a WAS-only application.

The LysoTherm[™] thermal pressure hydrolysis system is distributed by Ovivo in North America. It is a continuous process that uses thermal pressure for WAS pretreatment. Sludge is fed into the LysoTherm[™] by means of a feed pump and pressurized between 5 and 10 bar. The sludge is then heated to 160 to 175 degrees Celsius (°C) using thermal oil and held at that temperature for 30 to 60 minutes. Sludge is then cooled and fed to the digesters. Recovered heat is used to preheat the incoming sludge flow. A schematic showing the process flow of the LysoTherm[™] process is shown in Figure 4-3.





The LysoTherm[™] process has several full-scale installations in Europe but no reported installation in North America at the time of this evaluation.

4.1.4 Mechanical Pretreatment

Mechanical pretreatment technologies rely on high pressure and cavitation for cell destruction. The sludge is homogenized, pressurized, and forced through a nozzle, causing cell rupturing. Mechanical pretreatment systems include Crown™ Sludge Disintegration (Evoqua) and MicroSludge™ (Paradigm Environmental Technologies). The MicroSludge™ system is currently not available as Paradigm Environmental Technologies Inc. filed for bankruptcy a few years ago.

The Crown[™] disintegration system is a mechanical WAS pretreatment process distributed in North America by Evoqua. The main principle is cavitation created by operating the system at 12 bar and pumping through a pressure reduction nozzle (the disintegrator). Cavitation occurs in the second part of the nozzle as a result of the sudden pressure drop. Key components of the Crown[™] system include a homogenizer, disintegrator nozzle, pressurization pump, recirculation tank, and discharge pump. An installation of the Crown[™] system is illustrated in Figure 4-4.



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Figure 4-4. Crown™ disintegration system at Rosedale WWTP, North Shore, New Zealand

The Crown[™] system has been installed in approximately 20 facilities, most of which are in Germany. No full-scale installation in North America has been reported at the time of this evaluation.

4.2 Fatal-Flaw Screening of WAS Pretreatment Technologies

The WAS pretreatment technologies presented in Section 4.1 were screened using four fatal-flaw criteria, which were applied uniformly across all technologies. The four criteria developed in conjunction with EWA staff include the following:

- At least one successful North American installation of technology. There must be at least one full-scale installation of the technology at a WWTP in North America.
- At least one successful installation and operation in a facility of similar size. The technology should be sufficiently developed that it is applicable at a facility of comparable size to EWPCF to ensure compatibility.
- Available space. The technology must be accommodated within the limited available footprint at EWPCF.
- **Compatibility with plant site and any existing equipment.** The technology must be capable of being integrated into the existing EWPCF infrastructure.

For an alternative to be considered for the ranking process, the alternative must pass all four fatal-flaw criteria. The fatal-flaw screening results are presented in Table 4-1.

Table 4-1. WAS Pretreatment Technologies Fatal-Flaw Evaluation						
Technology	Technology Maturity	Successful Operation	Available Space	Compatibility		
Sonolyzer™	Fail	Fail	Pass	Pass		
Sonix™	Fail	Fail	Pass	Pass		
BioCrack®	Fail	Fail	Pass	Pass		
OpenCEL™	Fail	Fail	Pass	Pass		
Cambi™: WAS only	Pass	Pass	Pass	Pass		
Exelys™: WAS only	Fail	Pass	Pass	Pass		



Table 4-1. WAS Pretreatment Technologies Fatal-Flaw Evaluation						
Technology	Technology Maturity	Successful Operation	Available Space	Compatibility		
BioThelys™: WAS only	Fail	Pass	Pass	Pass		
LysoTherm™	Fail	Fail	Pass	Pass		
Crown™	Fail	Fail	Pass	Pass		
MicroSludge™	Fail	Fail	Pass	Pass		

4.3 Conclusions

Cambi[™] THP is the only WAS pretreatment technology that passed the fatal-flaw screening. Other technologies failed because of lack of technology maturity and/or successful operation in North America. Cambi[™] THP was evaluated as one of the solids stabilization technologies in TM 2 and was selected for further evaluation. It is important to note that in a WAS-only scenario, Cambi does not produce Class A biosolids. Nevertheless, WAS-only Cambi THP is being carried forward for further analysis.



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Section 5: Increased Gas Production: Co-digestion

Another means of increasing gas production is via the importation of HSW, such as fats, oil, and grease (FOG) and pre-processed food waste. These wastes can be co-digested with sludge to increase biogas production and potentially digester performance. This opportunity is discussed in detail below.

Anaerobic digestion is currently at the nexus of two important State of California goals: organics diversion from landfill and increased renewable energy and fuels generation. Organics diversion from landfill is the primary initiative in the State's 75 percent solid waste recycling goal and is backed up by new regulations, which require source separation and collection of organics (Assembly Bill 1826 and Senate Bill [SB] 1383). The goal of SB 1383 is to reduce CH₄ emissions from landfill and further promote/require organics diversion (Short-Lived Climate Pollutants Act, California Air Resources Board). The primary alternatives for organics management are anaerobic digestion and composting—of which anaerobic digestion is the only process that offers energy recovery potential. Over the next few years, California's municipal solid waste haulers, material recovery facilities, and landfills will need to develop collections, processing, and energy recovery infrastructure to address these State legislations and goals.

Existing WWTPs are uniquely positioned to play a role in the new organics marketplace. Whereas waste management facilities do not typically have anaerobic digesters, most WWTPs already operate digesters (with energy recovery facilities) and may have additional capacity for organic wastes beyond municipal wastewater solids. In addition, WWTPs are generally able to effectively manage the digestate- and nutrient-rich residuals in a beneficial way. Many WWTPs are already using available digestion and energy capacity for co-digestion of FOG and liquid organic HSW from industry. Tipping fees for waste acceptance and increased DG production for energy generation make co-digestion economically viable and potentially attractive to public agencies operating WWTPs. Acceptance of organics diverted from landfills would follow the same model, but perhaps with improved economies of scale due to the large and steady demand created by the landfill/organics regulations.

5.1 Co-digestion Feedstocks and Typical Characteristics

There are three general categories of co-digestion feedstocks: 1) HSW and FOG; 2) source-separated organics (SSO)/food waste; and 3) the organic fraction of municipal solid waste (not SSO). FOG is already being received by EWA in a quantity of approximately 261,000 gallons per month. Recently, EWA has completed trials, collecting brewery waste and co-digesting it. As part of the planning process, EWA and the BC team have started discussions with local waste haulers about obtaining a pre-processed SSO.

This section describes the characteristics of the pre-processed food waste that would be anticipated for EWA's facility. The analysis assumes that EWA will continue to receive the same amount of FOG as it does now. However, for mesophilic digestion, there will not be enough capacity with the current configuration of using Digesters 4 through 6, therefore EWA would need to stop accepting FOG in the future. As FOG is a known feedstock and discussed in TM 1 as part of existing conditions, this section focuses mainly on the pre-processed SSO characteristics.

The pre-processed SSO is expected to range in solids concentration from 12 to 15 percent, and may vary in pH ranging from 3 to 7, with the expected pH value being around 5. As part of the development of the preprocessed SSO receiving program, it is assumed that EWA will develop standards for quality related to minimum screen size, debris removal rates, and presence/absence of manufactured inerts. Generation of the pre-processed SSO will be accomplished by a third party, off site. Raw SSO will be processed into an organic feedstock, nearly free of contaminants, pulped, extruded, and/or slurried into a pumpable liquid. Attachment C summarizes the SSO requirements that the Sanitation Districts of Los Angeles County (LACSD) has developed for its pre-processed SSO receiving program. Other pertinent requirements include recent



requirements developed by CalRecycle under its new composting regulations (California Code of Regulations [CCR] Title 14, Chapter 3.1, Section 17868), which is included to provide some guidance on physical contamination requirements, which EWA may wish to incorporate (Attachment C). Viewed as a whole, these can be used as a guide for the desired feedstock quality for the partners that will provide EWA with pre-processed SSO.

5.2 Initial Estimation of Acceptable Co-Digestion Volumes

Estimation of acceptable co-digestion volumes was completed assuming existing sludge production values as well as 2030 project flows and loads. For these analyses, the amount of FOG was held constant at existing conditions at 8,700 gallons per day (gpd). The amount of acceptable co-digestion volumes was determined based on the process limiting factor, either hydraulic loading rate (HLR) or organic loading rate (OLR). For the initial estimates, only pre-processed SSO was considered, assuming at the lower end of the range at 12 percent total solids (TS) and 85 percent VS. Table 5-1 summarizes the existing and projected solids loadings.

Table 5-1. Summary of Annual Average Solids Conditions								
Digestion Feedatesk	E	Existing 2030						
Digestion Feedstock	Flow (gpd)	%TS	%VS	Flow (gpd)	%TS	%VS		
Primary sludge	140,282	4.1%	87%	179,596	4.1%	87%		
TWAS	60,232	5.6%	80%	79,835	6%	80%		
FOG	8,700	5.5%	80%	8,700	5.5%	80%		
SSO		12%	85%		12%	85%		

TWAS = thickened waste activated sludge

Furthermore, co-digestion capacity was analyzed under several conditions: mesophilic, thermophilic conventional, thermophilic 10-day, and THP. They were further analyzed with and without the small digesters, except for THP. The addition of the small digesters in each scenario provided additional capacity. The HLR and OLR were varied depending on the scenario reviewed. Table 5-2 provides the process values used for each of the stabilization scenarios.

Table 5-2. Process Data for Each Solids Stabilization Scenario							
Condition	Digester Volume (MG) ª	Digester Volume with Small Digesters (MG) ª	HLR (d)	OLR (Ib-VS/ft³)			
Mesophilic	4.1	5.0	15	0.18			
Thermophilic: 15-day	4.1	5.0	15	0.35			
Thermophilic: 10-day	4.1	5.0	10	0.35			
тнр	4.1		12	0.40			

a. Digester volume assumes service conditions, meaning the largest is out of service.

lb-VS/ft³ = pounds volatile solids per cubic feet; *MG* = million gallons.



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The OLR and HLR (expressed as VS equivalent load) were determined based on the loading rate and total digester capacity. The available capacity was determined by taking the difference between the actual OLR and the maximum OLR (Table 5-2) for OLR process as well as the difference between the actual HLR and the minimum HLR (Table 5-2). These differences became the available capacity. The process limiting factor was determined based on which factor had less capacity. For instance, in 2030, THP was organically limited (120,000 pounds VS per day [lbs-VS/day]), meaning that there was more hydraulic capacity estimated (157,000 lbs-VS/day).

This organic loading equates to a volume of preprocessed SSO based on the assumed 12 percent TS and 85 percent VS. Assessing capacity under service conditions and peak month loads is a conservative approach that will evaluate the worst-case scenario (least amount of capacity). In addition to the conservative approach, a less conservative approach was evaluated and are presented below. The less conservative approach assumes that all digesters are online and the flows are under peak month conditions. Because these assessments are less conservative, there may be times when EWA would have to stop accepting FOG and SSO from the haulers. Both scenarios are presented because it allows EWA to make the decision, does EWA want absolute redundancy (first assessment) or have provisions in the contract allowing EWA to reject loads when these worst-case loads occur.

Based on historical, projected, and assumed data, an amount of SSO feedstock was determined based on peak month conditions (peaking factor of 1.23 was applied to annual average values). Assuming peak month configuration provides a conservative value for co-digestion feedstocks. Table 5-3 summarizes the capacity available for each of the stabilization scenarios.

Table 5-3. Results of Capacity Analysis Under Service Conditions ^a							
	Cu	ırrent		2030			
Condition	SSO (gpd)	With Small Di- gesters SSO (gpd)	SSO (gpd)	With Small Digesters SSO (gpd)			
Mesophilic	18,000	45,600	0	5,500			
Thermophilic: 15-day	18,000	78,000	0	5,500			
Thermophilic: 10-day	129,700	129,200	82,200	152,000			
тнр	166,500	N/A	140,600	N/A			

a. Assumes SSO solids content of 12% TS. b. Digester volume is 4.1 MG. c. Digester volume is 5.0 MG.

As noted in Table 5-3 there is no capacity in the future for mesophilic digestion and 15-day thermophilic digestion. Under these conditions, there would not be enough capacity to treat the projected amount of sludge and FOG received under service conditions, unless Digesters 1 through 3, 5, and 6 are in service. Thermophilic operating in 10-day mode can accept approximately 82,200 gpd of SSO with only the two large digesters online. It can also accept 152,000 gpd with Digesters 1 through 5 online. This would result in an estimated biogas increase of approximately 1,100,000 standard cubic feet per day (scfd) and 2,100,000 scfd, respectively, assuming a biogas yield of 18 cubic feet per pound VS per day. Additionally, THP would yield an estimated biogas increase by 1,900,000 scfd from SSO.



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Table 5-4 summaries the available capacity when all of the digesters are online under peak month conditions. These estimated capacities are less conservative and allows for acceptance of more HSW. Because all of the digesters (Digesters 1 through 6) are in service, as part of the contract with the waste haulers, stipulations need to be made for times when HSW cannot be received. As mentioned previously, the additional HSW results in additional gas production. Biogas production ranges from 1,000,000 scfd to 3,600,000 scfd additional biogas from SSO only.

Table 5-4. Results of Capacity Analysis Under Full Operational Conditions ^a							
	Cur	rrent		2030			
Condition	SSO (gpd) ^b	With Small Di- gesters SSO (gpd) °	SSO (gpd) ^b	With Small Digesters SSO (gpd) ^c			
Mesophilic	78,200	103,600	50,900	76,400			
Thermophilic: 15-day	154,700	214,700	82,200	142,200			
Thermophilic: 10-day	242,500	292,000	215,200	264,700			
THP	295,400	N/A	269,500	N/A			

a. Assumes SSO solids content of 12% TS.

b. Digester volume is 6.15 MG. c. Digester volume is 7.05 MG.

Based on the above assessments and engineering judgement, it is recommended that Mesophilic could accept 30,000 gpd of SSO. Also, the 15-day thermophilic scenario could receive 50,000 gpd, while the 10-day thermophilic and THP scenarios would accept 80,000 gpd of SSO. These recommended values consider both assessments and are more conservative than the peak month assessment but not as conservative as the under-service condition assessments. These values also consider truck traffic. In the case of thermophilic 10-day and THP, the truck traffic was limited to 13 trucks per day (6,000-gallon trucks), which results in a limit of 80,000 gpd of SSO.

Finally, another area for concern with the addition of outside feedstocks is the potential for NH₃ toxicity. This is a concern especially with THP, when the amount of total NH₃ nitrogen (NH₃-N) is greater than 3,000 milligrams per liter (mg/L) (Gerardi 2003). Part of the co-digestion analysis reviews the amount of potential NH₃-N released during the digestion process. As historical data for NH₃ were not available, values were assumed for typical sludge NH₃ content. To provide a more accurate analysis of the soluble and total nitrogen content, primary sludge, TWAS, digester, and FOG samples should be analyzed for total Kjeldahl nitrogen and soluble NH₃ content. The total NH₃-N content may be an issue for THP at a 9 percent TS feed content. The NH₃-N content was 3,208 mg/L and 3,085 mg/L for THP under service conditions at peak month for current and in 2030, respectively. Under full operational conditions the NH₃-N values are higher at 3,358 mg/L and 3,276 mg/l for current and in 2030, respectively. Each of these conditions estimates NH₃.N greater than 3,000 mg/L. This could cause NH₃ toxicity issues in THP; however, additional samples should be tested to confirm estimated and assumptions used in these analyses. Additionally, the reduced amount of SSO recommended previously would also alleviate this issue. Attachment D presents the co-digestion model calculations and assumptions.



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5.3 Results of Initial Outreach to Feedstock Providers

Part of the project work includes understanding how much SSO is available in the market, and if the waste haulers processing it would be interested in bringing the SSO to EWPCF. A meeting was set up in September 2017 with the three major waste haulers in the EWA service area: Waste Management (WM), Republic Services, and EDCO. Others present at the meeting included representatives from EWA and BC.

The agenda started with providing the waste haulers with background information regarding EWA's current operations and capacity considerations. The evaluation for selecting the best biosolids process for EWA includes confirming that waste haulers could fill the volume capacity of whichever final biosolids process was selected. The consensus from the waste haulers was that if the capacity was there, the waste haulers would bring the material.

The waste haulers were then given an opportunity to share their plans for handling SSO diversion as organics are required to be diverted from landfills. As could be expected, the representatives were hesitant to share their goals and strategies with their fellow competitors in the room. However, each waste hauler indicated that they would reach out to EWA individually post-meeting to discuss further.

EWA then used the meeting to confirm its commitment to increasing organics loads. EWA highlighted the potential for a mutually beneficial public-private partnership, which would result in a public win with regional development addressing emerging organics diversion requirements. Each waste hauler expressed gratitude to EWA for taking the initiative to start conversations regarding organics waste diversion, and each waste hauler indicated that it would reach out to EWA separately to continue that conversation.



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Section 6: Digester Gas Management and Dryer Control

EWA's biogas production currently exceeds the permitted fuel input for the IC engines, even with the revised air permit (November 2017). Biogas to the engine is automated and controlled on pressure. Excess biogas is directed to the heat dryer. This practice makes use of the biogas and decreases NG purchase for the drying process. The control of biogas flow to the dryer is based on manual set points. In an effort to avoid drawing too much biogas to the dryer (and "starving" the engines), EWA operators typically set the dryer biogas flow rate lower than the actual available gas. As a result, some digester gas is wasted in the flare.

There are two solutions to this situation: 1) automate the dryer biogas flow; or 2) change the plant's approach to managing the set point. Automating the dryer biogas flow might take some additional SCADA programming and instrumentation, but most of the piping, valves and instruments are already in place. These programming upgrades should be considered for near-term implementation.

In the meantime, EWA can change its approach to the dryer biogas set point. Instead of setting a low flow, the plant can set a higher flow set point. The engines won't be "starved" if biogas production dips—the existing NG blending control scheme will kick in to maintain engine output. This overall approach would eliminate biogas flaring without increasing the plant's net purchase of NG.



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Section 7: Conclusions and Next Steps

Enhancements to the biogas train have been evaluated in this task. Options to provide gas treatment and gas storage, and improve biogas production that passed the fatal-flaw filter, will be combined with selected technologies screened in Tasks 2 and 3 for the solids and biogas use process areas. Once the full set of alternatives are developed, they will be evaluated on a net present value basis for further screening.



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References

Gerardi, Michael. *The Microbiology of Anaerobic Digesters,* John Wiley & Sons, Inc. Hoboken, NJ, 2003. Noelte, Jeff. *Technical Memorandum – Evaluation of Alternative Fuel Digester Loading Strategy,* Trussell Technologies, 2017.



REF-1

Attachment A: Workshop Meeting Minutes



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A-1



Meeting Minutes

9665 Chesapeake Drive, Suite 201 San Diego, CA 92123

T: 858.571.8822 F: 858.571.8833

Prepared for:Encina Wastewater AuthorityProject Title:Energy & Emissions Strategic Plan & Biosolids Management Plan UpdateProject No.:150871

Purpose of Meeting:	Workshop #3	Date: September 19, 2017
Meeting Location:	Encina Wastewater Authority	Time: 12:30 - 4:00 PM
Minutes Prepared by:	Jocelyn Lu, Brown and Caldwell	

 Attendees:
 Debbie Biggs, Encina JPA
 Adam

 Doug Campbell, Encina, JPA
 Hari S

 Jimmy Kearns, Encina JPA
 Jocely

 Mike Steinlicht, Encina JPA
 Scott

 Octavio Navarrete, Encina JPA
 Scott

 Scott McClelland, Encina JPA
 Scott

 Tucker Southern, Encina JPA
 Max

Adam Ross, Brown and Caldwell Hari Seshan, Brown and Caldwell Jocelyn Lu, Brown and Caldwell Scott Lacy, Brown and Caldwell Scott Goldman, RMC

Attachments:

• Workshop #3 Presentation Slides

Decisions

The following is a list of decisions made as a result of the meeting discussion:

• BC will update conceptual layouts per discussion with EWA staff.

Action Required

The following is a list of actions required as a result of the meeting discussion:

- Scott L to send out an outlook invitation for a biweekly conference call for the Encina and BC team.
- Scott L to send list of additional data/document requests over to Scott M after updating based on discussion.
- Adam to reach out to Tom to get information regarding the mixing analysis.
- Scott L to send a WEFTEC list to Encina and get their input.
- Hari to review the mass balance calculations and provide an explanation.
- Adam to confirm the specific CAMBI model for thermal hydrolysis with Tom.
- Adam to set a call between Kenny Klittich (BC) and Tucker (EWA) to discuss energy options.

Summary

Workshop #3 was held for the Encina Water Authority (EWA) Energy & Emissions Strategic Plan & Biosolids Management Plan Update. The purpose of this Workshop was to review pending administrative tasks and provide task updates. A summary of the discussion is provided below:

Introductory Items

BC started off the meeting by reviewing the schedule and goals for the meeting. The goals are to generate content and direction for the project team moving forward.

- This month, the Brown and Caldwell (BC) team will be:
 - Working on and finalizing TMs 2 and 3.
 - In October and November, BC will be developing SWEET alternatives and providing more clarity on how the pieces interact.
- Scott Lacy (Scott L) states that since the next workshop won't be until December, he'll send out a biweekly conference call invite for the team.
- ACTION: Scott L to send out an outlook invitation for a biweekly conference call for the Encina and BC team.

Outstanding Data Requests

BC reviewed outstanding data requests with EWA. They included:

- Cogen and solids systems drawings and engine cut-sheets
- Engine O&M services, intervals, and costs
- Dryer system drawings and cut sheets
- Copies of current air permits (SDAPCD and Title V)
- CEPT electrical demand discrepancies
 - Requesting information on why the electrical demand for CEPT changed from 1067 kWh/month prior to 2/1/16. After 2/1/16 it was either less than 650kWh/month or zero
- ACTION: Scott L to send list of additional data/document requests over to Scott M after updating based on discussion.

There was a subsequent discussion on the heat dryer in the building. Mike Steinlicht (Mike) states that the dryer is in a steel fabricated building (not a brick and mortar), so there is opportunity there to expand the building to put in a second dryer.

Report Out on Meeting with Waste Haulers

BC met with the waste haulers earlier the same day. Below is a summary of the report out from the team. For the full minutes, please see the minutes for the Waste Haulers meeting.

- The waste haulers present at the meeting included representatives from Waste Management (WM), Republic Services, and EDCO.
- Scott M states that the question was posed to the waste haulers on how much organic food waste they could bring to the plant, and the consensus was that if the capacity was there, they would bring the material.
 - Adam Ross (Adam) agreed and stated that Encina will want to think about how much cushion they'd want to give themselves, and that should be taken into consideration on the volumes given to the waste haulers.
- There was also a discussion regarding vehicle fuel with the waste haulers.

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- Adam presented 3 options to distribute vehicle fuel: (1) fueling station, (2) tube trailers, and (3) injecting it straight into the pipeline.
- o 2 out of the 3 haulers expressed hesitation with on-site vehicle fueling.
- Adam states that when evaluating vehicle fueling in the SWEET model, the RIN credit would be discounted in terms of value and/or duration (leading to a more conservation evaluation).
- Scott L states that it would make sense to develop a range of capacities for the vehicle fueling option, to support both internal evaluation and provide a range for the haulers.
- Scott M asks if BC would want to be involved in the conversations with the haulers. Adam states that BC is interested, but to not let it delay a convenient meeting.
- Encina is beginning a food waste receiving pilot with Waste Management. WM is currently delivering 10,000 gallons per day, which will increase to 15,000 gpd over the next week.
 - Deliveries are reported as 14% solids and no major issues so far

Report Out on Anaergia Meeting

BC and Encina provided an update on their respective discussions with Anaergia.

- Adam states that Anaergia is trying to find ways to secure dried cake from other sources in addition to bringing their own food waste and organics. Anaergia's Rialto facility is grant funded for pyrolysis demonstration, so they need to show proof of concept. If Encina was to give their dried cake to Anaergia, Encina would be paying Anaergia around \$50/ton.
- Anaergia's only completed installation is in Victorville. There are other installations planned in the US, but they're either in design or construction.
 - There are installations in Europe, but they're all on small digesters. BC's concern is putting Anaergia mixers on a 2 M gallon tank. However, putting the mixers on the smaller tanks may be a good fit.
- Mike states that Anaergia had previously provided them a quote on their equipment, and Anaergia was willing to give Encina a discount. Mike states that rehabbing one of the small digesters and installing an Anaergia mixer on it may be a small-scale project that can be started earlier.
- There was also a discussion on the potential consequences of starting and stopping mixers.
 - Adam states that there is potential for rapid rise to occur if you stop mixing.
 - o Scott Goldman (Scott G) states that that hasn't historically been a problem at Encina.
 - Adam states that he'll reach out to Tom Chapman (Tom) to get his input on the mixing analysis.
- ACTION: Adam to reach out to Tom to get information regarding the mixing analysis.

Planning for WEFTEC

Individuals from both BC and Encina will be at WEFTEC in October. There is a plan to meet Monday afternoon to walk the floor and talk to vendors together.

• ACTION: Scott L to send a WEFTEC list to Encina and get their input.



Review of Mass Balance and Project Flows and Loads

BC reviewed the changes to the mass balance and projected flows and loads from the last Workshop.

- The mass balance was updated from the previous Workshop by back-calculating from historical pellets and class B cake data.
 - Scott G asks why the slope of the projections from the 2016 PMP didn't match the slope of BC's calculated projections.
 - ACTION: Hari to review the mass balance calculations and provide an explanation.
- Peaking factors for maximum 2-week and maximum week conditions were proposed based on historical data.

Codigestion Planning Assumptions

BC reviewed the codigestion planning assumptions:

- BC will prioritize the high-yield, low contamination feed stocks and leave remaining capacity for food waste.
- Under the mesophilic alternative, Encina will need to rehabilitate small digesters to allow for additional codigestion.
- In some scenarios, it's possible to demo some of the small digesters to build a receiving station.
 - o Jimmy Kearns (Jimmy) states that the old maintenance building can be demo'd.
- Adam states that the current system is limited by the organic loading rate.
 - Mesophilic digestion could take about 20,000 gpd of food waste in addition to the current delivery volumes of FOG and brewery waste, but as the loads increase, small digesters would have to be brought online.
- For thermophilic digestion, you could take 22,000 gpd forecasted out to 2030 in addition to the current delivery volumes of FOG and brewery waste. However, this is limited by the hydraulic residence time.
- However, Encina could opt for a 10-day residence day (instead of the current 15-day), and then Encina could take 92,000 gpd through 2030.
 - East Bay MUD was approved by the EPA to go down to a 10-day hydraulic residence time while operating at 120 degrees.
- Scott G states that the SWEET model should take into consideration recycle streams, ammonia, and the associated increased energy demand from the aeration process. Impacts to a future nitrification process should be considered.

Screening of WAS Pretreatment Technologies

BC reviewed the screening of WAS pretreatment technologies:

- The only technologies that passes the fatal flaw filter were CAMBI thermal hydrolysis (WAS only) and Orege SLG.
 - o Tom may want to show Encina Orege at WEFTEC.

Review of Biogas Train Enhancements

BC reviewed the screening of biogas train enhancements:

- Biogas Treatment Alternatives
 - Both gas conditioning and exhaust treatment pass the fatal flaw filter.



- They also both pass the evaluation criteria (greater than a score of 4.0), and so both alternatives will be evaluated in the SWEET model.
- Biogas Storage Alternatives
 - Dual-membrane gas holders pass the fatal flaw filter and may be a good option for the smaller tanks. Membranes are a good solution if you need gas storage and digester coverage. However, if just used as gas storage, it's not the best option because it's just a passive storage option, and it's hard to measure how much gas is in the system.
 - However, it is easier to add on older tanks because it's not as heavy as steel covers, and the dual membrane cover is compatible with Anaergia mixers.
 - The dedicated gas holder fails the fatal flaw filter because it's a new 50-foot diameter tank that Encina would need space for.

Air Permitting Impacts on Project

BC provided an update on where the air permitting process was for the project:

- Don King (Don) has submitted a BACT evaluation to the air district. The current BACT, which includes selective catalytic reduction (SCR), is not cost effective.
- Air district has responded with the question about what the "next best" threshold would be, and Don is currently preparing a response.
- Don will be submitting his final response to air permitting within the next couple of days.

Conceptual Alternatives

Thickening Alternatives

BC reviewed the thickening alternatives with Encina. The alternatives include:

- Mesophilic with the existing thickening scheme (rehab DAFTs)
- Mesophilic with RDTs
- Thermophilic with existing thickening scheme (rehab DAFTs)
- Thermophilic with RDTs
- Thermal Hydrolysis Process (THP) with RDTs

Generally, more efficient thickening provides more digestion capacity and efficiency.

Stabilization and Dryer Alternatives

BC reviewed the stabilization and dryer alternatives with Encina. The alternatives include:

- 1. Mesophilic and RDTs, with only one dryer, create Class B cake to land applications
- 2. Same as #1, but with two dryers
 - a. You wouldn't have any Class B cake going offsite.
- 3. Thermophilic and RDTs, with only one dryer, create Class B cake to land applications
- 4. Same as #3, but with two dryers
- 5. Start with #4, but move to an aggressive 10-day thermophilic option with two dryers
- 6. "Class B" THP (WAS only), Class B cake to land applications
 - a. The dryer would still be used, but anything additional would go to land application.
- 7. Class B THP, with two dryers
 - a. There's a lot of capital cost here, so probably won't be feasible.
- 8. Class A THP, with only one dryer

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- a. This would create a Class A product.
- b. Most THP facilities don't have a dryer because they're confident that people would want that Class A cake.

The options with the most codigestion capacity is Option #5, then #3, #4, and then #8. RDTs would provide more hydraulic capacity, which would change the limiting factor to dryer capacity. Scott G states that the current county litigation may force all facilities to produce Class A cake.

Review of Thermophilic Process and Conceptual Layout

BC reviewed the pros and cons of the thermophilic process, and then reviewed the conceptual layout.

- Thermophilic operates at a higher temperature, within a range of 120 140 Fahrenheit.
- There is a higher organic loading rate, and the process is stable at 10-day HRT. There also wouldn't need to be a significant change in operations to implement.
- Review of the conceptual layout (Slide 38):
 - Where the heat exchangers are proposed, the gap there needs to be preserved. The gap is just big enough to let a vehicle through.
 - The location for the RDTs is okay.
 - The red box for the second dryer is currently pushing beyond the limits of the existing building. The existing wall may need to be pushed out to make room for a second dryer. The red box is pushing out over the existing DAFTs, which wouldn't be needed anymore in this alternative.
 - The green box notes the receiving area. This location isn't preferred because it's farther from the digesters and closer to the admin building.
 - The magenta box is the blend tanks. These are optional, but nice to have. The current location is problematic because it blocks the roadway in an area with high truck traffic. Another potential location to put it is south of cogeneration.
- EWA notes that the annex and old maintenance can be demolished if necessary.

Review of Thermal Hydrolysis and Conceptual Layouts

BC reviewed the pros and cons of the thermal hydrolysis process, and then reviewed the conceptual layouts:

• Thermal hydrolysis would require the addition of new equipment, including: sludge screening, centrifuge pre-dewatering, steam, and a Class A THP process.

• ACTION: Adam to confirm the specific CAMBI model with Tom.

- The end-product would be Class A with all streams being sent through the Class A THP process.
- Review of Conceptual Layout 1 (slide 40):
 - o Most of the layout is in the area where the three smaller digesters are.
 - EWA staff state that that area is very busy, and construction sequencing would be tough. This wouldn't be an ideal layout.
 - The receiving area (green box) represents an expansion of the current receiving facility. There's potential to reconfigure the existing receiving area for more capacity.
 - Adam states that the main process units that need to stay together are the pre-watering building, cake storage, and THP process. Other units, like the electrical building, could go anywhere.

- EWA staff proposed moving most of the equipment to where the old maintenance building currently is. They state that the building next to the old maintenance building, called "The Shop" is also available for repurposing. "The Shop" is a nice, high ceiling building that can repurposed for new equipment.
- Prior evaluations suggested that the THP process could be located within the existing dryer building.
- Review of Conceptual Layout 2 (slide 41):
 - Most of the equipment in this layout is moved from the three small digesters area to where the existing DAFTs are.
 - EWA staff proposes to move the receiving area (green box) to the current old maintenance building and Shop area. However, they note that there are a lot of large utilities in that area.
 - Octavio Navarrete (Octavio) asks if there's a way to put the new electrical building closer to the existing MCC. There's some space next to the MCC, where DAFT 3 currently is. If DAFTs will be demolished, there is potential to put the new electrical building there.

Codigestion Alternatives

- BC will review codigestion with all the stabilization alternatives.
- BC will also analyze the cost benefit of bringing the small digesters online.

Digestion Alternatives

• BC will compare the belt filter presses and centrifuges to stabilization alternatives.

Power Production Alternatives

BC reviewed the power production alternatives and conceptual layouts:

- All the power production will be paired with a thermophilic digestion baseline for comparison. The best performing power production alternatives will then be combined with the best performing stabilization alternatives in the second round of analysis.
- BC will see a range of gas production, and that range will be taken into consideration in the evaluation.
- Reviewed Conceptual Layout: Engine Gas Conditioning + Exhaust Treatment (slide 47):
 - In the upper left-hand corner (north of the small digesters), there are some agency manholes that can't be blocked.
 - EWA staff proposes to move the gas conditioning (orange box) slightly east, and replace the existing equipment there.
 - For the exhaust treatment, relocation of the existing equipment would be necessary.
- Reviewed Conceptual Layout: Microturbines with Gas Conditioning (slide 48):
 - The microturbines is a small shipping container, and it would be located wherever the gas conditioning is.
 - Adam explains that microturbines would only be used if EWA's existing permit can't be modified, and if it's not cost effective to do SCR.
- Reviewed Conceptual Layout: Digester Gas Upgrading Pipeline Injection (slide 49):
 - This alternative would require a slightly bigger footprint, and separation equipment would be added to wherever the gas conditioning equipment is.
 - EWA states that the annex area could be used for gas conditioning.

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- EWA informs that the current gas pipeline that feeds the facility operates at 60 65 psi. There is a big one on Avenida Encinas that's 100 psi.
- Reviewed Conceptual Layout: Digester Gas Upgrading Vehicle Fuel (slide 50):
 - Adam states that there's no room on-site to place a vehicle fueling station. That's why the conceptual layout has the vehicle fueling station south of the facility.
 - Scott M states that SANDAG is interested in building compressed natural gas (CNG) facilities in San Diego. On the bottom left corner of the figure, you can see the turnout into the transit system parking lot. That could be a convenient location for a transit fueling station.
 - Tucker Southern (Tucker) states that EWA has been approached by Volkswagon to build a fueling station because they're required to spend \$100 million.
- Reviewed Conceptual Layout: Small Scale Solar PV (slide 51):
 - The current layout proposes putting the small-scale solar PV panels over the primaries. EWA states that they don't like it over the primaries. It would be better over the aeration basins; however, EWA had already gotten a quote for that, and it wasn't cost effective.
 - Adam states that if cogeneration is maxed out, solar would be unnecessary.
 - Mike states that member agencies will have questions regarding solar, so BC should come prepared with numbers.
- Reviewed Conceptual Layout: Large Scale Solar PV (slide 52):
 - EWA staff states that the southern parcel is 28-acre's total.
 - The current box (purple) drawn for large scale solar PV could be moved farther north to match up with the fence line.
 - EWA staff proposes the equalization (EQ) basins as potentially a good place for solar, and it would keep the algae levels down.
 - o BC and EWA discussed the possibility of virtual net metering:
 - EWA is in a position where they may produce more power than they use, which they would then export to the grid. Mike asks if there's a way to sell excess power to their member agencies, and only pay a transmission fee (not have to buy back the power from SDG&E).
 - Tucker states that SDG&E has a requirement where properties must be joined to share meters.
 - Mike states that EWA should know what the loads are from the member agencies, so they could have an "member agency demand" value.
 - ACTION: Adam to set a call between Kenny Klittich (BC) and Tucker (EWA) to discuss energy options.
- Reviewed Conceptual Layout: Dual Membrane Gas Storage (slide 53):
 - The dual gas membranes would be added atop the 3 smaller digesters.



Grant Updates

Adam provides an update on potential grants applicable to the project:

- There are no current advertisements for grant funding. There are some for batteries, but none for organics.
- BC is continuing to track the EPA's RIN quotas and determining what the values would be for codigestion.
- Mike states that EWA has elected officials that are interested in grants, and EWA should take the leadership in that arena.

Look Ahead and Wrap-Up

BC and EWA staff end the workshop with a look ahead:

- BC will schedule a webinar to present initial SWEET results in late October.
- Adam states that BC has developed a solids and energy baseline. However, BC still needs the current cost of operations, which will be part of the next data request.
- For Workshop 4, BC will have started some SWEET analysis, but the workshop will be focused on receiving feedback on assumptions and inputs. That feedback would then be used to finish the TM.
- During Workshop 5, BC will review the SWEET model results and present conclusions.





Energy & Emissions Strategic Plan & Biosolids Management Plan Update



Workshop #3 – September 19, 2017

Encina Water Pollution Control Facility



Project Schedule

- Progress on schedule
- TM 1 submitted
- Other Tasks are under way
- Workshop #3 today

TASK 4 - Biogas Tech TASK 5 - Waste Heat Tech TASK 6 - Air Emissions Evaluation TASK 7 - Alternatives and Evaluation TASK 8 - Grants/Incentives TASK 9 - Management/QC Workshops	◆ W1	♦ W2	• w:			♦ ₩4	♦ W5		W6
TASK 5 - Waste Heat Tech TASK 6 - Air Emissions Evaluation TASK 7 - Alternatives and Evaluation TASK 8 - Grants/Incentives									
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ASK 2 - Biosolids Tech ASK 3 - Power Tech	1		-		-				
ASK 1 - Baseline Energy ASK 2 - Biosolids Tech									
Combined Project Schedule	JUL '17	AUG '17	SEP '17	OCT '17	NOV '17	DEC '17	JAN '18	FEB '18	MAR '
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 TM 1 submitted 									

Agenda

- Administrative (30 min)
 - Status of data requests
 - Report out on waste hauler meeting
 - Report out on call with Anaergia
 - Review of WEFTEC schedule
- Confirm Final Mass Balance and Projected Flows and Loads (15 min)
- Presentation and Discussion on Codigestion Assumptions (20 min)
- Presentation and Screening of WAS Pretreatment Considerations (15 min)
- Review of Biogas Train Enhancements (30 min)
- Review Air Permitting Impacts on Project (30 min)
- Presentation of Conceptual Alternatives (60 min)
- Grants Update (10 min)
- Wrap-Up/Review Action Items (10 min)

New Data Requests

Energy & Emissions Strategic Plan & Energy & Emissions Strategic Plant Update Biosolids Management Plant Update Workshop #3 Biosolids Workshop and Caldwell Prepared by Brown and Caldwell

Outstanding Data Requests

- Cogen and solids systems drawings, engine cut sheets
- Engine O&M services, intervals, and costs
- Dryer system drawings and cut sheets
- Copies of current air permits (SDAPCD and Title V)
- CEPT electrical demand discrepancies

Report Out on Waste Hauler Meeting

- Waste hauler meeting held this morning
- Goals:
 - Provide background info to haulers about EWA's goals and BEE effort
 - Determine availability of pre-processed food waste, market demand for an EWA initiative to receive more material, tipping fee range for SWEET analysis
 - Gauge interest in a renewable CNG partnership
 - Discuss "next steps" such as letter of intent, future coordination

Report Out on Call with Anaergia from 8/29/17

- Pyrolysis project in Rialto is interested in dried cake
 - Anaergia starting to consider contracts to secure product
 - Have not determined a tipping fee. Estimate around \$50/ton range.
 - There may be an opportunity to influence a tipping rate for Encina if we get in early.
- Rialto facility will also accept dewatered cake
 - Dewatered cake target around 25% TS

Report Out on Call with Anaergia from 8/29/17

- UTS mixing system and Omnivore
- One installation in the US (Victorville, CA)
- Other installations planned in US (in design or construction)
- Several installations in Europe (on digesters less than 200,000 gal)
- Dialogue with Anaergia is ongoing
- Food waste pre-processing:
 - Orex or Biorex for food waste preprocessing



UTS Mixer Access Hatch



Omnivore recuperative thickener

Discussion on WEFTEC Schedule



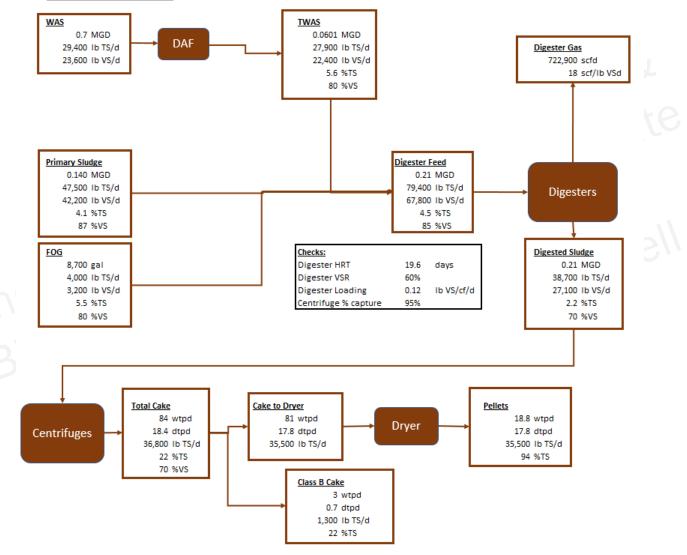


Mass Balance and Projected Flows and Loads



Mass Balance

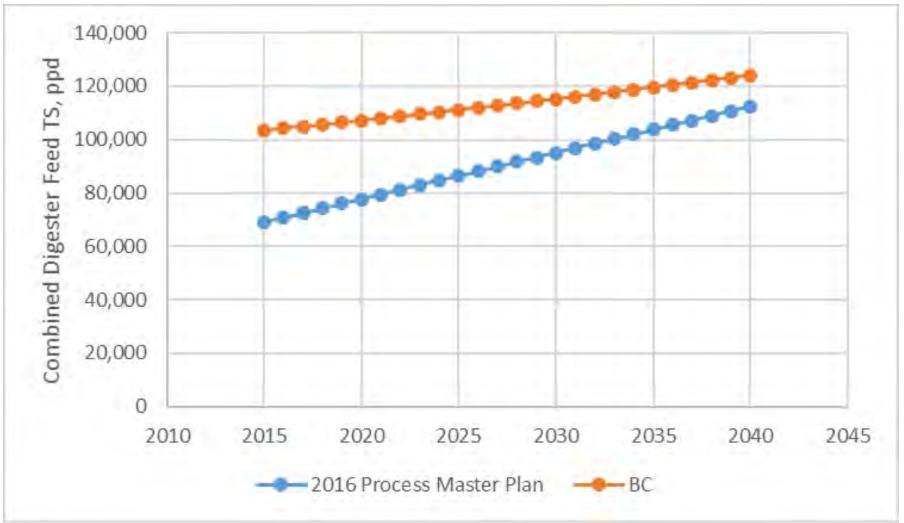
MAY 2015 - JUNE 2017



Mass Balance Assumptions

- The mass balance was determined using backward calculation based on historical data from pellets and class B cake. The Class B cake data were averaged with zero data to obtain an annualized daily average
- The centrifuge had an assumed percent capture rate of 95%.
- The VSR was 60% based on Van Kleeck, mass balance and engineering experience.
- WAS flows and loads were calculated based on historical data. TWAS was determined assuming percent capture rate of 95% for the DAFTs.
- FOG data were a daily average of the volumes received. This assumes FOG is fed 24/7/365. Assumes %TS and %VS are 5.5% and 80%, respectively.
- The primary sludge load was assumed to the difference of the sum of digester feed with TWAS and FOG load help constant.

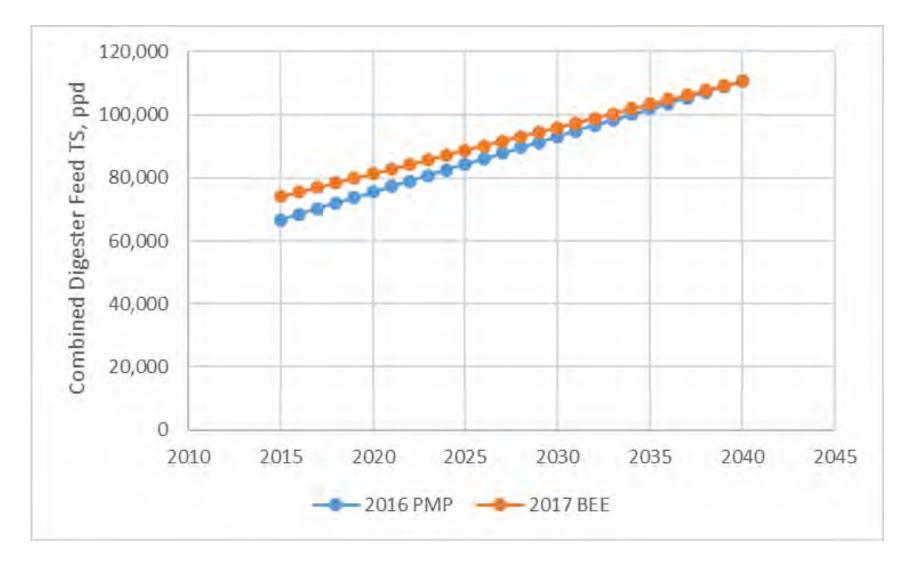
Solids Mass Balance Comparison



Brown and Caldwel

13

Solids Mass Balance Comparison (Updated)



Sludge Production Peaking Factors

	Max Month	Peak 2-Week	Peak Week	Peak Day
Primary Sludge	1.23	1.3	1.4	1.60
WAS	1.23	1.3	1.4	1.60
Combined Sludge	1.23	1.3	1.4	1.60

Notes:

- Peaking factors for maximum month and peak day conditions are developed based on 2016 PMP solids projections.
- Peaking factors for maximum 2-week and maximum week conditions are proposed based on historical data.

Power Loads and Gas Usage

• Power:

- Monthly production: 1,507 kW (2,750 kW engines full output) 83% of total electrical demand)
- Monthly import: 319 kW equivalent (1,390 MWh per year)

Digester gas:

- Average production: 1,580,000 therms per year ;sign
- Engines: 1,234,000 therms per year
- Waste gas: 160,000 therms per year
- Heat dryer: 99,000 therms per year
- Natural gas: 696,000 therms per year
 - Engines: 116,000 therms/year
 - Other plant use: 580,000 therms/year



Codigestion Planning Assumptions (Task 4)



Items for Discussion in Codigestion Analysis

- Will look at prioritizing high-yield, low contamination feedstocks and leaving remaining capacity for food waste
- Under mesophilic scenario, need to rehabilitate small digesters to allow additional codigestion
- Pros and cons of separate food waste digestion in small digesters
- Under other scenarios, possible to demo some of the small digesters to build a receiving station
- Analyzed scenarios up through 2030 loads

Initial Feedstock Analysis

- Current system limited by organic loading rate
- Mesophilic digestion could take about 20,000 gpd of food waste but as loads increase, need to bring small digesters on line.
- 15-day thermophilic digestion could take 22,000 gpd of food waste but is limited by hydraulic residence time
- Can opt to move towards 10-day thermophilic operation (EBMUD), which allows up to 92,000 gpd through 2030



Screening of WAS Pretreatment Technologies (Task 4)



Fatal Flaw Filter

- Applied uniformly across all technologies
- Four criteria:
 - At least one successful North American installation of technology
 - At least one successful installation in a facility of similar size
 - Available space
 - Compatibility with plant size and any existing equipment

WAS Pre-Treatment Technologies Analyzed

- Sonolyzer: Sonication cell lysis
- BioCrack: Electrokinetic cell disintegration
- Lysotherm: Temperature and pressure hydrolysis using thermal oil
- Crown Disintegration: Pressure release disintegration
- OpenCEL: Electric focused pulse disruption. Bankrupted
- Microsludge: High pressure cell disruption. Bankrupted
- WAS Only Cambi*: Thermal hydrolysis WAS only
- Orege SLG Solution: compressed air addition upstream of digestion

WAS Pre-Treatment Technologies – Fatal Flaw

	Technology Maturity	Successful Operation of Comparable Size	Available Space	Compatibility
Sonolyzer	Fail	Fail	Pass	Pass
BioCrack	Fail	Fail	Pass	Pass
Lysotherm	Fail	Fail	Pass	Pass
Crown Disintegration	Fail	Fail	Pass	Pass
OpenCEL	Fail	Fail	Pass	Pass
Microsludge	Fail	Fail	Pass	Pass
Cambi Thermal Hydrolysis – WAS only	Pass	Pass	Pass	Pass
Orege SLG	TBD	TBD	Pass	Pass



Review of Biogas Train Enhancements (Task 4)



Biogas Treatment Alternatives

	Technology Maturity	Successful Operation	Available Space	Compatibility
Gas Conditioning	Pass	Pass	Pass	Pass
Exhaust Treatment	Pass	Pass	Pass	Pass

Biogas Treatment Alternatives

		Gas Conditioning	Gas Conditioning +Exhaust Treatment	
	Proven Technology Performance	5	4	
	Minimize Life Cycle Costs	3	4	
	Energy/Resource Recovery	4	5	
	O&M Impacts	4	3	
2	Environmental Impacts	3	4	
	Community & Stakeholder Impacts	4	5	
	Project Site Compatibility	5	4	
	Weighted Score	4.05	4.25	

Biogas Storage Alternatives

	Technology Maturity	Successful Operation	Available Space	Compatibility
Dystor type double membrane gas holder	Pass	Pass	Pass	Fail
Dedicated gas holder	Pass	Pass	Fail	Pass







Air Permitting Impacts on Project



EWA is actively pursuing air permit modification

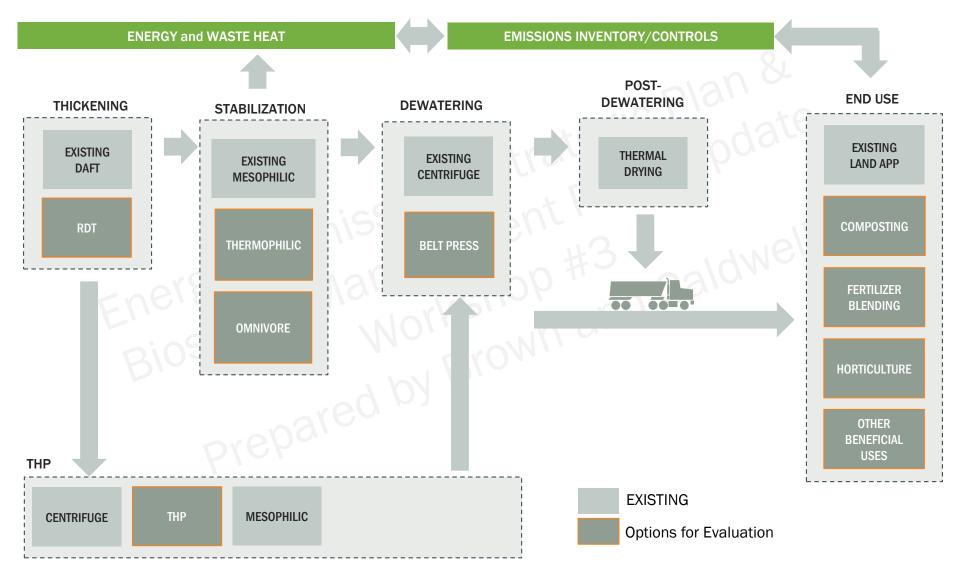
- EWA (with Don King) submitted a request for permit modification
- Current BACT (requiring SCR) not cost effective
- The air district responded with question about "next best" threshold – EWA (with Don King) preparing a response
- Goal is to adjust the CO emission rate from 530 ppm to ~400 ppm, and thereby adjust the fuel input limit aimed at keeping CO emissions below Title V synthetic minor threshold
- If successful, this effort would increase permitted cogen capacity by ~20%
- This increase would allow EWA to meet plant electricity demand with current digester gas flows and cogen system



Conceptual Alternatives



Evaluating Technologies and Markets Together



Thickening Alternatives

- Mesophilic and existing thickening scheme (rehab)
- Mesophilic and RDTs
- Thermophilic and existing thickening scheme (rehab)
- Thermophilic and RDTs
- Cambi and RDTs

Generally, more efficient thickening provides more digestion capacity and efficiency

Stabilization and Dryer Alternatives

- 1. Mesophilic and RDTs, one dryer, Class B cake to land app
- 2. Same as #1 but with 2 dryers
- 3. Thermophilic and RDTs, one dryer, Class B cake to land app
- 4. Same as #3 but with 2 dryers
- 5. Maximize codigestion Aggressive (10-day) Thermophilic, two dryers
- 6. "Class B" Cambi, WAS only, Class B cake to land app
- 7. Class B Cambi with two dryers
- 8. Class A Cambi, only one dryer

Mesophilic

Features

- Operates at 95-100 ^oF
- Requires 15-day HRT/SRT to comply with Process to Significantly Reduce Pathogen (PSRP, EPA part 503)
- Organic loading typically limited to 0.18 lbs. VS/cf-day
- Produces Class B biosolids

Pros and Cons

- Pros:
 - Simple to operate
 - Lower energy demand than other processes
 - No additional footprint needed
- Cons:
 - Limited capacity to accept high strength waste; would need to rehab small digesters to accommodate other feedstocks
 - Current end use markets limited to regional compost or bulk agriculture in Arizona

Thermophilic

Features

- Operation at ~135°F
- Can be stable at 10-day HRT based on organic loading limitation of 0.35 lbs. VS/cf-day
- Minor improvement in process VSR and gas production
- In proposed configurations, generates
 Class B biosolids

Pros and Cons

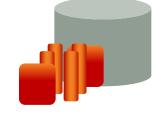
• Pros:

- Comparable operation to mesophilic; no significant operational change necessary
- Higher allowable OLR provides capacity for acceptance of high strength wastes

Cons:

Current end use markets limited to regional compost or bulk agriculture in Arizona

Thermal Hydrolysis



Features

- Requires addition of new equipment:
- Addition of Sludge Screening
- Addition of Centrifuge Pre-Dewatering
- THP Will assume Cambi B6-4(s)
- Requires steam
- Produces Class A with all streams sent through Cambi

Pros and Cons

• Pros

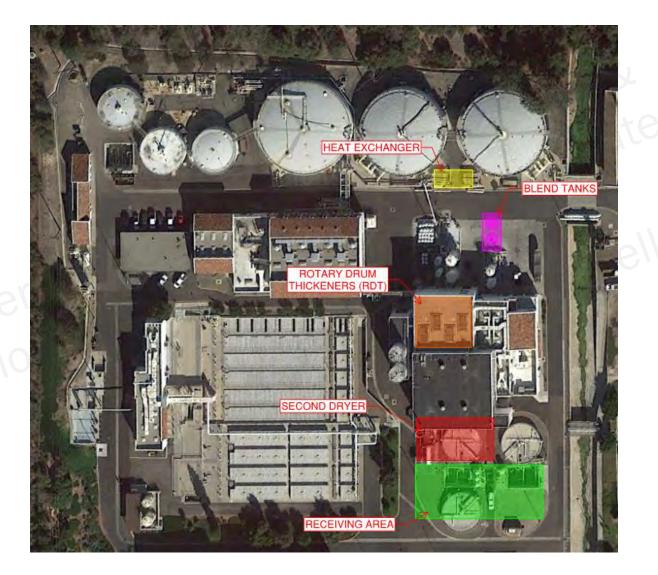
- Improved digestion and dewaterability allows for greater digester and dryer capacity; prolonging available dryer capacity
- Allows for addition of high strength wastes into process train
- Generates a high quality Class A cake, suitable for more local reuse
- Cons
 - More operational complexity
 - Occupies a greater footprint than digestion-only options
 - Somewhat greater energy demand

Building Dimensions – Biosolids Alternatives

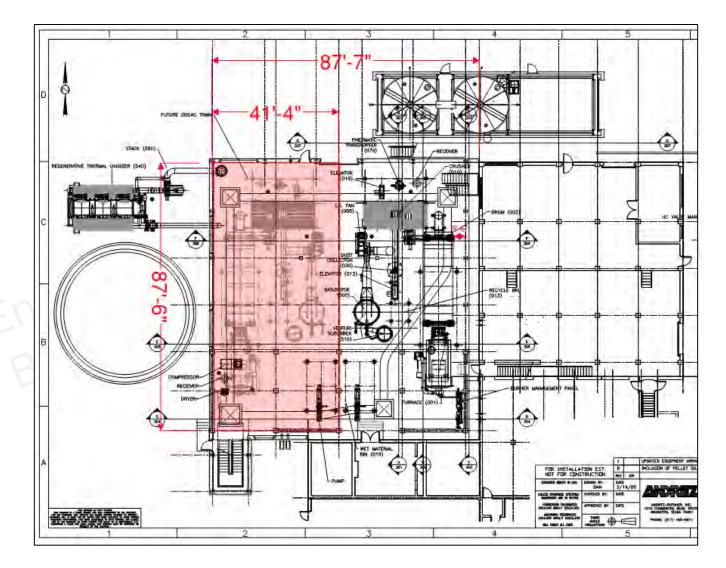
• For THP Layout:

- Pre-THP Dewatering Building: 60' x 90'
- Odor Control Building: 60' x 30'
- Thermal Hydrolysis Process (THP): 50' x 90'
 Cooling HEX: Classical Content of the second second
- Prepared by Brown and Caldwell • Cooling HEX: 8' x 22' each

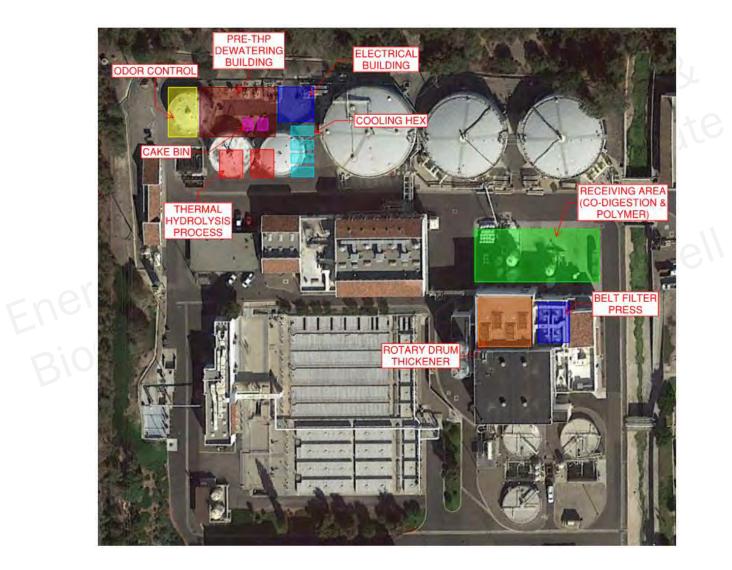
Thermophilic – Conceptual Layout



Thermophilic – Andritz Dryer



THP – Conceptual Layout 1



THP – Conceptual Layout 2



Codigestion Alternatives

- Codigestion with all stabilization alternatives
- Possibility to include separate food waste digestion in little nt Updi tanks (for discussion) workshop #3 Caldwell Workshop and Caldwell Prepared by Brown and Caldwell Energy & Emissions Energy & Emissions Energy Biosolids Management

Dewatering Alternatives

. atives . atives Energy & Emissions Strates Blosolios Management Plant Belt filter presses and centrifuges to be compared for performance with stabilization alternatives

Power Production Alternatives

- Will be paired with a thermophilic digestion baseline for comparison
- Best performing power production alternatives will be uon altern. Calowell Norkshop #3 Calowell Brown and Calowell Brown and Calowell combined with best performing stabilization alternatives in second round of analysis

Alternatives: Power Production

- Baseline: Existing cogen + drying
- Baseline + gas conditioning
 - Gas conditioning serves to reduce O&M costs associated with engines and dryer
- Existing cogen + vehicle fuel (via pipeline injection or tube trailer)
 - No permit modification to cogen / no DG to dryer
 - Continue to operate two engines
 - Additional gas routed to vehicle fuel
- Existing cogen + microturbines
 - Includes gas conditioning
 - No permit modification to cogen / no DG to dryer
- Existing cogen + steam boiler/turbine
 - No permit modification to cogen / no DG to dryer
 - Additional gas routed to steam boiler; steam used in small turbine
- New cogen permit, CO catalyst and SCR, gas conditioning
 - Need to consider plant demand as a limit on power production
- Vehicle Fuel (primary use of DG) + existing cogen (natural gas + tail gas)
 - "All in" on vehicle fuel

Building Dimensions – Power Alternatives

- Gas Conditioning: 25' x 80' (+ chiller)
- Exhaust Treatment: 20' x 75'
- Digester Gas Upgrading:
 - Pipeline injection: 50'x 95'
 - On-site vehicle fueling: additional 120' x 150' (fast fill)
 - Replaced the old Maintenance Building
- Microturbines: depends on desired capacity

Engine – Gas Conditioning + Exhaust Treatment



Microturbines with Gas Conditioning



Digester Gas Upgrading – Pipeline Injection



Digester Gas Upgrading – Vehicle Fuel



Notes:

- 400 scfm fast fill station with 48 hours of CNG storage, medium pressure storage, single stage separation membranes and 4 fuel dispensers.
- Footprint can be smaller with slow fill station, less storage, and fewer dispensers

Small Scale Solar PV



Large Scale Solar PV



Dual Membrane Gas Storage





Grant Updates



Grant Updates

- No current advertisements for grant funding
- Tracking EPA movements on RIN guotas and determination on codigestion (D3 or D5 RINs) workshop #3 Caldwell Workshop and Caldwell Prepared by Brown and Caldwell
- Potential for local air district grant? Energy & Emise Biosolids Mana

Self Generation Incentive Program

Program	Self-Generation Incentive Program (SGIP)			
Agency	California Energy Commission / administered by SDG&E			
Eligible Projects	Self-generation projects such as new engines, microturbines, or steam turbines – increased incentives for renewable/biogas projects; Energy storage / batteries			
Funding	Incentives based on anticipated power output – based on fuel availabi not nameplate capacity; 50% paid upfront / 50% paid over 5 years based on performance			
Schedule	Funding available each year / first-come, first-served Battery funding decreases as tiers fill up Projects must be operational within 18 months of award			
How much are we talking?	~\$500k - \$1M depending on project size			
Recommendation for SWEET Analysis	Don't count on funding to justify project economics			
Next steps	Continue to track / pursue if selected alternatives meet criteria			

Low-Carbon Fuel Standard

Program	Low-Carbon Fuel Standard (LCFS)			
Agency	California Air Resources Board			
Eligible Projects	Part of AB 32 scoping plan – projects that reduce the carbon intensity o California's vehicle fuel – i.e. renewable compressed natural gas (CNG vehicle fuel)			
Funding	Incentives based on fuel production, market-based values; Paid on a per-gallon basis as the project performs			
Schedule	Ongoing program, recently extended through 2030			
How much are we talking?	Varies could equate to ~\$0.50/DGE - \$1.00/DGE depending on market factors			
Recommendation for SWEET Analysis	Include in SWEET analysis for vehicle fuel projects; Assume funding only through 2030, use conservative values			
Next steps	Continue to track / pursue if vehicle fuel is recommended			

Renewable Fuel Standard

Program	Renewable Fuel Standard			
Agency	US Environmental Protection Agency			
Eligible Projects	Renewable fuel projects - i.e. renewable compressed natural gas (CNG vehicle fuel)			
Funding	Incentives based on fuel production, market-based values; Paid on a per-gallon basis as the project performs			
Schedule	Ongoing program, not guaranteed beyond 2022			
How much are we talking?	A lot of uncertainty: Wastewater digester gas is eligible for highest value of RINs – D3 EPA has recently stated that DG from food waste is a lower value – D5 EPA has the ability to set RIN quotas, which drive supply-and-demand, market-based pricing			
Recommendation for SWEET Analysis	Include in SWEET analysis for vehicle fuel projects; Assume funding only through 2022, use conservative values			
Next steps	Continue to track / pursue if vehicle fuel is recommended			

Organics Grant Program

Program	Organics Grant Program	
Agency	Department of Resource Recovery and Recycling (CalRecycle)	
Eligible Projects	Projects that serve to divert organics (food waste) from landfill – towa anaerobic digestion or composting; recently issued with a food rescue requirement	
Funding	Incentives based on project size and potential tons diverted	
Schedule	Recently awarded, not expected to reissue for ~18 months	
How much are we talking?	Up to \$4M per project	
Recommendation for SWEET Analysis	Do not include – too competitive to count on	
Next steps	Continue to track / pursue if food waste receiving is recommended	

Heathy Soils Program

Program	Healthy Soils Program			
Agency	California Department of Food and Agriculture			
Eligible Projects	Demonstration projects that sequester carbon and reduce GHG emissions – groups within CASA			
Funding	Incentives based on project size and potential GHG benefit			
Schedule	Currently accepting applications through September 19 Annual funding program (AB 32 funds), amounts and criteria may vary			
How much are we talking?	Up to \$3.75M total			
Recommendation for SWEET Analysis	Do not include / ancillary benefit to support end use program			
Next steps	Continue to track / connect with CASA Science and Research Group for potential partnerships			

Green Project Reserve

Program	Green Project Reserve			
Agency	California Water Resources Control Board			
Eligible Projects	Projects that improve energy efficiency, renewable energy generation, or recycled water production			
Funding	A component of Clean Water State Revolving Funding; Green Project Reserve is a "loan forgiveness" program CWSRF is generally oversubscribed, but GPR is underutilized			
Schedule	Ongoing			
How much are we talking?	Up to \$4M per project, or 50% of project value, whichever is higher			
Recommendation for SWEET Analysis	Do not include			
Next steps	Something for EWA to keep in mind – if a larger capital project requires funding, consider CWSRF and adding an eligible GPR component			



Look Ahead & Wrap-Up



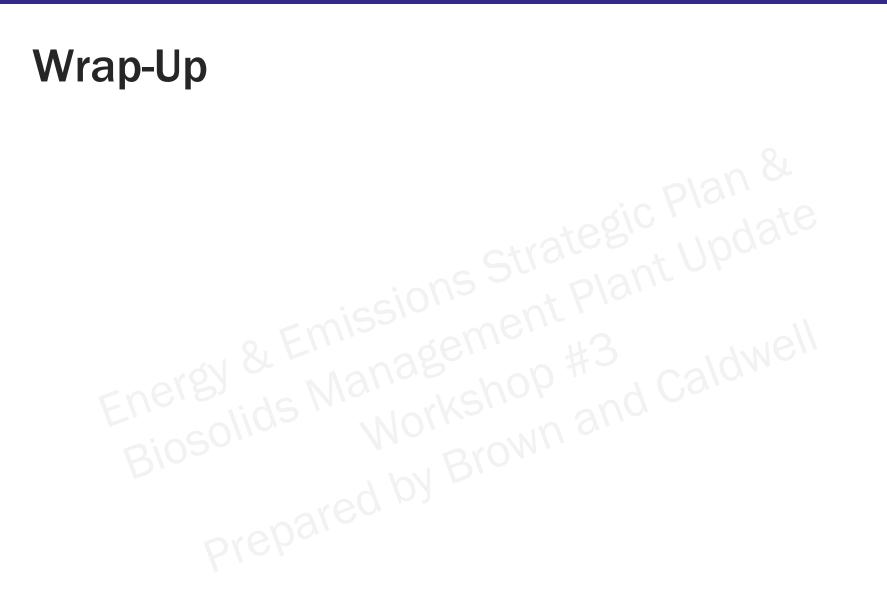
Project Schedule

- Schedule webinar for initial SWEET results in late October
- TM 1 delivered today
- TMs 2 and 3 delivered by month end
- Next in-person workshop in December

Combined Project Schedule	JUL '17	AUG '17	SEP '17	OCT '17	NOV '17	DEC '17	JAN '18	FEB '18	MAR'1
TASK 1 - Baseline Energy			-	1.000					1
TASK 2 - Biosolids Tech	L				1				
TASK 3 - Power Tech	1								
TASK 4 - Biogas Tech							-		1
TASK 5 - Waste Heat Tech		-							1
TASK 6 - Air Emissions Evaluation	10000								1
TASK 7 - Alternatives and Evaluation					-		-		
TASK 8 - Grants/Incentives									
TASK 9 - Management/QC	1						1 . C		
Workshops	♦ W1	🔶 W2	🔷 W:	3		🔷 W4	W 5	•	W6
	COLOR KE	Y:	Evaluation	Analyze	Report	Client R	eview	Final Repo	ort

Look Ahead – December Workshop

- Results of initial SWEET analysis
- SWEET sensitivity analysis
- Screening and creation of new alternatives for Round 2 **SWEET** analysis
- , and Caldwel Initial Development of Non-Cost Criteria
- Grants update



QUESTIONS?



it's about connecting

Brown AND Caldwell

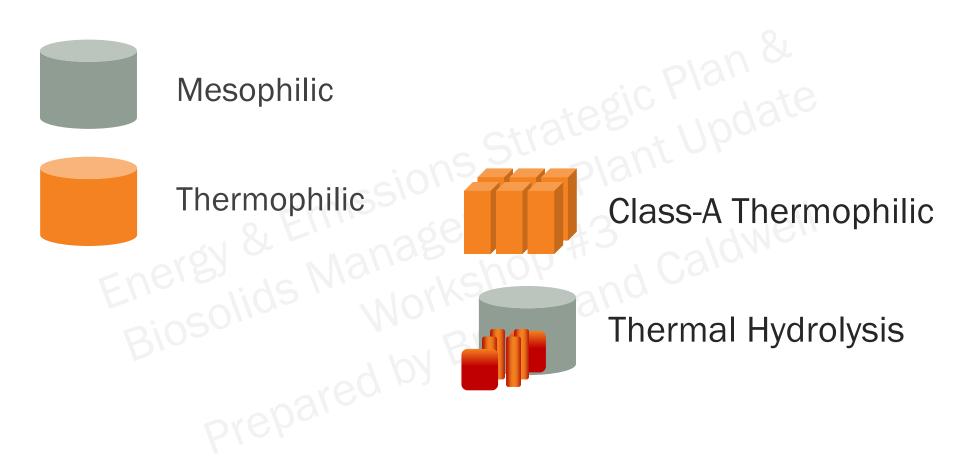
essential ingredients®









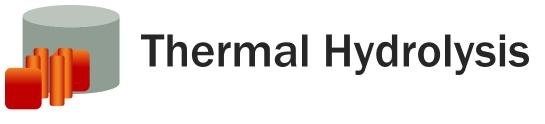


Mesophilic

- Operates at 95-100 °F
- Requires 15-day HRT/SRT at Max14 Loading to comply with Process to Significantly Reduce Pathogen (PSRP, EPA part 503)
- Organic loading limited to 0.18 lbs. VS/CF-Day at Max14 with one out of service

Thermophilic

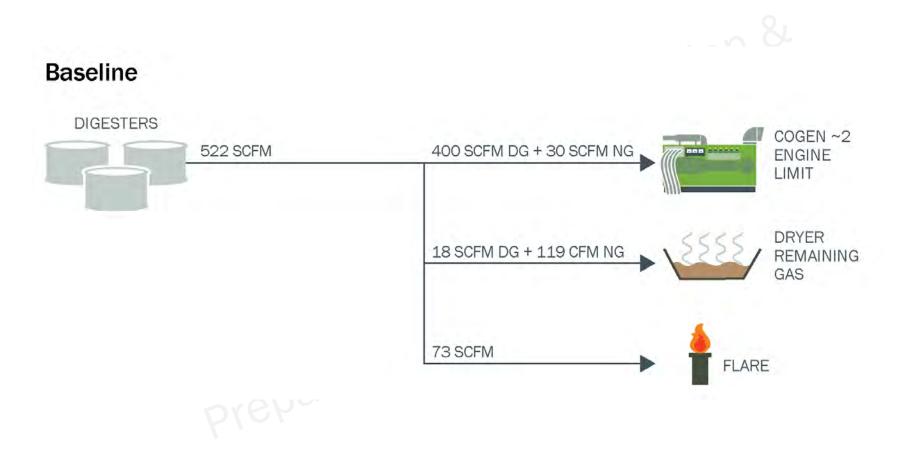
- Operation at ~135°F
- 7-Day SRT/HRT at Max07 with one unit out-of-service
- Likely limited to 9- or 10-Day based on organic loading limitation of 0.35 lbs. VS/CF-Day at Max07
- No improvement in process VSR and gas production
- Not Class-A by itself; But can be modified for Class-A



Assumes:

- Addition of Sludge Screening
- Addition of Centrifuge Pre-Dewatering
- THP Will assume Cambi B6-4(s)

Baseline includes cogeneration (permit limited), dryer and some flaring

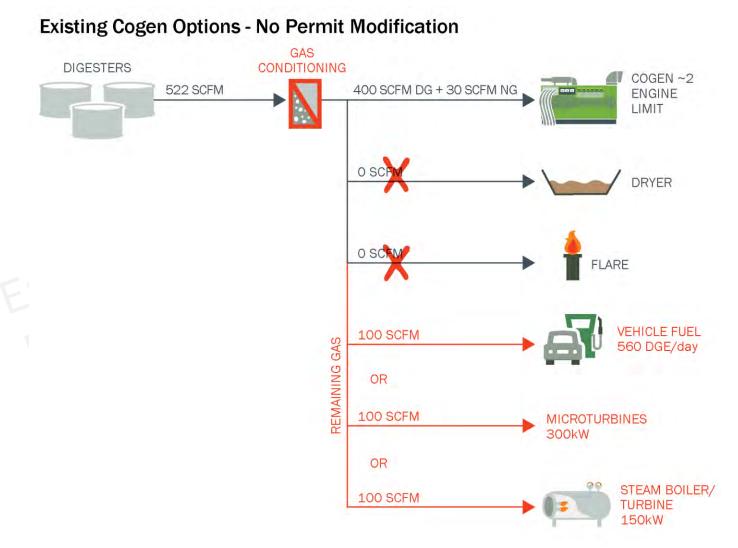


Gas conditioning could reduce engine and dryer O&M costs associated with siloxanes

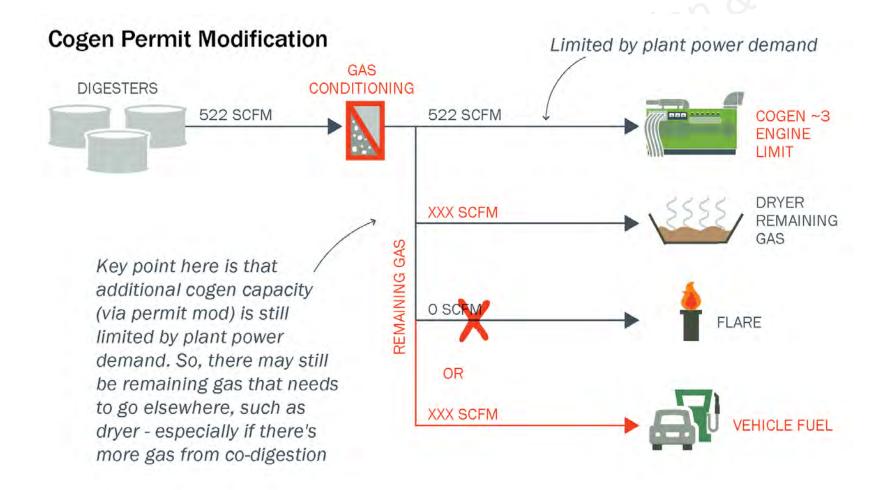
Baseline with Gas Conditioning GAS DIGESTERS CONDITIONING COGEN~2 522 SCFM 400 SCFM DG + 30 SCFM NG 000 -ENGINE LIMIT DRYER 18 SCFM DG + 119 CFM NG REMAINING GAS 73 SCFM FLARE

Brown and Caldwel

With the existing permit in place, where else can we send digester gas to get highest value?

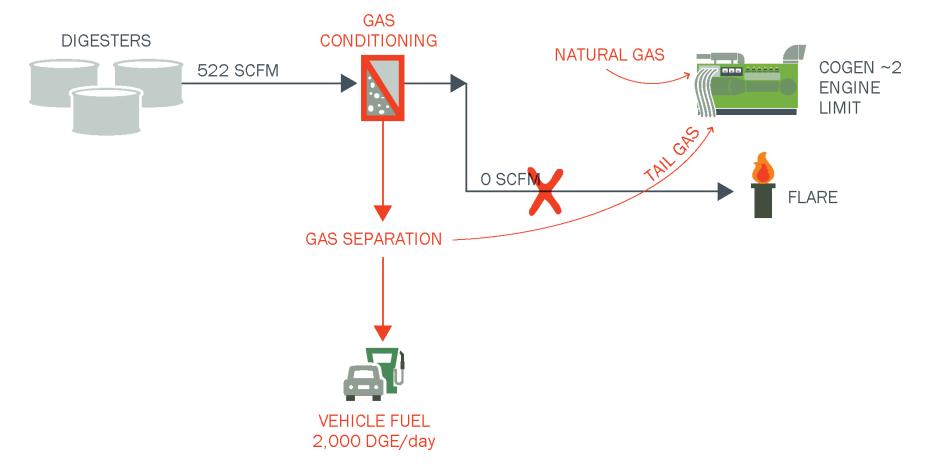


A permit modification allows EWA to meet plant electricity demand, but any additional gas would need to go to a non-generating use



An all-vehicle-fuel option may deliver the best economics

Vehicle Fuel



Attachment B: Evaluation of Alternative Fuel Digester Loading Strategy

Technical Memorandum, Trussell Technologies Inc.



Use of contents on this sheet is subject to the limitations specified at the beginning of this document. SC07039_TM4_Biogas Train Enhancements_FINAL.docx

B-1



Technical Memorandum

Evaluation of Alternative Fuel Digester Loading Strategy



October 2017

Prepared by:



Prepared By: Jeff Noelte, Ph.D., P.E., BCEE

Reviewed By: R. Shane Trussell, Ph.D., P.E., BCEE

TABLE OF CONTENTS

1. INTRODUCTION	1
1.1 Objectives of this Technical Memorandum	1
1.2 ALTERNATIVE FUEL CO-DIGESTION EXPERIENCE AT EWPCF	1
2. OVERVIEW OF CO-DIGESTION PROGRAMS AT WASTEWATER FACILITIES	2
2.1 FOG AT SAN FRANCISCO PUBLIC UTILITIES COMMISSION (SFPUC)	
2.2 FOOD WASTE SLURRY AT LOS ANGELES COUNTY SANITATION DISTRICTS	
2.3 HIGH-STRENGTH WASTE AT EAST BAY MUNICIPAL UTILITY DISTRICT (EBMUD)	4
3. LITERATURE REVIEW	5
3.1 FOG CO-DIGESTION	5
3.2 FOOD WASTE SLURRY CO-DIGESTION	
3.3 Brewery Waste Co-Digestion	
4.0 PROCESS CONSIDERATIONS FOR EWPCF	7
4.1 DIGESTER STABILITY	
4.2 DIGESTER GAS USE AND PRODUCTION	
4.3 Solids Dewatering and Drying	11
4.4 Centrate Quality	11
5. RECOMMENDATIONS	11
5.1 Alternative Fuel Loading Strategy	
5.2 Process Monitoring	12
6. REFERENCES	15

LIST OF FIGURES

LIST OF TABLES

TABLE 1 ALTERNATIVE FUEL COMPOSITION	2
TABLE 2 FOOD WASTE SLURRY CO-DIGESTION PLAN AT LACSD	4
TABLE 3 SUMMARY OF DG AND NG USE ALONG WITH DG PRODUCTION	10
TABLE 4 TYPICAL DATA FOR DIGESTER OPERATION (MAY 2016 TO APRIL 2017)	12
TABLE 5 RECOMMENDED AF CHARACTERIZATION DATA	13

LIST OF ABBREVIATIONS

Description	Abbreviation
Anaerobic Digestion	AD
Alternative Fuels	AF
Alternative Fuel Receiving Facility	AFRF
Chemical Oxygen Demand	COD
Digester Gas	DG
Engineered BioSlurry	EBS
East Bay Municipal Utility District	EBMUD
Encina Wastewater Authority	EWA
Encina Water Pollution Control Facility	EWPCF
Fats, Oil, and Grease	FOG
Food Waste	FW
Los Angeles County Sanitation Districts	LACSD
Long Chain Fatty Acid	LCFA
Liquid Environmental Solutions of California	LES
Lauter Tun Drip	LT Drip
Natural Gas	NG
San Francisco Public Utilities Commission	SFPUC
Total Kjeldahl Nitrogen	TKN
Technical Memorandum	TM
Total Solids	TS
Trussell Technologies, Inc.	TT
Volatile Acid	VA
Volatile Acid/Alkalinity	VA/Alk
Volatile Fatty Acid	VFA
Volatile Solids	VS
Volatile Solids Reduction	VSR
Water Reclamation Plant	WRP

1. INTRODUCTION

The co-digestion of biodegradable wastes with municipal sludge at wastewater facilities employing anaerobic digestion has been receiving more and more attention over the past several years. Some key drivers for this are:

- Produce additional biogas that can be used to generate electricity or offset natural gas needs
- Divert biodegradable wastes from other disposal paths (e.g., landfills)
- Utilization of existing anaerobic digestion capacity at wastewater facilities

In 2011, the Encina Wastewater Authority (EWA) decided to implement co-digestion of Alternative Fuels (AFs) through its energy and emissions strategic planning effort. EWA started operation of its Alternative Fuel Receiving Facility (AFRF) at the Encina Water Pollution Control Facility (EWPCF) in 2015.

1.1 Objectives of this Technical Memorandum

The EWA engaged Trussell Technologies, Inc. (TT) to provide technical support for the anaerobic digestion process at the EWPCF, focusing on an evaluation of the AF system. This technical memorandum (TM) presents the findings of the evaluation according to the objectives listed below:

- a) Summarize EWA's experience with AF co-digestion to date
- b) Provide an overview of relevant co-digestion programs in California
- c) Summarize the key findings from a literature review on co-digestion of AFs
- d) Describe process considerations for AF co-digestion at EWPCF, including capacities of the AF and related systems
- e) Present operational strategy and process monitoring recommendations

1.2 Alternative Fuel Co-Digestion Experience at EWPCF

Except for some short-term testing on brewery waste in April 2017, all the AF co-digested so far at EWPCF has been Fats, Oil, and Grease (FOG) from Liquid Environmental Solutions of California, LLC (LES) through a competitively let contract awarded in December 2013. FOG co-digestion has been conducted continuously since May 2015, with deliveries from LES of 80,000 gallons per week (the maximum contracted volume) since January 2017. A comparison performed by RMC of digester gas production in 2016 with FOG co-digestion to digester gas production in 2014 before FOG co-digestion showed a volumetric increase of 29% with similar methane content, which corresponds to a unit energy production factor of approximately 0.104 therms per gallon of LES FOG. It should be noted that, in addition to biomethane being produced directly from the AF, enhanced digestion of the municipal sludge due to co-digestion can contribute to the increase in biomethane production.

EWA performed side-by-side co-digestion testing of LES FOG and a brewery waste from Stone Brewery known as Dewatered Lauter Tun Drip (LT Drip) in April 2017. For the testing, FOG was fed to Digester 5 and Dewatered LT Drip was fed to Digester 6 to assess the relative performance of the two AFs as the two digesters were fed typical volumes of municipal sludge equally. The limited data on the composition of the AFs are presented in Table 1.

		Alternative Fuel (AF)		
Parameter	Units	LES FOG	Dewatered LT Drip	
Total Solids (TS)	%	1-10	4-6	
COD(total)	mg/L	100,000-200,000	60,000-130,000	
Volatile Solids (VS)	% of TS	-	~98	

Table 1 Alternative Fuel Composition

No problems related to digester stability were observed during the month-long test in which a total of 409,812 gallons of FOG and 290,365 gallons of Dewatered LT Drip were fed to Digester 5 and Digester 6, respectively. Dividing the digester gas produced from each digester by the volume of AF fed over the test period indicated the co-digestion of Dewatered LT Drip resulted in about 38% more digester gas production than co-digestion of LES FOG per gallon of AF. Lab analysis of Dewatered LT Drip performed after this testing indicated that nearly all the COD was in the soluble form, which allows this AF to biodegrade easily.

2. OVERVIEW OF CO-DIGESTION PROGRAMS AT WASTEWATER FACILITIES

An overview of three significant co-digestion programs implemented at California wastewater facilities is provided below. The AFs used in these programs include FOG, food waste (FW) slurry, food scraps, poultry processing waste (blood and body parts), cheese and yogurt production waste. Our review did not identify a program where brewery waste is being co-digested with municipal sludge at full scale.

2.1 FOG at San Francisco Public Utilities Commission (SFPUC)

The SFPUC began FOG co-digestion in 2010 at its Oceanside Plant, a 21 MGD (currently treating 15 MGD) pure oxygen activated sludge plant designed for BOD removal. It has four egg-shaped digesters (0.75 MG each) operated in a single-stage mesophilic mode. The FOG receiving and injection equipment includes six tanks (4,000 gallons each), and a mixing and heating system capable of heating the FOG to 150 degrees F. Over a study period of January to August 2012, the FOG averaged total solids (TS) of 6%, volatile solids (VS) of 93%, pH of 4.2, and chemical oxygen demand (COD) of approximately 144,000 mg/L. The VS from FOG fed to the digesters averaged 6% of the total VS fed, and for short periods this value reached as high as 47% with no negative impacts on the digestion process. FOG co-digestion increased the volume of biogas produced by 19%, and the methane content of the biogas from 59% to 63%. This corresponded to an increase in methane gas production of 27%.

Other impacts of FOG co-digestion on the performance of the Oceanside Plant's digestion system are summarized below.

- The seasonal foaming typically experienced during warmer months (June to October) was not observed to be different (i.e., was not made worse or improved).
- No significant difference was observed in the mass of digested sludge to be disposed of.
- No scum layer formation or grease flotation was observed in the egg-shaped digesters despite the gradual decrease in digester mixing from six turnovers per day to less than three.

2.2 Food Waste Slurry at Los Angeles County Sanitation Districts

The Los Angeles County Sanitation Districts (LACSD) started a demonstration program to co-digest FW slurry in one of its 24 active digesters (3.7 MG each) at the Carson facility in 2014. A single-stage mesophilic digestion process is utilized. They contracted with Waste Management to provide a FW slurry known as Engineered BioSlurry (EBS), which is source separated food wastes from grocery stores, food processors, and restaurants that are processed into a slurry of about 14% TS. The FW slurry, similar in thickness to cooked oatmeal, has a VS of approximately 92%, and COD of 222,400 mg/L. The food waste slurry specifications include the criteria listed below.

- 1. pH:
- 2. Total Solids:
- 3. Volatile Solids (% of Total Solids):
- 4. Electrical Conductivity:
- 5. Volatile Acids (Acetic Acid Equivalents):
- 6. Total COD:
- 7. Total BOD:
- 8. Specific Gravity@25°C:
- 9. Kinematic Viscosity@25°C:
- 10. Ammonia as Nitrogen (NH₃-N):
- 11. Total Kjeldahl Nitrogen (TKN):
- 12. Total Carbon:
- 13. Arsenic:
- 14. Calcium:
- 15. Chloride:
- 16. Chromium:
- 17. Magnesium:
- 18. Mercury:
- 19. Nickel
- 20. Potassium:
- 21. Sodium:
- 22. Total Heavy Metals(Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn):
- 23. Film Plastic > 4 mm
- 24. Glass > 4 mm
- 25. Total Inerts > 4 mm (Film and hard plastics, Glass, metal & rocks) (Method TMECC 0306)

LACSD's FW slurry co-digestion plan is summarized in Table 2.

3.0 - 7.010.0 - 15.0% Greater than 80% Less than 15 millimho/cm Less than 15,000 mg/L Greater than 160,000 mg/L Greater than 80,000 mg/L 0.95 - 1.10Less than 200 cps Less than 600 mg/L Less than 7,500 mg/L Greater than 9,000 mg/L Less than 1 mg/L Less than 3,000 mg/L Less than 3,000 mg/L Less than 2 mg/L Less than 500 mg/L Less than 1 mg/L Less than 5 mg/L Less than 3,000 mg/L Less than 3,000 mg/L

Less than 50 mg/L

Less than TBD % by dry weight Less than TBD % by dry weight

Less than TBD % by dry weight

Parameter	Units	Test Digester	Control Digesters
Wastewater Sludge Feed	gal/day	205,000	205,000
	% solids	3.2%	3.2%
	tons per day solids	27.3	27.3
Food Waste Slurry Feed	gal/day	20,000	
	% solids	14%	
	tons per day solids	11.7	
% Food Waste Slurry	volume basis	9%	
	solids basis	30%	
Total Feed	gal/day	225,000	205,000
	% solids	4.2%	3.2%
	HRT, days	16.4	18.0

Table 2 Food Waste Slurry Co-Digestion Plan at LACSD

The feed rate target of 20,000 gal/day for FW slurry was reached in October 2016, and the biogas production in the test digester has been about 62% greater than the control digesters. The test digester has demonstrated a higher volatile solids reduction (VSR) (54.4% versus 50.3% for the control), which translates to similar TS and VS in the digested sludge for the test and control digesters (test digester: 2.37% TS and 60.9% VS; control digester: 2.28% TS and 59.5% VS). LACSD reports that treatment plant operations are not significantly impacted by the co-digestion, and the success of this program has led to plans to expand the FW slurry co-digestion to four additional digesters (i.e., 100,000 gal/day). A couple of challenges to be aware of are controlling the amount of inert material in the food waste slurry (e.g., grit and plastics), and its relatively high viscosity can lead to long truck unloading times.

2.3 High-Strength Waste at East Bay Municipal Utility District (EBMUD)

Motivated in part by excess capacity in both the liquid and solids treatment processes (i.e., design capacity of 120 MGD and currently treats 50 MGD), EBMUD began co-digesting organic wastes with their municipal sludge more than a decade ago. Along the way, they've performed many studies and tests to improve the understanding of the mechanisms and impacts of co-digestion. Currently, the eleven digesters are operated in a two-stage, thermophilic configuration where the first stage is maintained at 50 degrees C (122 deg F), and the second stage is not heated. A summary of EBMUD's co-digestion program is given below.

- FOG is received at a rate of 50,000 60,000 gal/day
- Food scraps are received at 10 15 tons/day
- Protein wastes (e.g., blood, chicken parts, cheese waste, and yogurt waste) are also received
- All co-digestion waste is received in blend tanks (two at 200,000 gal each) where it is processed into a pulp for injection into first stage digesters
- Online COD analyzers are utilized to control loading rates
- The average HRT is about 15 days (facility is approved for a 10-day running average HRT)
- Energy from biogas met about 50% of facility demand prior to co-digestion
- Energy from biogas currently meets 130% of facility demand (i.e., export to grid)

Challenges have been experienced with the grit content of the FOG, inert debris in the food scraps (e.g., plastics), and digester foaming when lactose was co-digested. EBMUD has reported the following findings related to the co-digestion of food scraps.

- a) Food scraps produce as much or more energy than wastewater solids per ton of dry solids fed to the digesters.
- b) VSR of food scraps proceeds at a quicker rate and to a greater extent than wastewater solids (VSR is 70% 80% for food scraps, and 50% 60% for wastewater solids).
- c) Food scraps produce about half the dry tons of digested sludge compared to wastewater solids.

3. LITERATURE REVIEW

A literature review was conducted to identify items that could be relevant to the decisions EWA will be making on co-digestion of AFs. As such, this review focused on the co-digestion of FOG, FW slurry, and brewery wastes with wastewater solids since these AFs are the most likely to be utilized by EWA. The key areas of interest were the loading rates used, DG production, digester stability impacts, solids dewatering impacts, and impacts on the quality of return streams (e.g., centrate).

3.1 FOG Co-Digestion

Articles relating to FOG co-digestion have a common theme that a significant increase in DG production can be realized with little risk of negative impacts. Suto et al. (2006) conducted bench scale tests of FOG co-digestion with primary and secondary sludge from the main EBMUD plant at mesophilic (95 deg F) and thermophilic (122 deg F) temperatures. Their observations are summarized below.

- FOG characteristics (TS, VS, COD) were highly variable.
- FOG feed rates of 20% and 35% of total feed (by volume) resulted in increases in DG production of 17% to 94% while maintaining stable digester conditions.
- A FOG feed rate of 50% of total (by volume) resulted in digester instability after about 10 days.
- Thermophilic digestion showed an increased ability to degrade the long chain fatty acids (LCFAs) associated with FOG compared to mesophilic digestion.

A key component of FOG for methane production are the LCFAs, which are composed of a carbon chain (C_8 to C_{20}) with a carboxyl group on the end. Many researchers have observed inhibition of methane production due to LCFAs, with the mechanism thought to be LCFAs adsorbing to bacterial cell membranes, resulting in mass transfer limitations. Consequently, the upper limit for FOG loading to maintain stable digestion may be a function of LCFA concentrations. Suto et al. (2006) observed that oleic acid (C_{18}) and palmitic acid (C_{16}) were the most abundant LCFAs in the FOG used in their study. Addition of these specific LCFAs showed inhibitory effects when the concentrations in the mesophilic digester sludge reached 1,600 mg/L for oleic acid, and 4,000 mg/L for palmitic acid.

Kabouris et al. (2009) performed bench scale tests of FOG co-digestion with primary and secondary sludge from a plant in Pinellas County Florida at mesophilic (95 deg F) and thermophilic (126 deg F) temperatures. They observed stable digestion when FOG accounted for 48% of the VS loading, and the methane yield per unit mass of VS added at mesophilic temperature was 2.9 times greater than digestion without FOG addition (290% of the normal methane production). Pinellas County used a FOG that had been dewatered using gravity separation with polymer addition.

Other investigators (Li et al., 2013; Tandukar and Pavlostathis, 2015) have observed similar results (i.e., stable digestion at high FOG loading rates with significant increases in DG production). Due to the very high volatile solids reduction (VSR) for FOG (typically over 90%) and increased VSR for the wastewater

solids that often accompanies FOG co-digestion, the dry weight of solids to be dewatered is usually the same or less than digestion without FOG addition.

3.2 Food Waste Slurry Co-Digestion

The LACSD FW slurry program described earlier provides the most relevant guidance to potential FW slurry co-digestion at EWA, with the key items being the loading (30% of solids loading from FW slurry) and the criteria relating to the composition of the FW slurry. A review of the literature revealed that potential inhibition of methane production at higher loadings is likely caused by volatile fatty acid (VFA) accumulation resulting from the acidogenesis stage of digestion, which causes a drop in pH that inhibits methanogenesis (Hobbs et al., 2017). (note: volatile acid (VA) and VFA are often used interchangeably)

Cabbai et al. (2016) conducted a pilot scale study of the mesophilic co-digestion of FW slurry (derived from fruit and vegetable waste) with municipal sludge from a wastewater plant in Udine, Italy. The pilot digester (1:1000 scale of full size digester at the Udine facility) was initially operated without FW at a municipal sludge loading rate similar to the full scale (0.05 lb VS/ft³-day), followed by a series of phases in which the FW slurry was increased from 1.5% to 29% of the total feed (volume basis). The highest VS loading rate tested was 0.2 lb VS/ft³-day, with stable digester operation observed for all feed rates. The authors suggested the digester biology can tolerate higher organic loadings than the maximum value tested since their stability parameter (ratio of intermediate alkalinity from volatile organic acids to alkalinity from bicarbonates) never exceeded 0.10, well below 0.4 which is considered the upper limit for stable digester operation. The VSR increased as the FW slurry loading increased, with a VSR of 33% with no FW to 67% at the highest loading. As a result of the increased VSR, the TS in the digested sludge remained relatively constant at all loading rates. The methane content of the DG without FW slurry was 63%, and this value ranged between 64% and 71% during food waste co-digestion. The maximum DG production rate, observed at the highest loading rate, was 2.9 times greater than with no FW.

Our literature review re-emphasized the point that the nitrogen content (e.g., ammonia and protein content) of the FW slurry is an important consideration since nitrogen rich substrates can lead to high ammonia concentrations in the digesters. Inhibition of methane production can occur when ammonia reaches 1500 mg/L. Unlike FOG, which has a low nitrogen content, the nitrogen content of FW can vary greatly. The potential for ammonia toxicity is why LACSD has included ammonia and TKN (Total Kjeldahl Nitrogen) limits in their specifications for FW slurry.

3.3 Brewery Waste Co-Digestion

The beer brewing process produces multiple wastes, which includes spent grain, spent yeast, and the liquids from the processing and handling of the grain and yeast. Compared to FOG and FW co-digestion with wastewater solids, there has been much less published on the topic of brewery waste co-digestion. This is due to:

- Brewery waste being much less widespread than FOG and FW;
- Brewery waste has value as animal feed, and even as a component of food for human consumption;
- Breweries implementing their own waste-to-energy projects.

Nansubuga et al. (2015) studied the co-digestion of brewery waste with primary sludge from a wastewater plant in Kampala, Uganda. No details were given on whether the brewery waste was from a particular process at the brewery (e.g., spent yeast). The bench scale co-digestion was performed at mesophilic temperature at a retention time of 20 days. The brewery waste had a TS of 6.2%, VS of 77%, pH of 4.4, COD of 150,000 mg/L, and ammonia nitrogen of 67 mg/L. The primary sludge showed relatively poor biodegradability (VS around 50%) by itself due to long travel times in the sewers. The investigators

observed stable digester operation at a brewery waste feed rate of 50% of total (by volume), with a DG production rate three (3) times greater than with no brewery waste. A test receiving only brewery waste as feed became unstable (pH drop) at a retention time of 28 days.

Earlier studies (Pecharaply et al., 2007; Barbel et al., 2009) tested the co-digestion of brewery sludge with wastewater solids from a Bangkok, Thailand wastewater plant. Since the main objective of the studies was to assess the impact of co-digestion on the suitability of the dewatered sludge as a fertilizer for agriculture (e.g., pathogen, heavy metal, and nutrient content), the amount of data presented on the co-digestion process was limited. Their bench scale tests at mesophilic temperature did indicate that a brewery waste feed rate of 75% of total (by weight), which corresponded to a VS loading rate of 0.094 lb VS/ft³-day, provided the highest DG production and VSR (note: this is a relatively low loading rate in terms of typical anaerobic digesters). The reported DG methane content for all brewery waste feed rates tested was surprisingly high at over 70%.

4.0 PROCESS CONSIDERATIONS FOR EWPCF

For the co-digestion of AFs at EWPCF, process considerations relating to digester stability, digester gas use and production, solids dewatering and drying, and centrate quality are discussed in this section.

4.1 Digester Stability

The stability of the AD process can be affected in various ways when AFs are being co-digested and are summarized below:

- a) LCFA inhibition of methanogenesis due to high LCFA concentrations from FOG addition The inhibition of methanogenesis means the conversion of VFAs slows down, which in turn leads to an increase in VFA concentration and an associated drop in pH. Since the literature has mixed results as to whether higher FOG loadings translate to LCFA inhibition, the risk of this type of inhibition is expected to be relatively low.
- b) Digester acidification (pH drop) due to excessive loading (Volatile Solids or Organic) Under conditions of digester overloading, the formation of VFA (acidogenesis) exceeds the rate of VFA utilization by methanogens, which leads to VFA accumulation. All of the AFs considered in this memo (i.e., FOG, FW slurry, and brewery waste) have the potential for this type of impact.
- c) Ammonia inhibition due to the toxic effect of ammonia at high concentrations The AD of organic nitrogen (e.g., protein) produces ammonia, which is toxic in its nonionized form (NH₃) (Rittmann and McCarty, 2001). An ammonia nitrogen concentration of about 1500 mg/L is typically cited as the concentration where inhibition of methanogens begins. FW slurry and brewery waste containing significant organic nitrogen can lead to ammonia inhibition.
- d) Hydrogen sulfide inhibition due to toxicity at high concentrations The AD of sulfate and organic sulfur compounds produces hydrogen sulfide, which can be toxic to the digester biology at concentrations above 200 mg/L. FOG is typically low in sulfur, but food waste slurry and brewery waste may contain enough sulfur to be of concern.
- e) Heavy metal inhibition due to toxicity at high concentrations
 Since the AFs under consideration are typically low in heavy metals, the risk of this type of inhibition is expected to be relatively low.

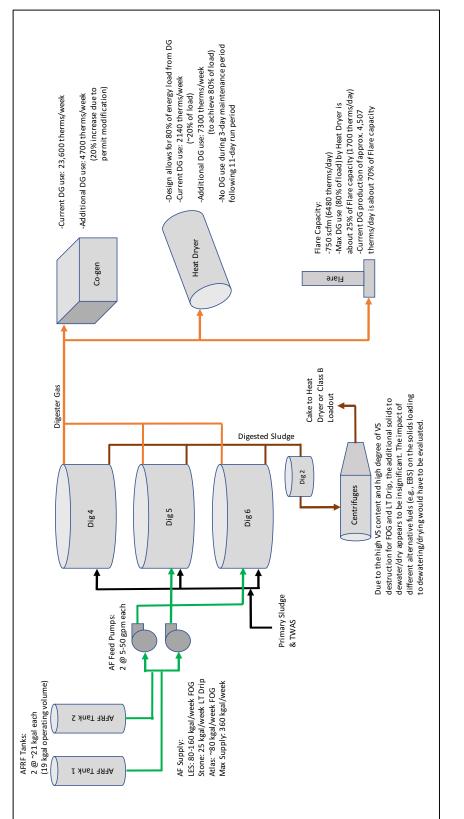
f) Potential to exacerbate digester foaming Lactose addition has been reported to have a high risk of digester foaming and/or acidification. Consequently, this AF should be avoided.

The monitoring of typical parameters associated with digester operation like the VFA to alkalinity ratio (VFA/Alk), ammonia concentration, hydrogen sulfide concentration, and heavy metal concentrations will

greatly reduce the risk of digester instability. Specifying and monitoring criteria for the content of AFs received will reduce the risk further. In addition, digester stability has been shown to be more robust at thermophilic temperature (Kabouris et al., 2009; Sprague et al., 2012), especially when it comes to VS/organic loading. This isn't surprising because of the fundamental impact of temperature on the rate of biochemical transformations (i.e., an increase in temperature of 10 degrees C typically results in a doubling of reaction rates). Implementation of thermophilic digestion is an option for increasing the VS loading capacity without increasing digester volume.

4.2 Digester Gas Use and Production

Since increasing DG production for beneficial use is an important motivation for implementing AF codigestion, we need to understand just how much DG can be utilized. A schematic representation of the AF System at the EWPCF is shown in Figure 1.





As shown in Figure 1, digester gas can be beneficially used by Co-gen and the Heat Dryer. By design, this equipment utilizes both natural gas (NG) and DG. A summary of DG and NG use, along with DG production, is presented in Table 3.

	Therms/week	<u>Therms/day</u>	Notes/Comments
leat Dryer			Based on May 2016 - April 2017 data
Total gas use	11,800	1,686	Heat Dryer typically runs at or near capacity
Current NG use	9,660	1,380	About 80% of capacity based on therms
Current DG use	2,140	306	About 20% of capacity based on therms
Max DG use	9,440	1,349	Design capacity is 80% of therm load
Min NG use	2,360	337	20% of therm load from design
Additional DG use	7,300	1,043	Additional DG that can be used by Heat Dryer
o-gen Engines			Based on May 2016 - April 2017 data
Current DG use	23,600	3,371	
Current NG use	2,245	321	
Additional DG use	4,700	671	20% increase in DG to co-gen upon permit modification
are			Based on May 2016 - April 2017 data
Current DG use	3,130	447	
DG capacity	-,	6,480	Based on design capacity of 750 scfm
		0,100	
<u>G Production</u>			
			Based on May 2016 to April 2017 data which includes
Current DG Production	31,550	4,507	FOG from LES (deliveries ranged from 46,000 to
			80,000 gal/week)
			Based on Unit Energy Production factor of 0.10425
Additional DG			therms/gal FOG from RMC memo (EWPCF Alternative
Production from	8,340	1,191	Fuels Receiving Facility Performance, May 2017). This
80,000 gal/week of	0,010	1)101	factor corresponds to the FOG delivered by LES during
FOG*			2016.
Additional DG			Based on Unit Energy Production factor of 0.14386
Production from			therms/gal LT Drip derived from April 2017 side-by-
25,000 gal/week of LT	3,600	514	side testing that showed LT Drip produced 38% more
Drip*			DG per unit volume than FOG (note: the initial estimate
Brip			of 50% more DG from LT Drip was adjusted to 38%).
Additional DG			Can be calculated by multiplying volume delivered
			(gal/week) by Unit Energy Production factor
Production from other			(therms/gal). This factor would have to be determined
FOG source (e.g.,			through testing, or estimated based on factor for LES
Atlas)			FOG.
			Can be calculated by multiplying volume delivered
			(gal/week) by Unit Energy Production factor
Additional DG			(therms/gal). This factor would have to be determined
Production from			through testing. Composition of SY (i.e., lipid,
Spent Yeast (SY)			carbohydrate, and protein content) should be
			evaluated prior to testing.
			Can be calculated by multiplying volume delivered
Additional DG			(gal/week) by Unit Energy Production factor
Production from Food			(therms/gal). This factor would have to be determined
Waste Slurry			through testing. Composition of EBS (i.e., lipid,
waste stally			carbohydrate, and protein content) should be
			evaluated prior to testing.

Table 3 Summary of DG and NG Use Along with DG Production

* The additional DG production estimated from an additional 80,000 gal /week of FOG and 25,000 gal/week of LT Drip (green cells; 11,940 therms/week) is about the same as the added DG demand from the Heat Dryer and Co-gen Engines (orange cells; 12,000 therms/week). An additional 12,000 therms/ week will increase the current DG production of approximately 4,500 therms/day to 6,200 therms/ day, which is approaching but still below the Flare's design capacity of 6,480 therms/day.

As noted in Table 3, the Heat Dryer and Co-gen Engines can use an additional 12,000 therms/week of DG to reach their maximum DG use (based on design and permit limits). This added DG demand can be met by co-digesting an additional 80,000 gal/week of FOG and 25,000 gal/week of Dewatered LT Drip. For completeness, Table 3 includes guidance on how DG production from FOG received from another source, spent yeast from a brewery, and FW slurry can be accounted for if these AFs are utilized.

The capacity for flaring DG is an important consideration because the flare needs to handle all the DG being produced in the event the Heat Dryer and Co-gen stop consuming DG. If an additional 12,000 therms/week of DG is produced (relative to May 2016 to April 2017 data), the total DG production is approaching the flare capacity. Therefore, an appropriate level of control over DG production via AF feed rates is needed to ensure DG production does not exceed the flare capacity. To reduce the risk of a DG venting incident, some agencies in Southern California have connected carbon canisters to the digester pressure relief valves to scrub hydrogen sulfide from any DG released, thus avoiding a permit violation during short-term increases in DG pressure.

4.3 Solids Dewatering and Drying

Highly biodegradable AFs like FOG and Dewatered LT Drip do not result in additional solids to be dewatered. In fact, they can lead to enhanced digestion of the wastewater solids, resulting in an overall reduction of solids to dewater relative to no AF co-digestion. This may not be the case for other AFs (e.g., FW slurry and brewery spent yeast). Testing would be needed to determine the VSR of these AFs, and the resulting impact on the solids content of the digested sludge.

4.4 Centrate Quality

The impact of AF co-digestion on the quality of centrate (or other return streams) has not been reported widely. The co-digestion of nitrogen-rich AFs would likely increase the ammonia content of the centrate being returned to the head of the plant. This would be significant for a nitrifying plant. For a non-nitrifying plant like the EWPCF, the impact may be minor.

Since digestion at thermophilic temperature was mentioned previously as an option to increase the VS/organic loading capacity, it should be noted that thermophilic digestion typically has a negative impact on centrate quality in terms of solids and organic content. The digested sludge floc characteristics in thermophilic digestion result in a lower solids capture in the dewatering process.

5. RECOMMENDATIONS

Recommendations for the AF loading strategy and process monitoring are presented in this section.

5.1 Alternative Fuel Loading Strategy

The key to the AF loading strategy is the target for the additional DG to be produced. As described in Section 4, this target is about 12,000 therms/week. It is recommended to prioritize FOG and Dewatered LT Drip to achieve the DG production target since these AFs are the most effective at producing DG with little risk of causing digester instability. Also, FOG and Dewatered LT Drip are not expected to increase the solids loading to the dewatering process or degrade the quality of the centrate. The quantities of FOG and Dewatered LT Drip needed to produce about 12,000 therms/week are consistent with the reported availability of these AFs from current suppliers. Guidance has also been given that FOG from another supplier, in significant quantities that undergo more quality control, is readily available. A practical

concern of FOG injection is the potential for FOG to congeal and plug piping. Fortunately, the AFRF was designed with relatively short pipe runs and a hot water flush system to address this concern. If the co-digestion of spent yeast and/or FW slurry is pursued, a thorough testing phase is recommended in which the loading rate of the AF is gradually ramped up to assess the process impacts. The main reasons for this are the potential for ammonia production in the digesters, and the potential to increase solids loading to dewatering and the dryer. A test period of three months or more in a digester dedicated to the co-digestion of the AF of interest is desirable to collect a representative body of data.

Before additional AF is received, an evaluation of the flare's ability to operate near its design capacity is recommended. Depending on this outcome, a determination can be made on whether the system's ability to respond to the various modes of failure will be acceptable if more DG is produced.

AF Strategy Summary:

- Prioritize FOG and Dewatered LT Drip to achieve target of 12,000 therms/week
- Evaluate flare's ability to operate near design capacity
- Testing phase recommended for spent yeast
- Testing phase recommended for FW slurry

5.2 Process Monitoring

The process monitoring parameters currently measured for the digestion system are comprehensive. These parameters and typical values are shown in Table 4.

Parameter	units	Average	Min	Max
Primary sludge to digesters	gal/day	166,402	146,869	189,562
Primary sludge TS	%	4.23	3.57	5.20
Primary sludge VS	%	86.78	82.60	87.85
TWAS to digesters	gal/day	84,279	77,889	95,341
TWAS TS	%	5.70	4.96	6.25
TWAS VS	%	80.10	78.00	82.40
Digester HRT	days	17.30	15.81	19.23
Digester Temperature	deg F	97.08	96.94	97.23
pH (digested sludge)	n/a	7.07	6.94	7.12
Alkalinity (digested sludge)	mg/L as CaCO3	4,834	4,438	5,283
VFA (digested sludge)	mg/L	226.00	165.00	276.00
NH3-N (digested sludge)	mg/L	n/a	n/a	n/a
VSR	%	54.66	46.62	60.21
Biogas production	cu ft/day	739,367	668,760	816,099
Methane content (digester gas)	%	58.60	55.37	61.34
H2S (digester gas)	ppm	180	100	275

Table 4 Typical Data for Digester Operation (May 2016 to April 2017)

The current monitoring should continue, and if an AF containing appreciable levels of nitrogen (e.g., protein) is co-digested, then monitoring the ammonia nitrogen concentration in the digested sludge (or centrate) is also recommended. When changes to the type of AF or changes to the loading rate are made, it is recommended to increase the frequency of measurements done in the lab from once per week to two or three times per week until the new steady state is reached (approximately 1 month). When considering an AF for co-digestion, characterizing the AF according to Table 5 is also recommended.

Parameter	units	Alternative Fuel Value	Notes/Comments
Source/AF Type	n/a		Describe the source of material
Quantity	gal/day		Provide the expected quantity of waste material
TS	%		Total Solids
VS	% of TS		Volatile Solids
TDS	mg/L		Total Dissolved Solids
COD (total)	mg/L		Total Chemical Oxygen Demand
COD (soluble)	mg/L		Soluble Chemical Oxygen Demand
рН	n/a		
Alkalinity	mg/L as CaCO3		
VFA	mg/L		Volatile Acids
TN	mg/L		Total Nitrogen
TKN	mg/L		Total Kjeldahl Nitrogen
NH ₃ -N	mg/L		Ammonia Nitrogen
TOC	mg/L		Total Organic Carbon
Phosphate as P	mg/L		
Phosphorus (total)	mg/L		
Sulfide (total)	mg/L		
Sulfide (soluble)	mg/L		
H ₂ S	mg/L		Hydrogen Sulfide
Sulfate	mg/L		
Protein content	%		
Fat content	%		
Carbohydrates	%		
C:N	mass ratio		Carbon to Nitrogen Ratio
BMP	volume of methane per mass of VS		Biomethane Potential
Viscosity	centistokes (cSt)		kinematic viscosity or other measure of viscosity

Table 5 Recommended AF Characterization Data

Knowing the composition of the AF is important for understanding the potential for digester instability and determining initial loading rates for co-digestion. For example, three different AFs from a local brewery known as Raw Spent Yeast, Dewatered Spent Yeast, and Dewatered LT Drip (same AF mentioned in Section 1.2), were analyzed for the parameters shown in Table 5 (except BMP) in July 2017. The Dewatered Spent Yeast is the liquid fraction produced from a solids removal process on Raw Spent Yeast, and Dewatered LT Drip is the liquid fraction resulting from a solids removal process on LT Drip. The results of this analysis are presented in Table 6.

Parameter	units		Alternative Fuel Value	9
Source/AF Type	n/a	Raw Spent Yeast	Dewatered Spent Yeast	Dewatered LT Drip
Quantity	gal/day	-	-	-
TS	%	11	1.4	5.1
VS	% of TS	>99	86	98
TDS	mg/L	11,000	9,800	35,000
COD (total)	mg/L	110,000	50,000	59,000
COD (soluble)	mg/L	58,000	52,000	60,000
рН	n/a	4.4	5	4.8
Alkalinity	mg/L as CaCO3	ND	120	110
VFA	mg/L	2,100	660	227
TN	mg/L	1,200	360	340
TKN	mg/L	1,200	350	340
NH ₃ -N	mg/L	44.3	19.3	25.3
TOC	mg/L	24,000	11,000	15,000
Phosphate as P	mg/L	160	120	130
Phosphorus (total)	mg/L	370	100	140
Sulfide (total)	mg/L	ND	ND	ND
Sulfide (soluble)	mg/L	ND	ND	ND
H ₂ S	mg/L	ND	ND	ND
Sulfate	mg/L	210	190	240
Protein content	%	2.98	0.19	0.18
Fat content	%	1.17	0.4	0.18
Carbohydrates	%	8.76	1.02	4.22
C:N	mass ratio	13:1	27:1	4:1
BMP	volume of methane per mass of VS	-	-	-
Viscosity	Bostwick (cm @ 30 sec)	2.5	>23	>23

Table 6 Brewery Waste Characterization Data

Based on the data in Table 6, the Dewatered Spent Yeast and Dewatered LT Drip have similar characteristics, which suggests their behavior as an AF in co-digestion would be similar. Relative to the brewery wastes that went through a solids removal process, the Raw Spent Yeast has a higher potential

for causing digester instability due to the significantly higher protein content (i.e., 2.98% compared to less than 0.2%).

To ensure the composition of AFs stays within acceptable limits, the development of a specification for each type of AF is recommended to include in the contract with the AF supplier. An enforceable AF specification that defines all the appropriate limits for AF quality will add to the success of the co-digestion program.

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Attachment C: Pre-Processed SSO Characteristics



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C-1

Detailed Summary of food waste characteristics from LACSD

Detailed Summary of food was		
ITEM	VALUE	REFERENCE
рН	3.0 - 7.0	LACSD SSO SPECIFICATION
Volatile Acids (Acetic Acid Equivalents)	Less than 8,000 mg/L	LACSD SSO SPECIFICATION
Total Solids	12.0 - 15.0%	LACSD SSO SPECIFICATION
Volatile Solids (% of Total Solids)	85 – 95%	LACSD SSO SPECIFICATION
Total COD	Greater than 180,000 mg/L	LACSD SSO SPECIFICATION
Total BOD	Greater than 80,000 mg/L	LACSD SSO SPECIFICATION
Specific Gravity@25 degC	0.95 - 1.10	LACSD SSO SPECIFICATION
Kinematic Viscosity@25 degC	Less than 200 cps	LACSD SSO SPECIFICATION
Ammonia as Nitrogen (NH3- N)	Less than 600 mg/L	LACSD SSO SPECIFICATION
Total Kjeldahl Nitrogen (TKN)	Less than 7,500 mg/L	LACSD SSO SPECIFICATION
Total Carbon	Greater than 9,000 mg/L	LACSD SSO SPECIFICATION
Electrical Conductivity	Less than 15 millimho/cm	LACSD SSO SPECIFICATION
Arsenic	Less than 1 mg/L	LACSD SSO SPECIFICATION
Calcium	Less than 3,000 mg/L	LACSD SSO SPECIFICATION
Chloride	Less than 3,000 mg/L	LACSD SSO SPECIFICATION
Chromium	Less than 2 mg/L	LACSD SSO SPECIFICATION
Magnesium	Less than 500 mg/L	LACSD SSO SPECIFICATION
Mercury	Less than 1 mg/L	LACSD SSO SPECIFICATION
Nickel	Less than 5 mg/L	LACSD SSO SPECIFICATION
Potassium	Less than 3,000 mg/L	LACSD SSO SPECIFICATION
Sodium	Less than 3,000 mg/L	LACSD SSO SPECIFICATION
Total Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)	Less than 50 mg/L	LACSD SSO SPECIFICATION
Specific Heavy Metal Limits		
Cadmium (Cd)	1 mg/L	Ordinance OCSD-48
Chromium (Cr)	35 mg/L	Ordinance OCSD-48
Copper (Cu)	25 mg/L	Ordinance OCSD-48
Lead (Pb)	10 mg/L	Ordinance OCSD-48
Nickel (Ni)	10 mg/L	Ordinance OCSD-48

ITEM	VALUE	REFERENCE
Zinc (Zn)	50 mg/L	Ordinance OCSD-48
Physical Contamination ⁽¹⁾ (greater than 4 millimeters)	0.5% by dry weight	Title 14 -Section 17868.3.1 – Physical Contamination Limits
Film Plastic (greater than 4 millimeters)	20% by dry weight of Physical Contamination	Title 14 -Section 17868.3.1 – Physical Contamination Limits

<u>Note</u>:

1. "Physical Contaminants" means human-made inert products contained within feedstocks, including, but not limited to, glass, metal, and plastic (Title 14 Section 17381).

Attachment D: Co-digestion Capacity Calculations



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Brown AND Caldwell	
Caluwell	

Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-001
	Pro	ject			Subject
Encina Biosolids, Energy, and Emiss	ions		Current Year - Service (Condition	

Mesophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.18	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	97	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dofo

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

Primary Slud	ge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter Input Values Reference		Parameter Input Values		Reference	
Nitrogen Specia	ation		Nitrogen Spec	ciation		Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)

Nutrients Speciation for HSOW

Parameter	Input values	Reference
Nitrogen Specia	ation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

		Table X	-X: Existing Mesophilic Digestion Feed Asses	sment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	3.90	3.90	3.90	3.90	3.90	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (Ib-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	19	15	14	13	12	
Base OLR (lbsVS/d-cf)	0.13	0.16	0.17	0.18	0.20	
Hydraulic Capacity (HC) (gpd)	50,570	4,478	-9,549	-29,589	-69,669	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (Ib-VS/day)	43,019	3,810	-8,124	-25,171	-59,266	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (lb-VS/day)	26,353	11,591	7,098	679	-12,158	Difference between max OLR (0.18 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Hydraulic	No Capacity	No Capacity	No Capacity	
			X-X: Mesophilic Co-digestion Feed Assessm			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	26,353	3,810	0	0	0	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/day)	26,353	3,810	0	0	0	
HSOW No. 2 Volatile Solids Load (lb-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	26,353	3,810	0	0	0	
SS0 Total Solids Load (Ib-TS/day)	31,004	4,482	0	0	0	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	31,004	4,482	0	0	0	
SSO (lb-wet/day)	258,364	37,349	0	0	0	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	258,364	37,349	0	0	0	
SSO (wtpd)	129	19	0	0	0	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	129	19	0	0	0	
SSO (gpd)	30,979	4,478	0	0	0	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	30.979	4,478	0	0	0 125.638	
Total Solids, Total Solids Load (lb-TS/d)	111,024	101,989	102,829	110,432		
Total Solids, Volatile Solids Load (Ib-VS/d)	111,024 93,730	85,949	86,632	93,051	105,887	
	111,024					

WAS percent of VS Load (%)	24%	32%	34%	34%	34%	
FOG percent of VS Load (%)	3%	4%	4%	3%	3%	
SSO percent of VS Load (%)	28%	4%	0%	0%	0%	
HSOW No. 2 percent of VS Load (%) Check	ok	0%	0% 0k	ok	ok	
Co-digestion HRT (days)	16	15	14	13	12	
Co-Digestion OLR (lbs-VS/d-cf)	0.18	0.17	0.17	0.18	0.20	
Process Check	OK	OK	No Cepacity	No Capacity	No Capacity	
		Table X-)	(: Existing Mesophilic Solids and Biogas Proc	luction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day) FOG Volatile Solids Destroyed (Ib-VSd/day)	10,536 2,873	12,960 2.873	2.873	14,751	16,858 2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	209.097	255.188	269-216	289.256	329.335	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	39,463	48,282	50,966	54,801	62,470	
Volatile Solids Effluent (Lbs-VS/d)	26,819	32,914	34,769	37,419	42,719	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68% 52.061	68%	
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	60 493 237	104	628 208	676 532	773 179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	187,548	230.684	243.813	262.568	300.077	Assumes a biogas vield of 17.8 scf/lb-VSd
FOG Biogas Production (scrd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	721,930	876,211	923,166	990,244	1,124,401	
		Table X-X: I	Mesophilic Co-digestion Solids and Biogas P	roduction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day) FOG Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
SSO Volatile Solids Destroyed (Ib-VSd/day)	2,873	3,429	2,873	2,813	2,873	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (lb-VSd/day)	64,276	52,654	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	240,076	259,667	269,216	289,256	329,335	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	46,748	49,335	50,966	54,801	62,470	
Volatile Solids (Lbs-VS/d) Total Solids (% TS)	29,454	33,295	34,769	37,419	42,719	
Volatile Solids (% IS)	2.3%	2.3%	68%	2.3%	2.3%	
Dewatered Solids (Lbs-TS/d)	44.411	46.868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	101	107	110	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd)	426,920	61,716	0	0	0	Assumes a biogas yield of 18 scf/lb-VSd
Total Biogas Production (scfd)	1,148,850	937.927	923,166	990,244	1,124,401	
rotal biogas i rotal dati (bold)					1,121,101	
		Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat	es		
HSOW No 1	Annual Average	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day	es Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS)	Annual Average 0.063	Tabl Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)		Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0	es Peak 7 day 0.063 0		Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	0.063 31,004 26,353	Peak Month 0.063 4,482 3,810	Peak 14 day 0.063 0 0	Peak 7 day 0.063 0 0	0.063 0 0	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	0.063	Peak Month	Peak 14 day 0.063	Peak 7 day 0.063	0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 31,004 26,353	Peak Month 0.063 4,482 3,810	Peak 14 day 0.063 0 0	Peak 7 day 0.063 0 0	0.063 0 0	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	0.063 31,004 26,353	Peak Month 0.063 4,482 3,810	Peak 14 day 0.063 0 0	Peak 7 day 0.063 0 0	0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Viotalis Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Ammonium-M Load (Ib-N/day) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Iotial Solids Load (b-TS/d)	0.063 31,004 26,353 0.053 1,260 0.000 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0	Peak 14 day 0.063 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0	Notes
SSD Organic Nitrogen Content (b-N/b-TS) SSD Ordari Solid Scald (b-TS/d) SSD Viatilitie Solidi Scald (b-TS/d) SSD Nitrogen Content (b-N/b VS) SSD Nitrogen Content (b-N/b VS) SSD Nitrogen Content (b-N/b VS) SSD Nitrogen Content (b-N/b-TS) ISOW No.2 Corganic Nitrogen Content (b-N/b-TS) ISOW No.2 Total Solidis Load (b-TS/d) ISOW No.2 Total Solidis Load (b-TS/d) ISOW No.2 Total Solidis Load (b-TS/d)	0.063 31,004 26,353 0.053 1,260 0.000	Peak Month 0.063 4,482 3,810 0.053 182	Peak 14 day 0.063 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0.000 0	0.063 0 0.000 0	Notes
SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Oradi Solids (and (Ib-TS/d) SSD Violatile Solids Load (Ib-TS/d) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Amonium-NL Add (Ib-V/day) HSOW No.2 HSOW No.2 <td>0.063 31.004 26.353 0.053 1,260 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 0 0.000 0 0 0.000 0 0 0 0 0 0 0</td> <td>Notes</td>	0.063 31.004 26.353 0.053 1,260 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solid Land (b-TS/d) SS0 Viatel Solid Land (b-TS/d) SS0 Viatel Solid Land (b-TS/d) SS0 Viatel Solid Land (b-N/b-VS) SS0 Ammonium-N Load (b-N/day) HBOW No2 SS0 Ammonium-N Load (b-TS/d) HSOW No2 Solid Land (b-N/day)	0.063 31,004 26,353 0.053 1,260 0.000 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0	Peak 14 day 0.063 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (h-TS/d) SS0 Violatile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/Ib-YS) SS0 Namonium-NL Add (b-V/day) HSOW No. 2 HSOW No. 2 MSOW No. 2 Violatile Solids Load (b-VS/d) HSOW No. 2 HSOW No. 2 Violatile Solids Load (b-VS/d) HSOW No. 2	0.063 31.004 26.353 0.053 1,260 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solids and (b-TS/d) SS0 Vitalitie Solids Load (b-VS/d) Vitalitie Solids Load (b-VS/d) VistoW to 2. Organic Nitrogen Content (b-V/b-VS) VistoW to 2. Total Solids Load (b-VS/d) VistoW to 2. Nitrogen Content (b-V/b-VS) Point to 2. Nitrogen Content (b-V/b-VS) <	0.063 31.004 26.353 0.053 1,260 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS). SS0 Total Solids and (b-TS/d). SS0 Vitrogin Content (b-N/b-VS). SS0 Nitrogin Content (b-N/b-VS). MSOW No. 2 Organic Nitrogen Content (b-N/b-TS). MSOW No. 2 Notatin Solids Load (b-VS/d). Minary Sludge Total Solids Load (b-TS/d). Primary Sludge Total Solids Load (b-TS/d).	0.063 31,004 26,353 0.053 1,280 0,000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (b-TS/d) SS0 Visitile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Almonithum AL Load (b-N/day) HBOW No.2 HSOW No.2 Nitrogen Content (b-N/b-TS) HSOW No.2 HSOW No.2 Not 2 Total Solids Load (b-TS/d) HSOW No.2 HSOW No.2 <td>0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Notes</td>	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS). SS0 Total Solids and (b-TS/d). SS0 Vitrogin Content (b-N/b-VS). SS0 Nitrogin Content (b-N/b-VS). MSOW No. 2 Organic Nitrogen Content (b-N/b-TS). MSOW No. 2 Notatin Solids Load (b-VS/d). Minary Sludge Total Solids Load (b-VS/d). Primary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-V/b-VS).	0.063 31,004 26,353 0.053 1,260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Viatal Solid Acad (b-TS/d) SS0 Viatal Solid Acad (b-TS/d) SS0 Nitrogen Content (b-N/b VS) SS0 Nitrogen Content (b-N/b-TS) ISOW No.2 Corganic Nitrogen Content (b-N/b-TS) ISOW No.2 Corganic Altrogen Content (b-N/b-TS) ISOW No.2 Contail Solid S. Ladd (b-TS/d) ISOW No.2 Nitrogen Content (b-N/b-VS) ISOW No.2 Nitrogen Content (b-N/b-TS) ISOW No.2 Nitrogen Content (b-N/b-TS) ISOW No.2 Nitrogen Content (b-N/b-TS) Primary Sludge Total Solid S. Ladd (b-TS/d) Nitrogen Content (b-N/b-NS) Ammonium-N Ladd (b-N/dy)	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS). SS0 Total Solids and (b-TS/d). SS0 Vitrogen Content (b-N/b-VS). SS0 Nitrogen Content (b-N/b-VS). MSOW No. 2 Organic Nitrogen Content (b-N/b-TS). MSOW No. 2 Ordatile Solids Load (b-VS/d). MSOW No. 2 Notatile Solids Load (b-VS/d). Mitray Sludge Total Solids Load (b-VS/d). Primary Sludge Total Solids Load (b-VS/d). Mitrogen Content (b-V/b-VS). Annonium-N Load (b-V/day). MAS	0.063 31,004 26,353 0.053 1,260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solids and (b-TS/d) SS0 Viatalis Solids and (b-TS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Ammonium-N Load (b-N/day) HSOV No 2 HSOV N	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 59,049 51,373 0.057 1,900 1	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Valadi Solid add (b-TS/d) SS0 Viotali Solid add (b-TS/d) SS0 Viotagen Content (lb-N/b VS) SS0 Ammonium-NL load (lb-N/day) HSOW No 2 HSOW	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 4,482 1,810 0.003 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (b-TS/d) SS0 Viatile Solids and (b-TS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Almonidum-M Load (b-K/day) HSOW No. 2 HSOW No. 2 <t< td=""><td>0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak Month 0.063 4,482 3.810 0.053 1.82 - 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.0065 59,049 51,373 0.057 1,900 1,900 0.0655 34,468 </td><td>Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Notes</td></t<>	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3.810 0.053 1.82 - 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.0065 59,049 51,373 0.057 1,900 1,900 0.0655 34,468	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS). SS0 Total Solids and (b-TS/d) SS0 Viralial Solids and (b-TS/d) Viralial Solids Load (b-Y/do) Virali	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3.810 0.053 1.82 - 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.0065 59,049 51,373 0.057 1,900 1,900 0.0655 34,468	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SSD Organic Nitrogen Content (b-N/b-TS). SSD Ordari Solids and (b-TS/d) SSD Vitagin Control (B-N/b-VS). SSD Nitrogen Content (B-N/b-VS). SSD Nitrogen Content (B-N/b-VS). SSD Nitrogen Content (B-N/b-VS). SSD Nitrogen Content (B-N/b-S). Pimary Sidge Total Nitrogen Content (B-N/b-S). Primary Sidge Total Solids Load (B-N/day). Primary Sidge Solids Load (B-N/day).	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.063 0.063 182 0.000 0 0 0 0.000 0 0.005 59.049 51.373 0.065 34.468 27.574 0.052 678	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Total Solids and (b-TS/d) SS0 Visitile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/lb-VS) SS0 Nitrogen Content (b-N/lb-VS) SS0 Nitrogen Content (b-N/lb-VS) SS0 Nitrogen Content (b-N/lb-TS) HSOW No. 2 SS0 Nitrogen Content (b-N/lb-TS) HSOW No. 2 HSOW No. 2 SS0 Nitrogen Content (b-N/lb-TS) HSOW No. 2 HSOW No.2	0.063 31.004 26.353 0.053 1,280 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 1.82 182 0.000 0 0.000 0 0.000 0 0.005 59.049 5.1,373 0.055 0.065 59.049 1.900 0 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 5.1,374 0.055 678 678 0.010 3.991	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0	Notes
SSD Organic Nitrogen Content (b-N/Ib-TS) SSD Viatal Solid Scald (b-TS/d) SSD Viatal Solid Scald (b-TS/d) SSD Nitrogen Content (b-N/Ib-VS) SSD Nitrogen Content (b-N/Ib-VS) SSD Nitrogen Content (b-N/Ib-TS) ISSO No. 2. Total Solids Load (b-TS/d) ISSO No. 2. Total Solids Load (b-TS/d) ISSO No. 2. Total Solids Load (b-TS/d) ISSON No. 2. Organic Nitrogen Content (b-N/Ib-TS) ISSON No. 2. Notagen Content (b-N/Ib-TS) ISSON No. 2. Notagen Content (b-N/Ib-TS) Pimary Solidge Total Nitrogen Content (b-N/Ib-TS) Pimary Solidge Total Solids Load (b-TS/d) Nitrogen Content (b-N/Ib-TS) TWAS Total Nitrogen Content (b-N/Ib-TS) TWAS Total Solids Load (b-TS/d) TWAS Total Nitrogen Content (b-N/Ib-TS) TWAS Total Nitrogen Content (b-N/Ib-TS) TWAS Total Nitrogen Content (b-N/Ib-TS) Hisow T	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.063 0.063 182 0.000 0 0 0 0.000 0 0.005 59.049 51.373 0.065 34.468 27.574 0.052 678	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SSD Organic Nitrogen Content (b-N/1b-TS). SSD Total Solids and (b-TS/d) SSD Vitaging Content ((b-N/1b-TS)) Vitaging Content ((b-N/1b-TS)) Primary Sludge Total Solids Load ((b-N/2d)) Primary Sludge Total Solids Load (b-N/2d) Primary Sludge Total Nitrogen Content ((b-N/1b-TS) Primary Sludge Total Nitrogen Content ((b-N/2d)) PMAS Total Solids Load (b-N/2d) Nitrogen Content ((b-N/1b-TS)) PMAS Total Solids Load (b-N/2d) Nitrogen Content	0.063 31.004 26.353 0.053 1,280 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 1.82 182 0.000 0 0.000 0 0.000 0 0.005 59.049 5.1,373 0.055 0.065 59.049 1.900 0 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 5.1,374 0.055 678 678 0.010 3.991	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Valazilis Caul (d-TS/4) SS0 Visitilis Solids Land (b-TS/4) SS0 Visitilis Solids Land (b-TS/4) HSOW No.2 (Carganic Nitrogen Content (lb-N/1b-TS) HSOW No.2 (National B-Sidds Land (lb-TS/4) HSOW No.2 Nitrogen Content (lb-N/1b-TS) HSOW No.2 Nitrogen Content (lb-N/1b-TS) HSOW No.2 Nitrogen Content (lb-N/1b-TS) HSOW No.2 Nitrogen Content (lb-N/1b-TS) Primary Sludge Total Nitrogen Content (lb-N/1b-TS) Primary Sludge Total Solids Land (lb-TS/4) Primary Sludge Total Solids Land (lb-TS/4) Primary Sludge Total Solids Land (lb-TS/4) Nitrogen Content (lb-N/1b-TS) Nitrogen Content (lb-N/1b-TS) Nitrogen Content (lb-N/1b-TS) Nitrogen Content (lb-N/1b-TS) Nitrogen Content (lb-N/1b-TS) Nitrogen Content (lb-N/1b-TS) HSOW Total Solids Land (lb-TS/4) Nitrogen Content (lb-N/1b-TS) HSOW Total Nitrogen Content (lb-N/1b-TS) HSOW Yotalis Solids Land (lb-TS/4) HSOW Yotalis Solids Land (lb-TS/4) HSOW Yotalis Solids Land (lb-Y5/4) HSOW Yotalis Solids Land (lb-Y4/4) HSOW Yotalis Solids Land (lb-Y5/4) HSOW Yotalis Solids Land (lb-Y4/4) HSOW Yotalis Solids Land (lb-Y4/4) HSOW Yotalis Solids Land (lb-Y4/4) HSOW Yotalis Solid	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 1.82 182 0.000 0 0.000 0 0.000 0 0.005 59.049 5.1,373 0.055 0.065 59.049 1.900 0 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 5.1,374 0.055 678 678 0.010 3.991	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Total Solids and (b-TS/d) SS0 Vitrogen Content (b-N/1b-YS) SS0 Nitrogen Content (b-N/1b-YS) SS0 Nitrogen Content (b-N/1b-TS) SS0 Nitrogen Content (b-N/1b-VS) SS0 Nitrogen Content (b-N/1b-VS) HSOW No. 2 Nitrogen Content (b-N/1b-VS) HSOW No. 2 Primary Sudge Total Solids Load (b-N/2d) Primary Sudge Total Solids Loa	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 1.82 182 0.000 0 0.000 0 0.000 0 0.005 59.049 5.1,373 0.055 0.065 59.049 1.900 0 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 5.1,374 0.055 678 678 0.010 3.991	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids and (Ib-TS/d) SS0 Vitragic Content (Ib-N/Ib VS) SS0 Vitragic Content (Ib-N/Ib-TS) HSOW No.2 SS0 Vitragic Content (Ib-N/Ib-TS) HSOW No.2 HSOW No.2 SS0 Vitragic Content (Ib-N/Ib-TS) HSOW No.2 HSOW Nolatili Solids Load (Ib-Ys/d) HTMAY SUBAILS Solids Load (Ib-Ys/d) HWAS Total Solids Load (Ib-Ys/d) HWAS Total Solids Load (Ib-Y/day) E	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 1.82 182 0.000 0 0.000 0 0.000 0 0.005 59.049 5.1,373 0.055 0.065 59.049 1.900 0 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 5.1,374 0.055 678 678 0.010 3.991	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0	Notes
SS0 Organic Nithogen Content (b-N/1b-TS). SS0 Total Solids and (b-TS/d) SS0 Vitagen Content (b-N/1b-YS). SS0 Nithogen Content (b-N/1b-YS). Pitmary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-N/1b-YS). Pitmary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-N/1b-YG). Pitmary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-N/1b-YG). Ammonium-N Load (b-N/4dy). TMAS Total Solids Load (b-YG/d). Nitrogen Content (b-N/1b-YG). Pitmary Sludge Solids Load (b-YG/d). Nitrogen Content (b-N/1b-YG). PMAS Total Solids Load (b-YG/d). Nitrogen Content (b-N/1b-YG). PMAS Total Solids Load (b-YG/d). Nitrogen Content (b-N/1b-YG). PMAS Total Solids Load (b-YG/d). <td< td=""><td>0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak Month 0.063 4.482 3.810 0.053 1.82 182 0.000 0 0.000 0 0.000 0 0.005 59.049 5.1,373 0.055 0.065 59.049 1.900 0 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 5.1,374 0.055 678 678 0.010 3.991</td><td>Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0</td><td>Notes</td></td<>	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 1.82 182 0.000 0 0.000 0 0.000 0 0.005 59.049 5.1,373 0.055 0.065 59.049 1.900 0 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.065 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 0.055 59.049 5.1,373 0.055 5.1,374 0.055 678 678 0.010 3.991	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0	Notes
SS0 Organic Nithogen Content (b-N/1b-TS). SS0 Total Solids and (b-TS/d) SS0 Vitagen Content (b-N/1b-YS). SS0 Nithogen Content (b-N/1b-YS). Pitmary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-N/1b-YS). Pitmary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-N/1b-YG). Pitmary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-N/1b-YG). Ammonium-N Load (b-N/4dy). TMAS Total Solids Load (b-YG/d). Nitrogen Content (b-N/1b-YG). Pitmary Sludge Solids Load (b-YG/d). Nitrogen Content (b-N/1b-YG). PMAS Total Solids Load (b-YG/d). Nitrogen Content (b-N/1b-YG). PMAS Total Solids Load (b-YG/d). Nitrogen Content (b-N/1b-YG). PMAS Total Solids Load (b-YG/d). <td< td=""><td>0.063 31.004 26.353 0.053 1,260 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59.049 51.373 0.057 1,900 0.065 678 0.010 3.991 3.193 0.020 3.4468 2.4 3.6 3.6</td><td>Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 0 0 0.000 0 0 0.000 0 0.000 0 0 0.065 2,471 0.065 2,471 0.065 2,471 0.065 882 0.057 2,471 0.065 882 0.007 2,471 0.005 882 2,471 0.005 882 0.000 0.000 0.000 0 0 0 0 0 0 0 0 0 0</td><td>Notes</td></td<>	0.063 31.004 26.353 0.053 1,260 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59.049 51.373 0.057 1,900 0.065 678 0.010 3.991 3.193 0.020 3.4468 2.4 3.6 3.6	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0.000 0 0.000 0 0 0.065 2,471 0.065 2,471 0.065 2,471 0.065 882 0.057 2,471 0.065 882 0.007 2,471 0.005 882 2,471 0.005 882 0.000 0.000 0.000 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids and (Ib-TS/d) SS0 Vitrage Content (Ib-N/Ib-YS) SS0 Vitrage Content (Ib-N/Ib-YS) SS0 Vitrage Content (Ib-N/Ib-YS) SS0 Vitrage Content (Ib-N/Ib-TS) Pimary Suidge Total Nitrogen Content (Ib-N/Ib-TS) Pimary Suidge Total Solids Load (Ib-TS/d) Pimary Suidge Total Solids Load (Ib-TS/d) Pimary Suidge Total Solids Load (Ib-TS/d) Witrogen Content (Ib-N/Ib-TS) Pimary Suidge Total Solids Load (Ib-TS/d) Witrogen Content (Ib-N/Ib-TS) History Total Solids Load (Ib-N/do) Details Solids Load (Ib-N/do) Details Solids Load (Ib-N/do) Mitrogen Content (Ib-N/Ib-TS) Histow Total Xinds Load (Ib-N/do) <t< td=""><td>0.063 31.004 26.353 0.053 0.053 0.053 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak Month 0.063 3.810 0.053 3.810 0.053 3.810 0.053 3.810 0.003 0 0 0 0 0 0 0 0 0 0 0.065 59,049 51.373 51.373 0.057 1,900 0.065 27.574 0.052 6.75 0.010 3.991 3.193 0.005 24 36 7 7.574 0.26</td><td>Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Notes</td></t<>	0.063 31.004 26.353 0.053 0.053 0.053 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 3.810 0.053 3.810 0.053 3.810 0.053 3.810 0.003 0 0 0 0 0 0 0 0 0 0 0.065 59,049 51.373 51.373 0.057 1,900 0.065 27.574 0.052 6.75 0.010 3.991 3.193 0.005 24 36 7 7.574 0.26	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Total Solids and (b-TS/d) SS0 Vialidie Solids Land (b-VS/d) SS0 Viangen Content ((b-N/1b-TS) SS0 Amonhum-N Load (b-N/day) HBOW No 2 HBOW No 2 HSOW	0.063 31.004 26.353 0.053 1,260 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solids and (b-TS/o) SS0 Viotalie Solids and (b-TS/o) SS0 Viotagen Content ((b-N/b-YS) SS0 Ammonium-N Load (b-N/day) MSOW No. 2 Pojanic Nitrogen Content ((b-N/b-TS) HSOW No. 2 Pojanic Nitrogen Content ((b-N/b-TS) Himary Sludge Total Solids Load ((b-TS/d) Primary Sludge Total Solids Load ((b-TS/d) NKS5 Total Solids Load ((b-TS/d) TWAS Total Solids Load ((b-TS/d) HYAS Total Solids Load ((b-TS/d) HSOW Yolatile Solids Load ((b-TS/d) HSOW Yolatile Solids Load ((b-TS/d) HSOW Yolatile Solids Load ((b-TS/d) TWAS Total Solids Load ((b-TS/d) HSOW Yolatile Solids Load ((b-TS/d) HSOW Yola	0.063 31.004 26.353 0.053 1.260 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pek 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Viotal Solid ad (b-TS/d) SS0 Viotal Solid ad (b-TS/d) SS0 Viotal Solid ad (b-TS/d) SS0 Viotal Solid ad (b-TS/d) SS0 Viotal Solid ad (b-TS/d) HSOW No. 2 (respine Nitrogen Content (b-N/1b-TS) HSOW No. 2 (respine Nitrogen Content (b-K/d) HSOW No. 2 (respine Nitrogen Content (b-K/d) HSOW No. 2 Nitrogen Content (b-K/d) Primary Sidge Total Nitrogen Content (b-K/d) Primary Sidge Total Solids Load (b-TS/d) Primary Sidge Total Solids Load (b-TS/d) Primary Sidge Notal Solids Load (b-TS/d) Nitrogen Content (b-K/b-TS) Nitrogen Content (b-K/b-TS) HSOW Total Nitrogen Content (b-K/b-TS) HSOW Total Nitrogen Content (b-K/b-TS) HSOW Total Solids Load (b-TS/d) Nitrogen Content (b-K/b-TS) HSOW Total Solids Load (b-TS/d) Nitrogen Content (b-K/b-TS) HSOW Total Solids Load (b-TS/d) Nitrogen Content (b-K/b-TS) HSOW Total Solids Load (b-Y/d) Nitrogen Content (b-K/b-TS) HSOW Total Solids Load (b-H/b-TS) HSOW Total Solids Loa	0.063 31.004 26.353 0.053 1,280 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0.000 0 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SSO Organic Nitrogen Content (b-N/b-TS) SSO Varial Solida add (b-TS/d) SSO Varialit Solida add (b-TS/d) SSO Variange Content (b-N/b-YS) SSO Ammonium-N Load (b N/day) MEOW No. 2 Organic Nitrogen Content (b-N/b-TS) MEOW No. 2 National Solida Load (b-N/d) MEOW No. 2 National National (b-N/b-TS) MEOW No. 2 National National (b-N/b-TS) MEOW No. 2 National National (b-N/d) MEOW No. 2 National National National (b-N/d) MEOW No. 2 National Natio	0.063 31.004 26.353 0.053 1,260 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0	Notes

-	Date Checked	Checked By	Job Number	By	Date		Calc No
Brown AND	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-001	
Caldwall		Project				Subject	
Caldwell	Encina Biosolids, Energy, and Emissio	ins		Current Year - Service Co	indition		

Mesophilic Digestion with Digesters 1-6

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.18	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	97	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Primary Sludge Flow (gpd) 140,397 1 Use if facility already receives HSOW (blank if not applicable)	
Primary Sludge Total Solids (%) 4.1% 1 HSOW Name FOG	1
Primary Sludge Volatile Solids (%) 87% 1 FOG Flow (gpd) 8,700	1
TWAS Flow (gpd) 60,000 1 FOG Total Solids (%) 5.5%	1
TWAS Total Solids (%) 6% 1 FOG Volatile Solids (%) 80%	2
TWAS Volatile Solids (%) 80% 1 Are peaking factors applied to FOG? No	
Domestic Sludge Blogas production yield (scf/lb-VS d) 18 1 FOG Blogas production yield (scf/lb-VSd) 17.8	1

High Strength Organic Waste (HSOW)

Input Values	Reference	Parameter	Input Values	Reference
SS0	0	Percent of SSO (%)	100%	Assumed
		Percent of (%)	0%	
12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
	\$\$0 12%	SSO 0 12% 4	SS0 0 Percent of SS0 (%) Percent of (%) Percent of (%) 12% 4 SSO Biogas production yield (sc//lb-V5d)	SS0 0 Percent of SS0 (%) 100% P Percent of (%) 0% 12% 4 SS0 Biggas production yield (sc//lb-VS0) 18

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

Primary Sludge			TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speciation			Nitrogen Speciation			Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (lb-N/lb-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen Speciation		
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

Table X-X: Existing Mesophilic Digestion with Digesters	1-6 Feed Assessment					
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	4.75	4.75	4.75	4.75	4.75	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (lb-TS/d)	28.022	34,468	36.429	39.231	44.836	
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (Ib-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	23	19	18	16	14	
Base OLR (lbsVS/d-cf)	0.11	0.13	0.14	0.15	0.17	
Hydraulic Capacity (HC) (gpd)	107,570	61,478	47,451	27,411	-12,669	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (Ib-VS/day)	91,507	52,298	40,365	23,318	-10,777	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	46,928	32,166	27,673	21,254	8,417	Difference between max OLR (0.18 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	No Capacity	
Table X-X: Mesophilic Co-digestion Feed Assessment						
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (lb-VS/day) SSO Volatile Solids Load (lb-VS/day)	46,928	32,166	27,673	21,254	0	Calculated available organic load, based on defined limit
	46,928	32,166	27,673	21,254	0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	
HSOW No. 2 Volatile Solids Load (lb-VS/day) Total HSOW Volatile Solids Load (lb-VS/day)	0 46,928	0 32,166	0 27,673	0 21,254	0	Communican to Total Solida land based on SSO 8/US
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day)	0 46,928 55,209	0 32,166 37,842	0 27,673 32,556	0 21,254 25,005	0 0 0	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day)	0 46,928 55,209 0	0 32,166 37,842 0	0 27,673 32,556 0	0 21,254 25,005 0	0 0 0 0	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day)	0 46,928 55,209 0 55,209	0 32,166 37,842 0 37,842	0 27,673 32,556 0 32,556	0 21,254 25,005 0 25,005	0 0 0 0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-vet/day)	0 46,928 55,209 0 55,209 460,078	0 32,166 37,842 0 37,842 315,349	0 27,673 32,556 0 32,556 211,301	0 21,254 25,005 0 25,005 208,375	0 0 0 0 0 0	Conversion to Total Solids load based on SSD %VS Conversion to Wet Solids load based on SSD %TS
HSOW No. 2 Volatile Solids Load (b-VS/day) Total HSOW Volate Solids Load (h-VS/day) SS0 Total Solids Load (h-VS/day) HSOW No. 2 Total Solids Load (h-TS/day) SS0 Total Solids Load (h-TS/day) SS0 Total Solids Load (h-VS/day) SS0 Total Load (h-vet/day)	0 46,928 55,209 0 55,209 460,078 0	0 32,166 37,842 0 37,842 315,349 0	0 27,673 32,556 0 32,556 271,301 0	0 21,254 25,005 0 25,005 208,375 0	0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (Ib-Y5/day) Total HSOW Volatile Solids Load (Ib-Y5/day) SSO Total Solids Load (Ib-T5/day) HSOW No. 2 Total Solids Load (Ib-T5/day) SSO Total Solids Load (Ib-T5/day) SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day)	0 46,928 55,209 0 55,209 460,078 0 460,078	0 32,166 37,842 0 37,842 315,349 0 315,349	0 27,673 32,556 0 32,556 271,301 0 271,301	0 21,254 25,005 0 25,005 208,375 0 208,375	0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (b-VS/day) Total HSOW Volatile Solids Load (h-VS/day) SS0 Total Solids Load (b-TS/day) HSOW No. 2 Total Solids Load (b-TS/day) SS0 Novel / day) SS0 Novel / day) SS0 Novel / day SS0 Novel / day	0 46,928 55,209 0 55,209 460,078 0 460,078 230	0 32,166 37,842 0 37,842 315,349 0 315,349 158	0 27.673 32.556 0 33.556 271.301 0 271.301 136	0 21,254 25,005 0 25,005 208,375 0 208,375 104	0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO (Ib-wet/day)	0 46,928 55,209 0 55,209 460,078 0 460,078 230 0	0 32,166 37,842 0 37,842 315,349 0 315,349 158 0	0 27,673 32,556 0 32,556 271,301 0 271,301 136 0	0 21,254 25,005 0 25,005 208,375 0 208,375 0 208,375 104 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSDW No. 2 Volatile Solids Load (b-VS/day) Total HSDW Volatile Solids Load (b-VS/day) SS0 Total Solids Load (b-VS/day) SS0 Total Solids Load (b-TS/day) SS0 No. 2, Total Load (b-Wet/day) SS0 (whyd) HSDW No. 2, Total Load (b-Wet/day) SS0 (whyd) HSDW No. 2, Cotal Load (b-SS (day)	0 46,928 55,209 0 55,209 460,078 0 460,078 230 230	0 32,166 37,842 0 37,842 315,349 0 315,349 158 0 158	0 27,673 32,556 0 32,556 271,301 0 271,301 136 0 136	0 21,254 25,005 0 25,005 208,375 0 208,375 104 0 104	0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO (Ib-wet/day) SSO (Ib-wet/day) SSO (wet/day)	0 46,928 55,209 0 55,209 460,078 0 460,078 230 0	0 32,166 37,842 0 37,842 315,349 0 315,349 158 0	0 27,673 32,556 0 32,556 271,301 0 271,301 136 0	0 21,254 25,005 0 25,005 208,375 0 208,375 0 208,375 104 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (b-VS/day) Total HSOW Volatile Solids Load (b-VS/day) SS0 Total Solids Load (b-VS/day) SS0 Total Solids Load (b-TS/day) SS0 Total Load (b-TS/day) SS0 (b-Nd (day) SS0 (day) SS0 (day)	0 46,928 55,209 0 55,209 460,078 0 460,078 230 0 0 230 55,105	0 32,166 37,842 0 33,842 315,349 0 315,349 158 0 158 37,812 0	0 27,673 32,856 0 271,301 0 271,301 136 0 136 0 32,530 0	0 21,254 25,005 0 25,005 208,375 0 208,375 104 0 104 24,985 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO (Ib-wet/day) SSO (Ib-wet/day) SSO (wet/day)	0 46.928 55.209 55.209 460,073 0 460,078 230 230 55.165 0	0 32,166 37,842 0 31,5,349 0 315,5,49 158 0 158 37,812	0 27.673 32.556 0 22.556 271.301 0 271.301 136 0 136 0 136 25.50	0 21,254 25,005 0 25,005 208,375 0 208,375 104 0 104 24,985	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSD Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSD Total Load (Ib-TS/day) SSD (Ib-wet/day) SSD (Ib-wet/	0 46,928 55,209 0 55,209 460,078 0 460,078 230 0 230 55,165 0 55,165	0 22,166 37,842 0 37,842 0 315,349 0 315,349 0 158 0 158 37,812 0 37,812	0 27 673 32,556 0 22,556 271,301 0 271,301 136 0 136 22,530 0 0 22,530	0 21.254 25.005 0 25.005 208.375 0 208.375 104 0 104 24.885 0 24.885 0 24.885	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSDW No. 2 Volatile Solids Load (b-VS/day) Total HSDW Volatile Solids Load (b-VS/day) SS0 Total Solids Load (b-VS/day) SS0 Total Solids Load (b-TS/day) SS0 Total Solids Load (b-TS/day) SS0 Total Load (b-TS/day) SS0 (b-wet/day) SS0 (b-b-b) SS0 (b-b) SS0 (b-b) <t< td=""><td>0 46.928 55.209 55.209 460.078 0 460.078 230 230 230 55.165 0 55.165 135.230</td><td>0 32,166 37,842 0 37,842 315,349 158 0 158 37,812 0 37,812 0 37,812 135,349</td><td>0 27,673 32,856 0 271,301 0 271,301 136 0 136 0 136 22,530 0 22,530 0 32,530 135,385</td><td>0 21,254 25,005 0 25,005 208,375 0 208,375 104 0 104 104 24,985 0 24,985 135,437</td><td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td></td></t<>	0 46.928 55.209 55.209 460.078 0 460.078 230 230 230 55.165 0 55.165 135.230	0 32,166 37,842 0 37,842 315,349 158 0 158 37,812 0 37,812 0 37,812 135,349	0 27,673 32,856 0 271,301 0 271,301 136 0 136 0 136 22,530 0 22,530 0 32,530 135,385	0 21,254 25,005 0 25,005 208,375 0 208,375 104 0 104 104 24,985 0 24,985 135,437	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-TS/day) SSD Total Solids Load (Ib-TS/day) SSD Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSD Total Load (Ib-We/day) SSD Werd (May) SSD Whon 2. Total Load (Ib-we/day) SSD (Mpd)	0 46.928 55.209 0 55.209 460.078 230 0 230 55.165 135,230 114.305	0 22,166 37,842 0 37,842 0 315,349 0 315,349 0 158 0 158 37,812 0 37,812 113,305	0 27 673 32,556 0 22,556 271,301 0 271,301 136 0 136 0 32,530 0 32,530 0 32,530 135,385 114,305	0 21.254 25.005 0 25,005 208,375 0 208,375 104 0 104 24,985 0 24,985 135,437 114,305	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (b-VS/day) Total HSOW Volatile Solids Load (b-VS/day) SS0 Total Solids Load (b-TS/day) SS0 Total Solids Load (b-TS/day) SS0 Total Load (b-VS/day) SS0 Total Load (b-VS/day) SS0 Total Load (b-VS/day) SS0 (bay) SS0 (bay) <td>0 46.928 55.209 55.209 460,078 0 460,078 230 0 230 55.165 0 55.165 135.230 114,305 264.262</td> <td>0 32,166 37,842 0 37,842 315,349 0 315,349 158 0 158 37,812 0 37,812 0 37,812 114,305 223,000</td> <td>0 27,673 32,856 0 32,856 271,301 0 271,301 136 0 136 32,530 0 22,530 0 22,530 135,385 114,305 301,746</td> <td>0 21,254 25,005 0 25,005 208,375 0 208,375 104 0 104 24,985 24,985 135,437 114,305 314,241</td> <td>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td></td>	0 46.928 55.209 55.209 460,078 0 460,078 230 0 230 55.165 0 55.165 135.230 114,305 264.262	0 32,166 37,842 0 37,842 315,349 0 315,349 158 0 158 37,812 0 37,812 0 37,812 114,305 223,000	0 27,673 32,856 0 32,856 271,301 0 271,301 136 0 136 32,530 0 22,530 0 22,530 135,385 114,305 301,746	0 21,254 25,005 0 25,005 208,375 0 208,375 104 0 104 24,985 24,985 135,437 114,305 314,241	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (b-VS/day) Total HSOW Volatile Solids Load (b-VS/day) SS0 Total Solids Load (b-TS/day) HSOW No. 2 Total Solids (b-15/day) SS0 Total Solids Load (b-TS/day) SS0 Total Solids Load (b-TS/day) SS0 Total Solids Load (b-TS/day) SS0 Total Solids Load (b-Ydy) SS0 New Clay) Total Solids, Notal Solids Load (h-VS/d) Total Solids, Notal Solid	0 46.928 55.209 0 55.209 460.078 230 0 230 55.165 0 55.165 135.230 114.305 264.262 37%	0 22,166 37,842 0 37,842 0 315,349 0 158 0 158 37,812 0 37,812 37,812 135,349 114,305 293,000 45%	0 27 673 32,556 0 23,556 271,301 0 271,301 136 0 32,530 32,530 135,385 114,305 301,746 48%	0 21.254 25,005 0 25,005 208,375 0 208,375 208,375 104 0 104 24,985 0 24,985 135,437 114,305 314,241 51%	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSDW No. 2 Volatile Solids Load (b:VS/day) Total HSDW Volatile Solids Load (b:VS/day) SSO Total Solids Load (b:TS/day) SSO Total Solids Load (b:TS/day) SSO Total Solids Load (b:TS/day) SSO Total Load (b: VS/day) SSO (b:wet/day) SSO (b:bit) SSO (b:bit) SSO (bit)	0 46.928 55.209 0 55.209 460,078 2.30 0 2.30 55.165 0 55.165 135.230 114.305 264.262 37%	0 32,166 37,842 0 37,842 315,349 0 315,349 158 0 158 37,812 0 37,812 0 37,812 114,305 1293,000 45% 24%	$\begin{array}{c} 0\\ 0\\ 27,673\\ 32,856\\ 0\\ 32,856\\ 271,301\\ -\\ 0\\ 271,301\\ -\\ 136\\ 0\\ 136\\ 32,530\\ 0\\ 32,530\\ 0\\ 32,530\\ 135,385\\ 114,305\\ 301,746\\ 48\%\\ 22\%\\ \end{array}$	0 21.254 25.005 0 25.005 208.375 0 208.375 0 208.375 104 0 104 24.985 0 24.985 135.437 114.305 314.241 51%	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Volatile Solids Load (b-VS/day) Total HSOW Volatile Solids Load (b-VS/day) SS0 Total Solids Load (b-TS/day) HSOW No. 2 Total Solids (b-TS/day) SS0 Total Solids Load (b-TS/day) SS0 Net/day) SS0 Net/day) SS0 Net/day) HSOW No. 2 Total Load (b-wet/day) SS0 Net/day) HSOW No. 2 (wpd) HSOW No. 2 (wpd) SS0 (mpd) HSOW No. 2 (wpd) SS0 (mpd) Total Solids Load (b-TS/d) Total Solids, Total Solids, Load (b, S) WAS percent of VS Load (S) WSO percent of VS Load (S) <	0 46.928 55.209 0 55.209 460.078 0 460.078 230 230 230 55.165 0 55.165 0 55.165 135.230 114,305 114,305 264,262 37% 20% 3%	0 32,166 37,842 0 37,842 0 315,349 0 315,349 0 158 37,812 0 37,812 0 37,812 0 37,812 135,349 114,305 293,000 455 245 3%	0 27.673 32.556 0 23.556 211.301 0 271.301 136 0 136 0 32.530 0 32.530 135.355 114.305 301.746 48% 25% 3%	0 21.254 25,005 25,005 205,375 0 208,375 208,375 208,375 104 0 104 24,985 0 104 24,985 115,437 114,305 115,437 114,305 314,241 314,241	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSDW No. 2 Volatile Solids Load (b-VS/day) Total HSDW Volatile Solids Load (b-VS/day) SSO Total Solids Load (b-TS/day) SSO Total Solids Load (b-TS/day) SSO Total Solids Load (b-TS/day) SSO Total Load (b-TS/day) SSO Total Load (b-TS/day) SSO Total Load (b-TS/day) SSO Total Load (b-TS/day) SSO (b-wet/day) SSO (bred)	0 46.928 55.209 0 55.209 460.078 230 0 230 230 55.165 0 55.165 135.230 114.305 264.262 37% 20% 3%	0 32,166 37,842 0 37,842 315,549 158 0 315,349 158 37,812 0 37,812 114,305 293,000 45% 24% 3% 28%	0 27,673 32,556 0 32,556 271,301 0 271,301 136 0 136 32,530 0 32,530 135,385 114,305 301,746 48% 25% 3% 24%	0 21.284 25.005 0 25.005 208.375 208.375 104 0 24.885 0 24.885 0 24.885 3135.437 114.305 314.241 51% 27% 3%	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	

	0.18	0.18	0.18	0.18	0.17	
Co-Digestion OLR (lbs-VS/d-cf) Process Check	0.18 OK	0.18 OK	0.18 OK	0.18 OK	0.17 No Capacity	
Table X-X: Existing Mesophilic Solids and Biogas Product	tion					
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (lb-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	209,097	255,188 48,282	269,216	289,256	329,335	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d) Volatile Solids Effluent (Lbs-VS/d)	39,463 26,819	48,282	50,966 34,769	54,801 37,419	62,470 42,719	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	85 483.237	104	110	118	135 773.179	Assumes biosolids cake has a solids content of 22% TS Assumes a biogas yield of 17.8 scf/lb-VSd
Primary sludge Biogas Production (scfd) WAS Biogas Production (scfd)	483,237	230 684	628,208 243,813	676,532	300.077	Assumes a biogas yield of 17.8 sch/lb-VSd Assumes a biogas yield of 17.8 sch/lb-VSd
FOG Biogas Production (sofd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	721,930	876,211	923,166	990,244	1,124,401	
Table X-X: Mesophilic Co-digestion Solids and Biogas Pro		Peak Month				
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	Annual Average 27.148	Peak Month	Peak 14 day	Peak 7 day 38,007	Peak day 43,437	Notes
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	42,235	28,949	24,905	19,129	0	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day) Total Volatile Solids Destroyed (Ib-VSd/day)	0 82,793	0 78,174	0 76,769	0 74,761	0 63,169	
Total Sludge Effluent (gpd)	264.262	293,000	301,746	314,241	329.335	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	52,437	57,175	58,617	60,677	62,470	
Volatile Solids (Lbs-VS/d)	31,512	36,130	37,536	39,544	42,719	
Total Solids (% TS) Volatile Solide (% VS)	2.4%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS) Dewatered Solids (Lbs-TS/d)	49,815	54,316	55,686	57,643	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	113	123	127	131	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) SSO Biogas Production (scfd)	51,145	51,145 521.082	51,145 448,297	51,145 344,318	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
Total Biogas Production (scfd)	1,482,163	1,397,293	1,371,463	1,334,563	1,124,401	
Table X-X: Nutrient Loading - Ammonia-N Estimates						
	Annual Avenue de	Deals Meath	Darah 4.4 day	Deals 7 days	Deals day	Natas
HSOW No 1 SSO Organic Nitrogen Content (Ib.N /Ib.TS)	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063 55,209	0.063	Peak 14 day 0.063 32,556	0.063	Peak day 0.063 0	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	0.063	0.063 37,842 32,166	0.063 32,556 27,673	0.063 25,005 21,254	0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-VS/d) SS0 Nitrogen Content (Ib-V/Ib-VS)	0.063 55,209 46,928 0.053	0.063 37,842 32,166 0.053	0.063 32,556 27,673 0.053	0.063 25,005 21,254 0.053	0.063	Notes
SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSO Volatlle Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 55,209 46,928	0.063 37,842 32,166	0.063 32,556 27,673	0.063 25,005 21,254	0.063 0 0	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Vistali Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Amnonium-N Load (Ib-N/day) ISSO Mano	0.063 55,209 46,928 0.053	0.063 37,842 32,166 0.053	0.063 32,556 27,673 0.053	0.063 25,005 21,254 0.053	0.063 0 0	Notes
SS0 Organic Nitrogen Content (D-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-YS/d) SS0 Mitogen Content (Ib-N/Ib-YS) SS0 Ammonium-N Load (Ib-H/day) HSOW No. 2 HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS)	0.063 55.209 46,928 0.053 2,244 0.000 0	0.063 37,842 32,166 0.053 1,538 0.000 0	0.063 32,556 27,673 0.063 1,323 0.000 0	0.063 25,005 21,254 0.053 1,016 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (D-V/Ib-TS) SS0 Orlad Solids Load (D-157/g) SS0 Orlad Solids Load (D-157/g) SS0 Nitrogen Content (D-V/Ib-VS) SS0 Amonium - N Load (D-V/Vga) NSOW No.2 NSOW No.2 Content (D-V/Ib-TS) MSOW No.2 Toadi (D-157/g)	0.063 55.209 46.928 0.053 2,244 0.000 0 0 0	0.063 37,842 32,166 0.053 1.538 0.000 0 0	0.063 32,556 27,673 0.053 1,523 0.000 0 0	0.063 25,005 21,254 0.053 1,016 0.000 0 0	0.063 0 0.000 0 0 0.000 0 0	Notes
SS0 Organic Nitrogen Content (D-A/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatils Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-A/Ib-YS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Violatile Solids Load (Ib-TS/d) HSOW No. 2 Violatile Solids Load (Ib-TS/d) HSOW No.2 Violatile Solids Load (Ib-TS/d) HSOW No.2 Violatile Solids Load (Ib-TS/d)	0.063 55.209 46,928 0.053 2,244 0.000 0	0.063 37,842 32,166 0.053 1,538 0.000 0	0.063 32,556 27,673 0.063 1,323 0.000 0	0.063 25,005 21,254 0.053 1,016 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (D-A/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatils Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-A/Ib-YS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Violatile Solids Load (Ib-TS/d) HSOW No. 2 Violatile Solids Load (Ib-TS/d) HSOW No.2 Violatile Solids Load (Ib-TS/d) HSOW No.2 Violatile Solids Load (Ib-TS/d)	0.063 55.209 46.928 0.053 2,244 0.000 0 0 0	0.063 37,842 32,166 0.053 1.538 0.000 0 0 0.000	0.063 32,556 27,673 0.063 1,323 0.000 0 0 0 0 0 0 0.000	0.063 25,005 21,254 0.053 1,016 0.000 0 0 0 0.000	0.063 0 0.000 0 0 0 0 0 0 0 0 0.000	Notes
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Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-001
	Pro	ject			Subject
Encina Biosolids, Energy, and Emi	sions		Current Year - Service C	condition	

15 day Thermophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter Input Values Refe		Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed Peaking Factors			
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d) 0.35 Assumed		Annual Average	1	2	
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	Dewatering Total Solids (%TS) 22% 1		Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production vield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

	Parameter	Input Values	Reference	Parameter	Input Values	Reference
HS	DW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HS	DW No. 2 Name			Percent of (%)	0%	
SSC	Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO	/olatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW M	o. 2 Total Solids (%)					
HSOW No	. 2 Volatile Solids (%)					

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Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Slud	ge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speci	ation		Nitrogen Spec	iation		Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (lb-N/lb-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	Input values	Reference
Nitrogen Specia	ation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

			isting 15 day Thermophilic Digestion Feed A	ssessmen		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
						Service condition assumes largest digester is out of service with the
Digester Volume (MG)	3.90	3.90	3.90	3.90	3.90	active volume of each digeser reduced to account for process
						inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (Ib-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (Ib-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	19	15	14	13	12	
Base OLR (lbsVS/d-cf)	0.13	0.16	0.17	0.18	0.20	
Hydraulic Capacity (HC) (gpd)	50,570	4,478	-9,549	-29,589	-69,669	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (lb-VS/day)	43,019	3,810	-8,124	-25,171	-59,266	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	114,876	100,113	95,621	89,202	76,365	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Hydraulic	Hydraulic	No Capacity	No Capacity	No Capacity	
Process Limitation		Table	X-X: Mesophilic Co-digestion Feed Assessn	ent		
	Annual Average	Table Peak Month			No Capacity Peak day	Notes
Total HSOW Volatile Solids Load (lb-VS/day)	Annual Average 43,019	Table Peak Month 3,810	X-X: Mesophilic Co-digestion Feed Assessm Peak 14 day 0	ent Peak 7 day 0	Peak day 0	Notes Calculated available organic load, based on defined limit
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day)	Annual Average 43,019 43,019	Table Peak Month 3,810 3,810	X-X: Mesophilic Co-digestion Feed Assessn Peak 14 day 0 0	ent Peak 7 day 0 0	Peak day 0 0	
Total HSOW Volatile Solids Load (lb-VS/day)	Annual Average 43,019 43,019 0	Table Peak Month 3,810 3,810 0	X-X: Mesophilic Co-digestion Feed Assessn Peak 14 day 0 0 0 0	ent Peak 7 day O O O	Peak day 0 0 0	
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Total HSON Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day)	Annual Average 43,019 43,019 0 43,019 50,610	Table Peak Month 3,810 3,810 0	X-X: Mesophilic Co-digestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0 0 0 0 0 0	Peak day 0 0 0	
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Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day)	Annual Average 43,019 0 43,019 0 43,019 50,610 0 50,610	Table Peak Month 3,810 0 3,810 4,482 0 4,482 0	XX: Mesophilic Ocdigestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Comension to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violaile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO (Ib-wet/ab) SSO (Ib-wet/ab)	Annual Average 43,019 0 43,019 0 43,019 50,610 0 50,610 421,751	Table Peak Month 3,810 0 3,810 0 3,810 0 3,810 0 3,810 0	XX: Mesophilic Co-digestion Feed Assessn	Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO (Ib-wt/day) HSOW No. 2 Total Load (Ib-MS/day) HSOW No. 2 Total Load (Ib-MS/day)	Annual Average 43,019 0 43,019 50,610 0 50,610 421,751 0	Table Peak Month 3,810 0 3,810 0 3,810 0 4,482 37,349 0	XX: Mesophilic Codigestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Comension to Total Solids load based on SSO %VS
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Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wel (Jay) HSOW No. 2 Total Load (Ib-wel/day) SSO (Ib-wel (Jay) HSOW No. 2 Total Load (Ib-wel/day) SSO (Ib-wel (Jay) HSOW No. 2 (wtpd) SSO (wtpd) SSO (wtpd)	Annual Average 43.019 43.019 0 43.019 50.610 0 50.610 421.751 421.751 211 0 211	Table Peak Month 3,810 3,810 0 3,810 4,482 0 4,482 0 3,7,349 0 37,349 19 0 19 19 19	XX: Mesophilic Godigestion Feed Assessm Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	ent Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Comension to Total Solids load based on SSO %VS
Total HSON Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2V Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) HSOW No. 2 Total Solids Load (Ib-VS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Load (Ib-TS/day) SSO (Ib-wet/day)	Annual Average 43.019 0 43.019 0 50.610 0 50.610 421.751 0 421.751 211 0 211 50.570	Table Peak Month 3,810 0 3,810 0 3,810 0 4,482 0 4,482 0 37,349 19 0 19 4,478	XX: Mesophilic Godigestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	entl Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0	Calculated available organic load, based on defined limit Comension to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO Ib-wet /day) SSO Ib-wet /day <	Annual Average 43.019 0 43.019 50.610 0 50.610 421.751 0 421.751 0 422.751 0 211 0 211 50.570 0 0	Table Peak Month 3,810 0 3,810 4,482 0 4,482 37,349 0 37,349 0 37,349 0 37,349 0 37,349 0 37,349 0 19 0 19 0 19 0	XX: Mesophilic Codigestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	ent Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
Total HSON Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2: Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-YS/day) SSO Total Load (Ib-TS/day) SSO Total Load (Ib-TS/day) SSO Interty (day) SSO Intery (day) SSO Interty (day) <td>Annual Average 43.019 0 43.019 0 50.610 0 50.610 421.751 0 422.751 211 0 0 211 50.570 0 50.570</td> <td>Table Peak Month 3,810 3,810 0 3,810 4,482 0 4,482 37,349 0 37,349 19 4,478</td> <td>XX: Mesophilic Godigestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>ent Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak day 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS</td>	Annual Average 43.019 0 43.019 0 50.610 0 50.610 421.751 0 422.751 211 0 0 211 50.570 0 50.570	Table Peak Month 3,810 3,810 0 3,810 4,482 0 4,482 37,349 0 37,349 19 4,478	XX: Mesophilic Godigestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	ent Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wcl / day) SSO (Ib-S) (Ib-day) SSO (Ib-Mcl /	Annual Average 43.019 0 43.019 0 50.610 0 50.610 421.751 0 421.751 211 0 211 50.570 0 130.631	Table Peak Month 3,810 0 3,810 0 4,482 0 4,482 0 4,482 0 37,349 0 37,349 0 37,349 19 0 19 19 19 19 19 19 19 19 19 19 19	XX: Mesophilic Codigestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	ent Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-YS/day) SSO Ib New (Jay) SSO Ib New (Jay) SSO (Ib New (Jay) SSO (Jay) SSO (Jay) Total Solids, Total Solids Load (Ib-TS/d) Total Solids, Joalat Solids Load (Ib-TS/d)	Annual Average 43.019 0 43.019 0 50.610 0 50.610 0 50.610 0 421.751 0 421.751 211 50.570 0 50.570 130.631 110.395	Teble Peak Month 3,810 0 3,810 4,482 0 4,482 4,482 0 37,349 0 37,349 19 0 19 19 4,478 0 19 9 0 19 4,478 0 19 9 85,949	XX: Mesophilic Godigestion Feed Assess Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	ent Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Comension to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wcl / day) SSO (Ib-S) (Ib-day) SSO (Ib-Mcl /	Annual Average 43.019 0 43.019 0 50.610 0 50.610 421.751 0 421.751 211 0 211 50.570 0 130.631	Table Peak Month 3,810 0 3,810 0 4,482 0 4,482 0 4,482 0 37,349 0 37,349 0 37,349 19 0 19 19 19 19 19 19 19 19 19 19 19	XX: Mesophilic Codigestion Feed Assessn Peak 14 day 0 0 0 0 0 0 0 0 0 0 0 0 0	ent Peak 7 day 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0 0 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Comension to Total Solids load based on SSO %VS

WAS percent of VS Load (%)	20%	32%	34%	34%	34%	
FOG percent of VS Load (%)	3%	4%	4%	3%	3%	
SSO percent of VS Load (%) HSOW No. 2 percent of VS Load (%)	39%	4%	0%	0%	0%	
HSOW No. 2 percent of VS Load (%) Check	0% ok	0%	0% ok	0%	0%	
Co-digestion HRT (days)	0K 15	ok 15	ок 14	0k 13	ok 12	
Co-Digestion OLR (lbs-VS/d-cf)	0.21	0.17	0.17	0.18	0.20	
Process Check	OK	OK	No Capacity	No Capacity	No Capacity	
	•	Table X-)	K: Existing Mesophilic Solids and Biogas Proc	uction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	209,097	255,188 48,282	269,216	289,256	329,335	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d) Volatile Solids Effluent (Lbs-VS/d)	39,463	48,282	50,966	54,801	62,470	
Total Solids (% TS)	20,015	2 3%	2 3%	2.3%	2 3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a blogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	721,930	876,211	923,166	990,244	1,124,401	
	Annual Average	Table X-X: I Peak Month	Mesophilic Co-digestion Solids and Biogas P Peak 14 day	oduction Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	Annual Average 27.148	Peak Month	Peak 14 day 35 293	Peak 7 day	Peak day	notes
WAS Volatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2.873	2.873	2.873	2.873	2.873	
SSO Volatile Solids Destroyed (Ib-VSd/ day)	38,717	3,429	0	0	0	
HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (lb-VSd/day)	79,275	52,654	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	259,667	259,667	269,216	289,256	329,335	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	51,356	49,335	50,966	54,801	62,470	
Volatile Solids (Lbs-VS/d)	31,121	33,295	34,769	37,419	42,719	
Total Solids (% TS)	2.4%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS) Dewatered Solids (Lbs-TS/d)	61% 48,788	67% 46.868	68% 48.418	68% 52,061	68% 59.346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	111	40,808	40,410	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	483.237	594.382	628,208	676.532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	696,901	61,716	0	0	0	Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
Total Biogas Production (scfd)	1,418,832	937,927	923,166	990,244	1,124,401	
	Annual Annuaria	Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat	es Deck 7 dec	Daals day	Netze
HSOW No 1 ESD Optionic Nitration Content (Ib N / Ib TS)	Annual Average	Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day	Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS)	Annual Average 0.063 50.610	Tabl Peak Month 0.063 4.482	Peak 14 day 0.063	Peak 7 day 0.063	0.063	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-YS/d)	Annual Average 0.063 50,610 43,019	Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0	es Peak 7 day 0.063 0 0		Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d)	0.063 50,610	Peak Month	Peak 14 day 0.063	Peak 7 day 0.063	0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 50,610 43,019	Peak Month 0.063 4,482 3,810	Peak 14 day 0.063 0 0	Peak 7 day 0.063 0 0	0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Viotalle Solids Load (Ib-V5/d) SS0 Viotalle Solids Load (Ib-V5/d) SS0 Nitrogen Content (Ib-N/Ib-V5) SS0 Ammonium-N Load (Ib-N/day) HSOW No 2	0.063 50,610 43,019 0.053 2,057	Peak Month 0.063 4,482 3,810 0.053 182	Peak 14 day 0.063 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0.000 0	0.063 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solids and (b-TS/d) SS0 Visitile Solids Land (b-VS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Ammonium- Land (b-N/dov) HSOV No.2 ISS0 No.2 (SS0 Amsolum- SS0 Ams	0.063 50,610 43,019	Peak Month 0.063 4,482 3,810	Peak 14 day 0.063 0 0	Peak 7 day 0.063 0 0	0.063 0 0	Notes
SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSD Violatile Solids Load (Ib-YS/d) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Ammonium-M Load (Ib-N/day) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Slits Load (Ib-TS/d)	0.063 50.610 43.019 0.053 2,057 0.000 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0.000 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0	Notes
SSD Organic Nitrogen Content (b-N/b-TS) SSD Ordari Solid Scald (b-TS/d) SSD Vintigen Content (b-N/b-VS) SSD Nitrogen Content (b-N/b-VS) SSD Nitrogen Content (b-N/b-VS) SSD Nitrogen Content (b-N/b-TS) NBOW No 2 NSOW No 2 <	0.063 50,610 43,019 0.053 2,057	Peak Month 0.063 4,482 3,810 0.053 182	Peak 14 day 0.063 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0.000 0	0.063 0 0.000 0	Notes
SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Oradi Solids (and (Ib-TS/d) SSD Violatile Solids Load (Ib-TS/d) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Amonium-NL Add (Ib-V/day) HSOW No.2 HSOW No.2 <td>0.063 50.610 43.019 0.053 2.057 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 0 0.000 0 0 0.000 0 0 0 0 0 0 0</td> <td>Notes</td>	0.063 50.610 43.019 0.053 2.057 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Total Solid Land (b-TS/d) SS0 Vitalit Solid Land (b-VS/d) SS0 Vitalit Solid Land (b-VS/d) SS0 Sol Amnonium-N Land (b-N/dsy) HBOW No 2 HSOW No 2	0.063 50.610 43.019 0.053 2,057 0.000 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0.000 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (h-TS/d) SS0 Violatile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/Ib-YS) SS0 Namonium-NL Add (b-V/day) HSOW No. 2 HSOW No. 2 MSOW No. 2 Violatile Solids Load (b-VS/d) HSOW No. 2 HSOW No. 2 Violatile Solids Load (b-VS/d) HSOW No. 2	0.063 50.610 43.019 0.053 2.057 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (h-TS/d) SS0 Violatile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/Ib-YS) SS0 Namonium-NL Add (b-V/day) HSOW No. 2 HSOW No. 2 MSOW No. 2 Violatile Solids Load (b-VS/d) HSOW No. 2 HSOW No. 2 Violatile Solids Load (b-VS/d) HSOW No. 2	0.063 50.610 43.019 0.053 2.057 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS). SS0 Total Solids and (b-TS/d). SS0 Vitalite Solids Load (b-VS/d). SS0 Vitalite Solids Load (b-VS/d). SS0 Nitrogen Content (b-N/b-VS). SS0 Nitrogen Content (b-N/b-TS). SS0 Nitrogen Content (b-N/b-TS). VSOW No. 2. Organic Nitrogen Content (b-N/b-TS). VSOW No. 2. Organic Nitrogen Content (b-N/b-TS). VSOW No. 2. Vitrogen Content (b-V/b-VS). VSOW No. 2. Notatie Solids Load (b-VS/d). VSOW No. 2. Notatie Solids Load (b-V/dy). Existing. Primary Sludge Total Solids Load (b-TS/d). Primary Sludge Total Solids Load (b-TS/d). Primary Sludge Total Solids Load (b-TS/d).	0.063 50,610 43.019 0.053 2,057 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (b-TS/d) SS0 Visitile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Almonithum AL Load (b-N/day) HBOW No.2 HSOW No.2 Nitrogen Content (b-N/b-TS) HSOW No.2 HSOW No.2 <td< td=""><td>0.063 50.610 43.019 0.053 2.057 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak 14 day 0.065 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Notes</td></td<>	0.063 50.610 43.019 0.053 2.057 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4.482 3.810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.065 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS). SS0 Total Solids and (b-TS/d). SS0 Vitrogin Content (b-N/b-VS). SS0 Nitrogin Content (b-N/b-VS). MSOW No. 2 Organic Nitrogen Content (b-N/b-TS). MSOW No. 2 Notatin Solids Load (b-VS/d). Minary Sludge Total Solids Load (b-VS/d). Primary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-V/b-VS).	0.063 50,610 43,019 0.053 2,057 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 4,482 3,810 0.053 182 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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	Date Checked	Checked By	Job Number	Ву	Date	Calc No
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-001
Caldwall		Project				Subject
Caldwell	Encina Biosolids, Energy, and Emissio	ons		Current Year - Service Co	ondition	
and the second se						

15 day Thermophilic Digestion with All digesters in service

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSOW (blank if not applicable))
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

Primary	Sludge		TWAS	TWAS		Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen	peciation	eciation Nitro		ciation		Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/I)	3.000	

	Table	X-X: Existing 15 day The	rmophilic Digestion with All digesters in ser	vice Feed Assessment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	4.75	4.75	4.75	4.75	4.75	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (lb-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	23	19	18	16	14	
Base OLR (lbsVS/d-cf)	0.11	0.13	0.14	0.15	0.17	
Hydraulic Capacity (HC) (gpd)	107.570	61.478	47.451	27,411	-12.669	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (Ib-VS/day)	91,507	52,298	40.365	23,318	-10,777	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	154.882	140.120	135.627	129.209	116.372	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Hydraulic	Hydraulic	Hydraulic	Hydraulic	No Cepacity	
			: Mesophilic Co-digestion Feed Assessmen			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	91,507	52,298	40,365	23,318	0	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (Ib-VS/day)	91,507	52,298	40,365	23,318	0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	91,507	52,298	40,365	23,318	0	
SSO Total Solids Load (Ib-TS/day)	107,656	61,528	47,489	27,433	0	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	107,656	61,528	47,489	27,433	0	
SSO (lb-wet/day)	897,131	512,729	395,738	228,607	0	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (Ib-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	897,131	512,729	395,738	228,607	0	
SSO (wtpd)	449	256	198	114	0	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	449	256	198	114	0	
SSO (gpd)	107,570	61,478	47,451	27,411	0	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	107,570	61,478	47,451	27,411	0	
Total Solids, Total Solids Load (Ib-TS/d)	187,676	159,035	150,318	137,865	125,638	
Total Solids, Volatile Solids Load (Ib-VS/d)	158,884	134,438	126,997	116,368	105,887	
Total Flow (gpd)	316,667	316,667	316,667	316,667	329,335	
Primary sludge percent of VS Load (%)	26%	38%	43%	50%	63%	
WAS percent of VS Load (%)	14%	21%	23%	27%	34%	
FOG percent of VS Load (%)	2%	2%	3%	3%	3%	
SSO percent of VS Load (%)	58%	39%	32%	20%	0%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	15	15	15	15	14	

Co-Digestion OLR (lbs-VS/d-cf) Process Check	0.25 0K	0.21 OK	0.20 OK	0.18 OK	0.17 No Capacity	
			sting Mesophilic Solids and Biogas Productio		NO CEPTORY	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day) FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	209,097	255,188	269,216	289,256	329,335	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	39,463	48,282	50,966	54,801	62,470	
Volatile Solids Effluent (Lbs-VS/d) Total Solids (% TS)	26,819	32,914 2.3%	34,769 2.3%	37,419 2.3%	42,719 2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd) WAS Biogas Production (scfd)	483,237	594,382 230,684	628,208 243,813	676,532	773,179 300.077	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scrd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scl/lb-VSd
Biogas Production (scfd)	721,930	876,211	923,166	990,244	1,124,401	
	-	Table X-X: Meso			-	
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	Annual Average 27.148	Peak Month 33.392	Peak 14 day	Peak 7 day	Peak day 43.437	Notes
WAS Volatile Solids Destroyed (Ib-VSd/day)	10.536	12,960	13.697	14,751	43,437	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (lb-VSd/day)	82,357	47,069	36,329	20,986	0	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day) Total Sludge Effluent (gpd)	122,915	96,294	88,192 316,667	76,618	63,169 329,335	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	64,762	62,741	62,126	61,247	62,470	
Volatile Solids (Lbs-VS/d)	35,970	38,144	38,805	39,751	42,719	
Total Solids (% TS) Volatile Solids (% VS)	2.5%	2.4% 61%	2.4% 62%	2.3%	2.3%	
Volatile Solids (% VS) Dewatered Solids (Lbs-TS/d)	61,524	61% 59,604	<u>62%</u> 59,020	65% 58,185	68% 59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	140	135	134	132	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) SSO Biogas Production (scfd)	51,145	51,145 847 234	<u>51,145</u> 653,917	51,145 377,750	51,145	Assumes a biogas yield of 11.8 scl/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
Total Biogas Production (scfd)	2,204,349	1,723,445	1,577,083	1,367,994	1,124,401	
			Nutrient Loading - Ammonia-N Estimates		-	-
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063	Peak Month 0.063	Peak 14 day	Peak 7 day	Peak day 0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS)		Peak Month 0.063 61,528	Peak 14 day 0.063 47,489	Peak 7 day 0.063 27,433	Peak day 0.063 0	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	0.063 107,656 91,507	0.063 61,528 52,298	0.063 47,489 40,365	0.063 27,433 23,318	0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-VS/d) SS0 Nitrogen Content (Ib-N/Ib-VS)	0.063 107,656 91,507 0.053	0.063 61,528 52,298 0.053	0.063 47,489 40,365 0.053	0.063 27,433 23,318 0.053	0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solidis Load (Ib-TS/d) SSO Volatile Solidis Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 107,656 91,507	0.063 61,528 52,298	0.063 47,489 40,365	0.063 27,433 23,318	0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Volatilie Solida Load (Ib-TS/0) SS0 Volatilie Solida Load (Ib-VS/0) SS0 Nitrogen Content (Ib-N/Ib-VS) SS0 Amonium-NL Load (Ib-V(day) NSW No. 2 NSW No. 2 NSW No. 2	0.063 107,656 91,507 0.053 4,375 0.000	0.063 61,528 52,298 0.053 2,501 0.000	0.063 47,489 40,365 0.053 1,930	0.063 27,433 23,318 0.053 1,115 0.000	0.063 0 0 0.000 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-YS/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Ammonium- Load (Ib-N/day) HSOW No. 2 HSOW No. 2 SHOW No. 2	0.063 107,656 91,507 0.053 4,375 0.000 0	0.063 61,528 52,298 0.053 2,501 0.000 0	0.063 47,489 40,365 0.053 1,930 0.000 0	0.063 27,433 23,318 0.053 1,115 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Orda Sidiels Cand (Ib-TS/0) SS0 Visitilité Solids Load (Ib-VS/0) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 No.2 Total Solids Load (Ib-TS/0) HSOW No.2 Total Solids Load (Ib-TS/0)	0.063 107,656 91,507 0.053 4,375 0.000 0 0	0.063 61.528 52,298 0.053 2,501 0.000 0 0 0	0.063 47.489 40.985 0.053 1.930 0.000 0 0	0.063 27,433 23,318 0.053 1,115 0.000 0 0	0.063 0 0.000 0 0 0.000 0 0	Notes
SS0 Organic Nithogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-YS/d) SS0 Nitrogen Content (Ib-N/Ib-YG) SS0 Nitrogen Content (Ib-N/Ib-YG) SS0 Nitrogen Content (Ib-N/Ib-TS) MSOW No.2 MSOW No.2 MSOW No.2 MSOW No.2 MSOW No.2 Volatile Solids Load (Ib-TS/d)	0.063 107,656 91,507 0.053 4,375 0.000 0	0.063 61,528 52,298 0.053 2,501 0.000 0	0.063 47,489 40,365 0.053 1,930 0.000 0	0.063 27,433 23,318 0.053 1,115 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Total Solids Load (Ib-TS/0) SS0 Volatile Solids Load (Ib-YS/0) SS0 Namonium-NL Load (Ib-H/Var) SS0 Namonium-NL Load (Ib-H/Var) HSOW No. 2 HSOW No. 2 THSOW No. 2 THSOW No. 2 SHSOW No. 2 HSOW No.2 HSOW No.2 HSOW No.2 HSOW No.2 HSOW No.2	0.063 107,656 91,507 0.063 4,375 0.000 0 0 0 0.000	0.063 61,528 52,298 0.053 2,501 0.000 0 0 0 0.000	0.063 47,489 40,365 0.053 1,930 0.000 0 0 0 0.000	0.063 27,433 23,318 0.053 1,115 0.000 0 0 0 0.000	0.063 0 0.000 0 0 0.000 0 0	Notes
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Orlati Solids Land (Ib-TS/0) SS0 Viabille Solids Land (Ib-VS/0) SS0 Mitrogen Content (Ib-H/Ib-VS) SS0 Ammonium-N Land (Ib-H/Id-S) ISOW No.2 Organic Nitrogen Content (Ib-H/Ib-TS) ISOW No.2 Total Solids Land (Ib-TS/0) ISOW No.2 Total Solid Scald (Ib-TS/0) ISOW No.2 Notes Solid Scald (Ib-VS/0) ISOW No	0.063 107,656 91,507 0.063 4,375 0.000 0 0 0 0.000	0.063 61,528 52,298 0.053 2,501 0.000 0 0 0 0.000	0.063 47,489 40,365 0.053 1,930 0.000 0 0 0 0.000	0.063 27,433 23,318 0.053 1,115 0.000 0 0 0 0.000	0.063 0 0.000 0 0 0.000 0 0	Notes
SSO Organic Nitrogen Content (Ib-H/Ib-TS) SSO Volatile Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-YS/d) SSO Nitrogen Content (Ib-H/Ib-YS) SSO Nitrogen Content (Ib-H/Ib-TS) HSOW No 2 HSOW HSO HSO HSOW HSO HSOW HSOW HSOW HSO	0.063 107,656 91,507 0.063 4,375 0.000 0 0 0 0.000	0.063 61,528 52,298 0.053 2,501 0.000 0 0 0 0.000	0.063 47,489 40,365 0.053 1,930 0.000 0 0 0 0.000	0.063 27,433 23,318 0.053 1,115 0.000 0 0 0 0.000	0.063 0 0.000 0 0 0.000 0 0	Notes
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Total Solids cand (Ib-TS/0) SS0 Valatile Solids Load (Ib-TS/0) SS0 Nitrogen Content (Ib-H/Ib-TS) SS0 Nitrogen Content (Ib-H/Ib-TS) HSOW No.2 Toganic Nitrogen Content (Ib-H/Ib-TS) HSOW No.2 Toganic Nitrogen Content (Ib-H/Ib-TS) HSOW No.2 Toganic Nitrogen Content (Ib-H/Ib-TS) HSOW No.2 Nitrogen Content (Ib-H/Ib-TS) Homary Studge Total Nitrogen Content (Ib-H/Ib-TS) Primary Studge Total Solids Load (Ib-TS/0) Primary Studge Total Solids Load (Ib-TS/0)	0.063 107.656 91.507 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 61.528 52.298 0.053 2.601 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 47,489 40.365 0.053 1.930 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 27,433 23,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (U-N/U-TS) SS0 Valati Solid cad (U-TS/d) SS0 Annonium-N Load (U-TS/d) HSOW No. 2 Organic Nitrogen Content (U-N/U-TS) HSOW No. 2 Organic Nitrogen Content (U-N/U-TS) HSOW No. 2 Natati Solid Load (U-TS/d) HSOW No. 2 Natati Solid Load (U-TS/d) HSOW No. 2 Natati Solid Load (U-N/d) Homary Sludge Total Solid Load (U-N/d) Primary Sludge Total Solid Load (U-N/d) Primary Sludge Total Solid Load (U-N/d)	0.063 107.656 91.507 0.053 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 61.528 52.298 0.053 2.501 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 47.489 40.365 0.053 1.930 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 21,433 23,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Total Solids cand (Ib-TS/0) SS0 Valatile Solids Load (Ib-TS/0) SS0 Valatile Solids Load (Ib-TS/0) SS0 Nitrogen Content (Ib-H/Ib-TS) SS0 Namoulan-V. Load (Ib-TS/0) SSO Namoulan-V. Load (Ib-TS/0) SSO Namoulan-V. Load (Ib-TS/0) SSO Namoulan-V. Solids Load (Ib-TS/0) SSO Na. 2 Nitrogen Content (Ib-M/Ib-TS) SSOW No. 2 Nitrogen Content (Ib-M/Ib-TS) SSOW No. 2 Nitrogen Content (Ib-M/Ib-TS) Primary Studge Total Solids Load (Ib-TS/0) Nitrogen Content (Ib-M/Ib-YS) Nitrogen Content (Ib-M/Ib-YS) Nitrogen Content (Ib-M/Ib-YS) Nitrogen Content (Ib-M/Ib-YS)	0.063 107.656 91.507 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 61.528 52.298 0.053 2.601 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 47,489 40.365 0.053 1.930 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 27,433 23,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids cad (Ib-TS/d) SS0 Writegen Content (Ib-N/Ib-NS) SS0 Nitrogen Content (Ib-N/Ib-NS) SS0 Mitrogen Content (Ib-N/Ib-NS) SS0 Nitrogen Content (Ib-N/Ib-NS) SS0 Nitrogen Content (Ib-N/Ib-NS) SS0 Nitrogen Content (Ib-N/Ib-NS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Natalite Solids Load (Ib-NS/d) Primary Sludge Total Solids Load (Ib-NS/d) Primary Sludge Total Solids Load (Ib-NS/d) Primary Sludge Total Solids Load (Ib-NS/d) Primary Sludge Notalite Solids Load (Ib-NS/d) Primary Sludge Total Solids Load (Ib-NS/d) Primary Sludge Notalite Solids Load (Ib-NS/d) Nitrogen Content (Ib-N/Lb-NS) Primary Sludge Total Solids Load (Ib-NS/d) Nitrogen Content (Ib-N/Lb-NS)	0.063 107.656 91.507 0.053 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 61.528 52.298 0.053 2.501 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 47.489 40.365 0.053 1.330 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0	0.063 22,433 23,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (U-N/U-TS) SS0 Total Solids cad (U-TS/d) SS0 Valids Solids Laad (U-YS/d) SS0 Nitrogen Content (U-N/U-YS) Primary Sludgen Total Solids Laad (U-N/d) Witrogen Content (U-N/U-YS) Primary Sludgen Total Solids Laad (U-N/d) Primary Sludgen Total Solids Laad (U-N/d) Witrogen Content (U-N/U-YS) Primary Sludgen Total Solids Laad (U-N/d) Witrogen Content (U-N/U-YS) Primary Sludgen Total Solids Laad (U-N/d) Witrogen Content (U-N/U-YS) Witrogen Content (U-N/U-YS) </td <td>0.063 107.656 91.507 0.053 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 61.528 52.298 0.053 2.501 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 47.489 40.365 0.053 1.930 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 27,433 22,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Notes</td>	0.063 107.656 91.507 0.053 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 61.528 52.298 0.053 2.501 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 47.489 40.365 0.053 1.930 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 27,433 22,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (U-N/Ib-TS) SS0 Total Solids cand (Di-TS/d) SS0 Vatal Context and (Di-TS/d) SS0 Vatal Solids cand (Di-TS/d) SS0 Nitrogen Content (U-N/Ib-TS) SS0 Nitrogen Content (U-N/Ib-TS) HSOW No. 2 HSOW No. 2 SS0 Administration (U-N/Ib-TS) HSOW No. 2 SS0 Administration (U-N/Ib-TS) HSOW No. 2 HSOW No. 2 SS0 Administration (U-N/Ib-TS) HSOW No. 2 HSOW No. 2 SS0 Administration (U-N/Ib-TS) HSOW No. 2 HSOW No. 2 Partiang Studge Total Nitrogen Content (U-N/Ib-TS) Prinang Studge Total Solids Load (U-N/Id-M) WAS Total Solids Load (0.063 107.656 91.507 0.053 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 61.528 52.288 0.053 2,501 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 47.489 40.265 0.053 1.530 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 27,433 22,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.083 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Total Solits Land (Ib-TS/0) SS0 Valuitie Solits Land (Ib-TS/0) SS0 Witzen Content (Ib-H/Ib-TS) Primary Studge Total Nitrogen Content (Ib-H/Ib-TS) Witzen Content (Ib-H/Ib-TS) Witze	0.063 107.656 91.507 0.053 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 61.528 52.298 0.053 2,501 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 47.489 40.395 0.053 0.053 1,530 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 27,433 23,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.083 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Laad (Ib-TS/d) SS0 Variagi Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 NEW No. 2 SS0 Amondum-N Laad (Ib-N/Ib-TS) HSOW No. 2 Voiatile Solids Laad (Ib-YS/d) Primary Studge Total Nitrogen Content (Ib-N/Ib-TS) Primary Studge Total Solids Laad (Ib-YS/d) WNAS Total Solids Laad (Ib-YS/d	0.063 107.656 91.507 0.053 4.375 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 61.528 52.288 0.053 2,501 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 47.489 40.265 0.053 1.530 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 27,433 22,318 0.053 1,115 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.083 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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Brown AND Caldwell	
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Date Checked	Checked By	Job Number	By	Date	Calc No		
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-001		
	Pro	ject	Subject				
Encina Biosolids, Energy, and E	missions		Current Year - Service C	Condition			

10 day Thermophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	10	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SSO	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dofo

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Slud	Primary Sludge			TWAS			Existing HSOW (if applicable)		
Parameter Input Values Reference		Parameter	Input Values	Reference	Parameter	Input Values	Reference		
Nitrogen Speci	ation		Nitrogen Speciation			Nitrogen Speciation			
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)	
PS Org. Nitrogen (Ib-N/Ib-TS)		TWAS Org. Nitrogen (lb-N/lb-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)				
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)			

Nutrients Speciation for HSOW

Parameter	Input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

			#REF!	-	-	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	3.90	3.90	3.90	3.90	3.90	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (lb-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (lb-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	19	15	14	13	12	
Base OLR (lbsVS/d-cf)	0.13	0.16	0.17	0.18	0.20	
Hydraulic Capacity (HC) (gpd)	180,403	134,312	120,284	100,244	60,165	Assumes the minimum allowable HRT 10 days
HC as Equivalent VS Load (lb-VS/day)	153,465	114,256	102,323	85,276	51,181	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (lb-VS/day)	114,876	100,113	95,621	89,202	76,365	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Organic Load		Hydraulic	Hydraulic	
			X-X: Mesophilic Co-digestion Feed Assessn	ient		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	114,876	100,113	95,621	85,276	51,181	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/day)	114,876	100,113	95,621	85,276	51,181	
HSOW No. 2 Volatile Solids Load (lb-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (lb-VS/day)	114,876	100,113	95,621	85,276	51,181	
SSO Total Solids Load (Ib-TS/day)	135,148	117,780	112,495	100,324	60,213	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (lb-TS/day)	135,148	117,780	112,495	100,324	60,213	
SSO (lb-wet/day)	1,126,233	981,504	937,456	836,037	501,774	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	1,126,233	981,504	937,456	836,037	501,774	
SSO (wtpd)	563	491	469	418	251	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	563	491	469	418	251	
SSO (gpd)	135,040	117,686	112,405	100,244	60,165	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	135,040	117,686	112,405	100,244	60,165	
Total Solids, Total Solids Load (lb-TS/d)	215,168	215,288	215,324	210,757	185,851	
Total Solids, Volatile Solids Load (Ib-VS/d)	182,253	182,253	182,253	178,326	157,068	
Total Flow (gpd)	344,137	372,875	381,621	389,500	389,500	
Primary sludge percent of VS Load (%)	23%	28%	30%	33%	43%	

WAS percent of VS Load (%)	12%	15%	16%	18%	23%	
FOG percent of VS Load (%)	2%	2%	2%	2%	2%	
SSO percent of VS Load (%)	63%	55%	52%	48%	33%	
HSOW No. 2 percent of VS Load (%) Check	0% 0k	0%	0% 0k	0%	0% 0k	
Cneck Co-digestion HRT (days)	0K 11	0K 10	0K 10	ок 10	0K 10	
Co-Digestion OLR (lbs-VS/d-cf)	0.35	0.35	0.35	0.34	0.30	
Process Check	OK	OK	OK	OK	OK	
		Table X-)	: Existing Mesophilic Solids and Biogas Proc	uction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (lb-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	40,558	49,225	51,863	55,632	63,169	Annual that where is small where and
Total Sludge Effluent (gpd) Total Solids Effluent (Lbs-TS/d)	39,463	48.282	50,966	54,801	62,470	Assumes that volume in equals volume out
Volatile Solids Effluent (Lbs-VS/d)	26.819	32,914	34,769	37,419	42,719	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	483,237 187,548	594,382 230,684	628,208 243,813	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	187,548	230,684	243,813 51,145	262,568	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) Biogas Production (scfd)	51,145	51,145 876,211	923.166	51,145 990.244	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
	121,000		Mesophilic Co-digestion Solids and Biogas Pi		1,124,401	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	103,388	90,102	86,058	76,748	46,063	
HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day) Total Volatile Solids Destroyed (lb-VSd/day)	0 143,946	0 139.327	0 137.922	0 132,380	0	
Total Volatile Solids Destroyed (Ib-VSd/day) Total Sludge Effluent (gpd)	344.137	372.875	381.621	389.500	389.500	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	71,222	75,960	77,402	78,377	76,620	
Volatile Solids (Lbs-VS/d)	38,307	42,925	44,331	45,946	47,837	
Total Solids (% TS)	2.5%	2.4%	2.4%	2.4%	2.4%	
Volatile Solids (% VS)	54%	57%	57%	59%	62%	
Dewatered Solids (Lbs-TS/d)	67,661	72,162	73,532	74,458	72,789	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd) Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	154 483.237	164	167 628.208	169 676.532	165 773,179	Assumes biosolids cake has a solids content of 22% TS Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187.548	230.684	243.813	262.568	300.077	Assumes a biogas yield of 17.8 scl/lb-VSd
FOG Biogas Production (scfd)	51.145	51.145	51.145	51.145	51.145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	1,860,988	1,621,837	1,549,052	1,381,467	829,132	Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
Total Biogas Production (scfd)	2,582,918	2.498.048			1.953.534	
Total Biogas (Totaloasii (Sola)	2,382,918		2,472,218	2,371,711	1,953,534	
		Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat	es		
HSOW No 1	Annual Average	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day	es Peak 7 day	Peak day	Notes
HSOW No 1 SSO Organic Nitrogen Content (lb-N/lb-TS)	Annual Average 0.063	Table Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	Annual Average	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day	es Peak 7 day	Peak day	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solidis Load (Ib-TS/d) SSO Volatile Solidis Load (Ib-YS/d)	Annual Average 0.063	Table Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
HSDW Ho 1 SSG Organic Nitrogen Content (Ib-A/Ib-TS) SSG Total Solids Load (Ib-TS/d) SSG Viotalis Solids Load (Ib-YS/d) SSG Nitrogen Content (Ib-A/Ib-YS) SSG Ammoultm-K Load (Ib-K/day)	Annual Average 0.063 135,148 114,876	Table Peak Month 0.063 117,780 100,113	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621	es Peak 7 day 0.063 100,324 85,276	Peak day 0.063 60,213 51,181	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-T5/d) SSO Viratil's Solids Load (Ib-Y/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-H Load (Ib-N/day) HSOW No 2	Annual Average 0.063 135,148 114,876 0.053 5,492	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572	es Peak 7 day 0.063 100,324 85,276 0.053 4,077	Peak day 0.063 60,213 51,181 0.053 2,447	Notes
HOW Ho 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotaliti Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HOW No 2 HSOW No 2 HSOH NO	Annual Average 0.063 135,148 114,876 0.053 5,492 0.000	Table Peak Month 0.063 117,780 100,113	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621	es Peak 7 day 0.063 100,324 85,276	Peak day 0.063 60,213 51,181	Notes
BSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-T5/d) SSO Total Solids Load (Ib-T5/d) SSO Vinatil Solids Load (Ib-V/d) SSO Montal Solids Load (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/d)	Annual Average 0.063 133,148 114,876 0.053 5.492 0.000 0	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0	Notes
How Ve 6 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotalite Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-YS) HSW Ve 2 HSW Ve 3 HSW HSW Ve 3 HSW Ve 3 HSW Ve 3 HSW Ve 3 HSW HSW V	Annual Average 0.063 135,148 114,876 0.053 5,492 0.000	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572	es Peak 7 day 0.063 100,324 85,276 0.053 4,077	Peak day 0.063 60,213 51,181 0.053 2,447	Notes
How No 1 SSO Organic Nitrogen Content (Ib N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Notencille Solids Load (Ib-TS/d) HSW No 2 HSW	Annual Average 0.063 133,148 114,876 0.053 5.492 0.000 0	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0	Notes
HSOW No. 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Visatils Solids Load (Ib-TS/d) SS0 Norganic Nitrogen Content (Ib-N/Ib-TS) SS0 Manualima-Wit Load (Ib-N/day) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Notatie Solids Load (Ib-TS/d) HSOW No. 2 Antononium-N Load (Ib-N/Lb-TS) HSOW No. 2 Antononium-N Load (Ib-N/Lb-TS)	Annual Average 0.063 135,148 0.053 5,492 0.000 0 0 0	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787 0.000 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0	Notes
HSOW No 1 HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Totalis Solids Load (Ib-TS/d) SSO Visatils Solids Load (Ib-TS/d) SSO Xinatils Solids Load (Ib-N/Ib-TS) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Visatile Solids Load (Ib-TS/d) HSOW No 2 Visatile Solids Load (Ib-TS/d) HSOW No 2 Visatile Solids Load (Ib-Y/B) HSOW No 2 Visatile Solids Load (Ib-V/B) HSOW No 2 Visatile Solids Load (Ib-V/Ga)	Annual Average 0.063 135,148 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112.495 95.621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0 0 0 0 0 0 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0 0 0 0 0 0 0 0 0 0	Notes
HeoW No. 1 SSO Onganic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitroalitie Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Homey Sludge Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063 135,148 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112.495 95.621 0.053 4.572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	23 Pesk 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes Notes
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BOW No 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Visatils Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-YG) SS0 Nitrogen Content (Ib-N/Ib-YG) SS0 Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Notalis Solids Load (Ib-TS/d) Himary Siludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Siludge Total Solids Load (Ib-TS/d) Primary Silu	Annual Average 0.063 135,148 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787 0	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60.213 51.181 0.053 2,447 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
Kerner Marken Konner Konner	Annual Average 0.063 135,148 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 117,780 100,113 0.053 4,787 0	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60.213 51.181 0.053 2,447 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Solivatils Solids Load (Ib-TS/d) SSO Mirotaline Solids Load (Ib-TS/d) SSO Mirogen-Content (Ib-N/Ib-TS) HSOW No. 2 (Total Solids Load (Ib-TS/d) Homay Sludge Total Solids Load (Ib-TS/d) Mitrogen Content (Ib-N/Ib-TS) Primary Sludge VolidIte Solids Load (Ib-TS/d) Mitrogen Content (Ib-N/Ib-TS) TWAS Total Solids Load (Ib-TS/d)	Annual Average 0.063 135,148 114,876 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.07780 117,780 100.113 0.053 4,787 0.000 0 0 0.000 0 0.065 59,049 51,373 0.057 1,900 0.065 34,468	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 0.053 0.057 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60.213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 76.812 66.826 0.057 2.4711 0.0656	Notes
Horov Ho 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Stol Solids Load (Ib-TS/d) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Not Solids Load (Ib-TS/d) HTMay Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Yitrogen Content (Ib-N/Ib-TS) Witrogen Content (Ib-N/Ib-TS) Witrogen Content (Ib-N/Ib-TS) WXS Total Stufts Load (Ib-TS/d) WXS Volati Solids Load (Ib-TS/d)	Annual Average 0.063 135,148 114,876 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 107.780 100.113 0.053 4.787 0.0000 0 0 0 0.0001 0 0 0.0065 59,049 51,373 0.057 1,900	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60.213 51.181 0.053 2,447 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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Kerner Marken Kerner Kerner Kerner Kerner Kerner Kerner	Annual Average 0.063 135,148 114,876 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 48,007 41,766 0.057 1,545 0.065 28,022 22,418 0.052 551 0.010 3.991 3.133 0.008 24 66 7 9.22 7,612 0.34 2,652	Ch5 Peak Month 0.063 117,780 110,113 0.053 4,77 0.001 0.000 0 0.001 0.0001 0 0.0001 0 0.0005 9.049 61,373 0.057 1.900 0.052 678 0.001 3.931 0.002 7 9.224 7,388 0.376 7,388 0.376	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 Peak 7 day 0.063 100.324 85.276 0.053 0.063 4.077 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 667.210 58.473 0.057 2.163 131.385 0.052 772 0.010 3.991 3.193 0.008 24 0 66 7 9.22 7.035 0.39 2.166 10.05	Peak day 0.065 0.213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
Berner Marken Stephen Ste	Annual Average 0.063 135,148 0.053 0.053 0.053 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tel: Peak Month 0.063 117,780 100,113 0.053 4,787 0.000 0 0.000 0 0.0000 0 0.0001 0.0002 0.0005 59.049 0.0051 34,468 27,574 0.0052 678 0.0010 3,9931 3,9931 3,9931 3,9931 3,9931 0.008 66 7 9,22 7,388 0.37 2,376	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 0.053 0.053 0.053 0.053 0.053 0.053 0.050 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.063 0.011 0.053 2.447 0.000 0 0.005 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
KOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Norganic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Norgen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Wirks Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Volds Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) HSW rotal Solids Load (Ib-TS/d) HSW rotal Solids Load (Ib-TS/d) HSW rotal Solids Load (Ib-YG/d) Nitrogen Content (Ib-N/Ib-TS) HSW rotal Solids Load (Ib-YG/d) HSW rotal	Annual Average 0.063 135,148 114,876 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 48,007 41,766 0.057 1,545 0.065 28,022 22,418 0.052 551 0.010 3.991 3.133 0.008 24 66 7 9.22 7,612 0.34 2,652	Ch5 Peak Month 0.063 117,780 110,113 0.053 4,787 0.000 0 0.001 0.0001 0 0 0.0001 0 0.0005 9.049 6.051 9.049 0.055 9.049 0.052 678 0.001 3.991 0.002 0.003 24 7,388 0.376 2.376	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 Peak 7 day 0.063 100.324 85.276 0.053 0.063 4.077 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 667.210 58.473 0.057 2.163 131.385 0.052 772 0.010 3.991 3.193 0.008 24 0 66 7 9.22 7.035 0.39 2.166 10.05	Peak day 0.653 0.053 0.213 0.51.181 0.053 0.244 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
Berner Mitogen Content (Ib-N/Ib-TS) SSO Total: Solids Load (Ib-TS/d) SSO Mononium-N Load (Ib-N/dav) HSOW No. 2 Total Solids Load (Ib-TS/d) Homay Solidge Total Nitrogen Content (Ib-N/Ib-TS) Primay Solidge Total Solids Load (Ib-TS/d) Witrogen Content (Ib-N/Ib-TS) How Solids Load (Ib-TS/d) Witrogen Content (Ib-N/Ib-TS) How Solids Load (Ib-TS/d) Witrogen Content (Ib-N/Ib-TS) How Solids Load (Ib-N/G) Mitrogen Content (Ib-N/Ib-TS) How Solids Load (Ib-N/G) How Solids Load (Ib-N/G) Hitrogen Content (Ib-N/Ib-TS) How Solids Load (Ib-N/G) How	Annual Average 0.063 135,148 114,875 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tels/ Peak Month 0.063 117,780 100,113 0.053 4,787 0.000 0 0.000 0 0.0000 0 0.0001 0.0002 0.0005 59.049 59.049 0.0052 678 0.0052 678 0.0010 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9931 3.9932 7.388 0.377 2.94 15.96	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 0.053 0.053 0.057 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.0213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
KOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Norganic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Norgen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Wirks Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Volds Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) HSW rotal Solids Load (Ib-TS/d) HSW rotal Solids Load (Ib-TS/d) HSW rotal Solids Load (Ib-YG/d) Nitrogen Content (Ib-N/Ib-TS) HSW rotal Solids Load (Ib-YG/d) HSW rotal	Annual Average 0.063 135,148 114,876 0.053 5,492 0.000 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 48,007 41,766 0.057 1,545 0.065 28,022 22,418 0.052 551 0.010 3.991 3.133 0.008 24 66 7 9.22 7,612 0.34 2,652	Test Peak Month 0.063 117,780 100,113 0.053 4,787 0.000 0 0.000 0 0.0000 0 0.0001 0.0002 0.0005 59.049 0.0051 34,468 27,574 0.0052 678 0.0010 3,9931 3,9931 3,9931 3,9931 3,9931 3,1933 0.0010 0.002 66 67 0.37 7,388 0.37 0.37	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 112,495 95,621 0.053 4,572 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 Peak 7 day 0.063 100.324 85.276 0.053 0.063 4.077 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 667.210 58.473 0.057 2.163 131.385 0.052 772 0.010 3.991 3.193 0.008 24 0 66 7 9.22 7.035 0.39 2.166 10.05	Pesk day 0.063 0.063 0.011 0.053 2.447 0.000 0 0.005 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes

	Date Checked	Checked By	Job Number	Ву	Date	Calc No	
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-001	
Caldwall		Project		Subject			
Caldwell	Encina Biosolids, Energy, and Emissio	ons		Current Year - Service Condition			
and the second se							

10 day Thermophilic Digestion with All digesters in service

Digester and Process Information

Parameter	Input Values	Reference	Parameter Input Values Reference		Parameter	Input Values	Reference	
Number of Primary Digesters	3	1	Minium HRT (days) 10 Assumed		Peaking Factors			
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d) 0.35 Assumed		Annual Average	1	2	
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS) 22% 1		Peak 7 day	1.4	2	
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSOW (blank if not applicable)		
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values Referen		Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

- [Parameter	Input Values	Reference	Parameter	Input Values	Reference
ſ	Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
[TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
[FOG VSR (%)	90%	3			
	SSO VSR (%)	90%	3			
[Do not use this row					

Nutrients Speciation for Existing Conditions

Primar	y Sludge		TWAS			Existing HSOW (if applicable)		
Parameter Input Values Reference		Parameter	Input Values	Reference	Parameter	Input Values	Reference	
Nitrogen Speciation			Nitrogen Spe	ciation		Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		
	_							

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/I)	3,000	

		Table X-X: Existi	ng 10 day Thermophilic Digestion Feed Asse	essment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	4.75	4.75	4.75	4.75	4.75	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (lb-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	23	19	18	16	14	
Base OLR (lbsVS/d-cf)	0.11	0.13	0.14	0.15	0.17	
Hydraulic Capacity (HC) (gpd)	265.903	219.812	205.784	185,744	145,665	Assumes the minimum allowable HRT 10 days
HC as Equivalent VS Load (Ib-VS/day)	226,198	186,989	175.056	158,009	123,914	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	154,882	140,120	135.627	129,209	116.372	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load	
		Table X-)	: Mesophilic Co-digestion Feed Assessmen	t		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	154,882	140,120	135,627	129,209	116,372	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/day)	154,882	140,120	135,627	129,209	116,372	-
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	Ó	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	154,882	140,120	135,627	129,209	116,372	
SSO Total Solids Load (Ib-TS/day)	182,215	164,847	159,561	152,010	136,908	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	182,215	164,847	159,561	152,010	136,908	
SSO (lb-wet/day)	1,518,456	1,373,726	1,329,678	1,266,753	1,140,901	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	1.518.456	1.373.726	1,329.678	1,266,753	1,140,901	
SSO (wtpd)	759	687	665	633	570	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	759	687	665	633	570	
SSO (gpd)	182.069	164.715	159.434	151.889	136,799	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	182.069	164.715	159,434	151.889	136,799	
Total Solids, Total Solids Load (Ib-TS/d)	262.235	262,354	262.391	262,443	262,546	
Total Solids, Volatile Solids Load (Ib-VS/d)	222,259	222,259	222,259	222,259	222,259	
Total Flow (gpd)	391,166	419,904	428,650	441,145	466,134	
Primary sludge percent of VS Load (%)	19%	23%	24%	26%	30%	
WAS percent of VS Load (%)	10%	12%	13%	14%	16%	
FOG percent of VS Load (%)	1%	1%	1%	1%	1%	
SSO percent of VS Load (%)	70%	63%	61%	58%	52%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	12	11	11	11	10	

Co-Digestion OLR (lbs-VS/d-cf)	0.35	0.35	0.35	0.35	0.35	
Process Check	OK	OK	ОК	OK	OK	
		Table X-X: Exist	ing Mesophilic Solids and Biogas Production	on		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (lb-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	209,097	255,188 48,282	269,216	289,256	329,335 62,470	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d) Volatile Solids Effluent (Lbs-VS/d)	26,819	48,282	34,769	37,419	42,719	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	B
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	37,489 85	45,868 104	48,418 110	52,061 118	59,346 135	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) Biogas Production (scfd)	51,145 721,930	51,145 876,211	51,145 923,166	51,145 990,244	51,145 1,124,401	Assumes a biogas yield of 17.8 scf/lb-VSd
slogas Production (scrd)	721,930	Table X-X: Mesoph			1,124,401	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960 2,873	13,697 2,873	14,751 2,873	16,858 2,873	
FOG Volatile Solids Destroyed (Ib-VSd/day) SSO Volatile Solids Destroyed (Ib-VSd/day)	139,394	126,108	122,064	2,873	104,735	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	Ö	0	Ó	Ö	
Fotal Volatile Solids Destroyed (lb-VSd/day)	179,952	175,333	173,928	171,920	167,903	
Fotal Sludge Effluent (gpd) Fotal Solids (Lbs-TS/d)	391,166 82,283	419,904 87,021	428,650 88,463	441,145 90,523	466,134 94,643	Assumes that volume in equals volume out
Volatile Solids (Lbs-VS/d)	42,307	46,926	48,332	50,340	54,356	
Total Solids (% TS)	2.5%	2.5%	2.5%	2.5%	2.4%	
Volatile Solids (% VS)	51%	54%	55% 84.040	56%	57%	Downstand asks assumes 05% senture rate
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	78,169	82,670 188	84,040 191	85,997 195	89,911 204	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
	51.145	51,145	51,145	51,145	51,145 1.885.225	Assumes a biogas yield of 17.8 scf/lb-VSd
350 Biogas Production (sofd)	2 509 096	2 260 046				
FOG Biogas Production (scfd) SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd)	2,509,096	2,269,946	2,197,161	2,093,182	1,885,225	Assumes a biogas yield of 18 scf/lb-VSd
So Biogas Production (scfd) SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)	2,509,096	3,146,156	0 3,120,326	0 3,083,426		Assumes a biogas yield of 18 sci/10-vSu
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)	2,509,096 0 3,231,027	3,146,156 Table X-X: N	0 3,120,326 Nutrient Loading - Ammonia-N Estimates	3,083,426	0 3,009,626	
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1	2,509,096	3,146,156	0 3,120,326		0	Assumes a toigas yield of 18 sc/ 10-45d
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)	2,509,096 0 3,231,027 Annual Average	3,146,156 Table X-X: N Peak Month	0 3,120,326 Nutrient Loading - Ammonia-N Estimates Peak 14 day	3,083,426 Peak 7 day	0 3,009,626 Peak day	
SS0 Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) rotal Biogas Production (scfd) SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-Ts/d)	2,509,096 0 3,231,027 Annual Average 0.063 182,215 154,882	3,146,156 Table X-X: N Peak Month 0.063 164,847 140,120	0 3,120,326 Nutrient Loading - Ammonia-N Estimates Peak 14 day 0.063 159,561 135,627	3,083,426 Peak 7 day 0.063 152,010 129,209	0 3,009,626 Peak day 0.063 136,908 116,372	
SS0 Biogas Production (sctd) SS0 Biogas Production (sctd) Total Biogas Production (sctd) SS0 Production (sctd) SS0 Nitrogen Content (lb-Nfx/d) SS0 Nitrogen Content (lb-Nfx/d)	2,509,096 0 3,231,027 Annual Average 0.063 182,215 154,882 0.053	3,146,156 Table X-X: N Peak Month 0.063 164,847 140,120 0.053	0 3,120,326 3,120,326 Peak 14 day 0,063 159,561 135,627 0,053	3,083,426 Peak 7 day 0.063 152,010 129,209 0.053	0 3,009,626 Peak day 0.063 136,908 116,372 0.053	
SS0 Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) rotal Biogas Production (scfd) SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-Ts/d)	2,509,096 0 3,231,027 Annual Average 0.063 182,215 154,882	3,146,156 Table X-X: N Peak Month 0.063 164,847 140,120	0 3,120,326 Nutrient Loading - Ammonia-N Estimates Peak 14 day 0.063 159,561 135,627	3,083,426 Peak 7 day 0.063 152,010 129,209	0 3,009,626 Peak day 0.063 136,908 116,372	
S00 Biogas Production (scfd) S04 Biogas Production (scfd) fotal Biogas Production (scfd) S04 Biogas Production (scfd) S00 Figure 3 S04 Biogas Production (scfd) S00 S07 tail Solids Load (Ib-TS/d) S05 Vision (Ib-TS/d) S00 Vision 4 S04 Vision (Ib-TS/d) S00 Vision (Ib-TS/d) S05 Vision (Ib-TS/d)	2,509,096 0 3,231,027 Annual Average 0,063 182,215 154,882 0,053 7,405 0,000	3,146,156 Table X.X: N Peak Month 0.063 164,847 140,120 0.053 6,699 0.000	0 3.120.326 Nutrient Loading - Ammonia-N Estimates Peak 14 day 0.063 159.561 135.627 0.053 6.485 0.000	3,083,426 Peak 7 day 0.063 152,010 129,209 0.053 6,178 0.000	0 3,009,626 Peak day 0.063 136,908 116,372 0.053 5,564 0.000	
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9/22/2017 Chris Muller 150871 Tracy Chouland 9/15/2017 C-0.1 Project Subject		Date Checked	Checked By	Job Number	Ву	Date	Calc No
	Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-001
	Oaldurall		Pro	ject			Subject
Caldwell Encina Biosolids, Energy, and Emissions Current Year - Service Condition	Caldwell	Encina Biosolids, Energy, and Emissi	ons		Current Year - Service Condition		

Thermal Hydrolysis with Mesophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	12	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.4	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1	Percent Solids Content of Digester Feed	9%	Assumed	Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	102	Assumed	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0		Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dofo

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Slud	ge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speci	ation		Nitrogen Spec	ciation		Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

	Tab	le X-X: Existing Th	ermal Hydrolysis with Mesophilic Digestio	n Feed Assessment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	3.90	3.90	3.90	3.90	3.90	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (lb-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (lb-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	106,609	129,906	136,996	147,125	167,384	
Total Percent Solids Load (%)	9.0%	9.0%	9.0%	9.0%	9.0%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	37	30	28	26	23	
Base OLR (lbsVS/d-cf)	0.13	0.16	0.17	0.18	0.20	
Hydraulic Capacity (HC) (gpd)	217.975	194.678	187.587	177.458	157.200	Assumes the minimum allowable HRT 12 days
HC as Equivalent VS Load (Ib-VS/day)	185,427	165,608	159,577	150,960	133,726	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (lb-VS/day)	140.912	126.150	121.657	115.238	102.401	Difference between max OLR (0.4 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load	
			K-X: Mesophilic Co-digestion Feed Assessi			
1	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	140,912	126,150	121,657	115,238	102,401	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/dav)	140.912	126,150	121.657	115.238	102,401	j , , , , , , , , , , , , , , , , , , ,
HSOW No. 2 Volatile Solids Load (lb-VS/dav)						
	0	0	0	0	0	
Total HSOW Volatile Solids Load (lb-VS/dav)	0 140.912				0 102.401	
	140,912	0	0 121,657	0		Conversion to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day)		0 126,150	0	0 115,238	102,401	Conversion to Total Solids load based on SSO %VS
SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day)	140,912 165,779 0	0 126,150 148,411 0	0 121,657 143,125	0 115,238 135,574 0	102,401 120,472 0	Conversion to Total Solids load based on SSO %VS
SSO Total Solids Load (Ib-TS/day)	140,912 165,779	0 126,150 148,411	0 121,657 143,125 0	0 115,238 135,574	102,401 120,472	Conversion to Total Solids load based on SSO %VS Conversion to Wet Solids load based on SSO %TS
SSO Total Solids Load (lb-TS/day) HSOW No. 2 Total Solids Load (lb-TS/day) SSO Total Solids Load (lb-TS/day)	140,912 165,779 0 165,779	0 126,150 148,411 0 148,411	0 121,657 143,125 0 143,125	0 115,238 135,574 0 135,574	102,401 120,472 0 120,472	
SS0 Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SS0 Total Solids Load (Ib-TS/day) SS0 (Ib-wet/day)	140,912 165,779 0 165,779 1,381,489	0 126,150 148,411 0 148,411 1,236,760	0 121,657 143,125 0 143,125 1,192,712	0 115,238 135,574 0 135,574	102,401 120,472 0 120,472 1,003,934	
SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day)	140,912 165,779 0 165,779 1,381,489 0	0 126,150 148,411 0 148,411 1,236,760 0	0 121,657 143,125 0 143,125 1,192,712 0	0 115,238 135,574 0 135,574 1,129,786 0	102,401 120,472 0 120,472 1,003,934 0	
SS0 Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SS0 Total Solids Load (Ib-TS/day) SS0 Total Solids Load (Ib-Net) SS0 Total Solids Load (Ib-TS/day) SS0 Total Solids Load (Ib-TS/day) SS0 Total Solids Load (Ib-TS/day) SS0 (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) SS0 (Ib-wet/day)	140,912 165,779 0 165,779 1,381,489 0 1,381,489	0 126,150 148,411 0 148,411 1,236,760 0 1,236,760	0 121,657 143,125 0 143,125 1,192,712 0 1,192,712	0 115,238 135,574 0 135,574 1,129,786 0 1,129,786	102,401 120,472 0 120,472 1,003,934 0 1,003,934	
SSO Total Solids Land (Ib:Ts/day) SSO Total Land (Ib:wet/day) SSO (Ib:wet/day) SSO (Ib:wet/day) SSO (Ib:wet/day) SSO (Ib:wet/day)	140,912 165,779 0 165,779 1,381,489 0 1,381,489 691	0 126,150 148,411 0 148,411 1,236,760 0 1,236,760 618	0 121.657 143.125 0 143.125 1,192,712 0 1,192,712 596	0 115,238 135,574 0 135,574 1,129,786 0 1,129,786 565	102,401 120,472 0 120,472 1,003,934 0 1,003,934 502	
SSD Total Solids Laad (Ib-TS/day) HSOW No. 2. Total Solids Laad (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSD Total Solids Load (Ib-TS/day) SSD (Ib-wet/day) SSO (Ib-wet/day) SSO (Ib-wet/day) SSO (wet/day) SSO (wet/day) SSO (wet/day)	140,912 165,779 0 1,361,469 0 1,381,489 691 0 0	0 126,150 148,411 0 148,411 1,236,760 0 1,236,760 618 0	0 121,657 143,125 0 143,125 1,192,712 0 1,192,712 596 0 0	0 115,238 135,574 0 135,574 1,129,786 0 1,129,786 565 0	102,401 120,472 0 120,472 1,003,934 0 1,003,934 502 0	
SSD Total Solids Load (Ib-TS/day) SSD Total Solids Load (Ib-TS/day) SSD Total Solids Load (Ib-TS/day) SSD (Ib-wel/ day) SSD (Ib-ba) SSD (Ib-ba) SSD (Ib-ba) SSD (Ib-ba) SSD (Ib-ba)	140,912 165,779 0 165,779 1,381,489 0 1,381,489 691 0 691	0 126,150 148,411 0 148,411 1,236,760 0 1,236,760 618 0 618	0 121.657 143.125 0 143.125 143.125 143.125 143.125 143.125 143.125 0 143.125 0 0 1,192.712 596 0 596	0 115,238 135,574 0 135,574 1,129,786 0 1,129,786 565 0 565	102,401 120,472 0 120,472 1,003,934 0 1,003,934 502 0 502	Conversion to Wet Solids load based on SSO %75
SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids (Ib-TS/day) SSO (Ib-Werk/day) SSO (Ib-SSO	140,912 165,779 0 165,779 1,381,489 0 1,381,489 691 0 691 220,862	0 126,150 148,411 0 148,411 1,236,760 0 1,236,760 618 0 618 197,723	0 121,657 143,125 0 143,125 1,192,712 0 1,192,712 586 0 596 190,681	0 115,238 135,574 0 135,574 1,129,786 0 1,129,786 565 565 565 180,621	102,401 120,472 0 120,472 1,003,934 0 1,003,934 502 0 502 160,501	Conversion to Wet Solids load based on SSO %15 Conversion to Wet Solids load based on SSO %15 Assume 9% TS
SSO Total Solids Load (Ib:TS/day) HSOW No. 2 Total Solids Load (Ib:TS/day) SSO Total Solids Load (Ib:TS/day) SSO Ibid Solids Ibid (Ib:TS/day) SSO Ibid Solids Ibid (Ib:TS/day) SSO Ibid Solids Ibid (Ibid Ibid Ibid Ibid Ibid Ibid Ibid Ibid	140,912 165,779 0 165,779 1,381,489 0 1,381,489 691 0 691 220,862 0 0	0 126,150 148,411 0 148,411 1,236,760 0 1,236,760 618 0 618 197,723 0	0 121.657 143.125 0 143.125 1,192,712 0 1,192,712 596 0 596 190.681 0	0 115,238 135,574 0 135,574 1,129,786 0 1,129,786 0 565 180,621 0	102,401 120,472 0 120,472 1,003,934 0 1,003,934 502 0 502 160,501 0	Conversion to Wet Solids load based on SSO %15 Assume 9% 15 Assume 9% 15
SSO Total Solids Load (Ib-Ts/day) SSO Total Load (Ib-wet/day) SSO Total Load (Ib-met/day) SSO Total Load (Ib-wet/day) SSO Total Load (Ib-met/day) SSO Lobert Feed(Ignd) SSO Lobert Feed(Ignd)	140,912 165,779 0 165,779 1,381,489 691 0 691 220,862 0 220,862	0 126,150 148,411 0 148,411 1,236,760 0 1,236,760 618 0 618 0 618 197,723	0 121,657 143,125 0 143,125 1,192,712 0 1,192,712 596 0 596 190,681 0 190,681	0 115,238 135,574 0 135,574 1,129,786 0 1,129,786 565 180,651 180,621	102,401 120,472 0 120,472 1,003,934 0 1,003,934 502 0 502 160,501 0 160,501	Conversion to Wet Solids load based on SSO %75 Conversion to Wet Solids load based on SSO %75 Assume 9% TS Assume 9% TS
SSO Total Solids Load (Ib:TS/day) HSOW No. 2 Total Solids Load (Ib:TS/day) SSO Total Solids Load (Ib:TS/day) SSO Ibid Solids Ibid (Ib:TS/day) SSO Ibid Solids Ibid (Ib:TS/day) SSO Ibid Solids Ibid (Ibid Ibid Ibid Ibid Ibid Ibid Ibid Ibid	140,912 165,779 0 165,779 1,331,489 0 1,331,489 691 0 691 220,862 0 220,862 165,646	0 126,150 148,411 0 148,411 1,236,760 618 0 618 197,723 0 1197,723 148,293	0 121,657 143,125 0 143,125 1,192,712 0 1,192,712 596 0 596 190,681 143,011	0 115,238 135,574 0 135,574 1,129,786 565 0 565 0 180,621 135,466	102,401 120,472 1,003,934 0 1,003,934 502 0 160,501 0 160,501 120,376	Conversion to Wet Solids load based on SSO %TS Conversion to Wet Solids load based on SSO %TS Assume 9% TS Assume 9% TS Assume 9% TS Assume 7% TS

Total Solids, Volatile Solids Load (Ib-VS/d)	208,289	208,289	208,289	208,289	208,289	
Total Flow (gpd)	327,470	327,629	327,678	327,747	327,885	
Primary sludge percent of VS Load (%)	20%	25%	26%	28%	32%	
WAS percent of VS Load (%)	11%	13%	14%	15%	17%	
FOG percent of VS Load (%)	2%	2%	2%	2%	2%	
SSO percent of VS Load (%) HSOW No. 2 percent of VS Load (%)	68% 0%	61% 0%	0%	0%	49%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	12	12	12	12	12	
Co-Digestion OLR (lbs-VS/d-cf)	0.40	0.40	0.40	0.40	0.40	
Process Check	OK	OK	OK	OK	ОК	
	-	Table X-)	: Existing Mesophilic Solids and Biogas Prod	uction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	40,558	49,225	51,863	55,632	63,169	Annual that where is a surface barry and
Total Sludge Effluent (gpd) Total Solids Effluent (Lbs-TS/d)	106,609	129,906 48.282	136,996 50,966	147,125 54.801	167,384 62,470	Assumes that volume in equals volume out
Volatile Solids Effluent (Lbs-VS/d)	26.819	32.914	34,769	37,419	42,719	
Total Solids (% TS)	4.4%	4.5%	4.5%	4.5%	4.5%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	721,930	876,211 Table Y-Y-I	923,166 Mesophilic Co-digestion Solids and Biogas Pr	990,244 aduction	1,124,401	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10.536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	126,821	113,535	109,491	103,714	92,161	
HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	167,379	162,760	161,354	159,346	155,330	
Total Sludge Effluent (gpd)	327,470	327,629	327,678	327,747	327,885	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d) Volatile Solids (Lbs-VS/d)	78,421	83,159	84,601	86,661 48 943	90,781	
Volatile Solids (LDS-VS/d) Total Solids (% TS)	40,910	45,529	46,935	48,943	52,959	
Volatile Solids (% VS)	52%	55%	55%	56%	58%	
Dewatered Solids (Lbs-TS/d)	74,500	79,001	80,371	82.328	86,242	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	169	180	183	187	196	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145 2.282.773	51,145 2.043.622	51,145 1.970.837	51,145	51,145 1,658,901	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)						
	2,202,113	2,043,022	1,970,837	1,866,858	1,030,501	Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	Assumes a biogas yield of 18 scl/10-vSd
	0 3,004,703	0 2,919,833	0 2,894,003	0 2,857,103	0	Assumes a diogas yield of 18 scl/10-v3d
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)	0	0 2,919,833	0	0 2,857,103 es	2,783,303	
HSOW No. 2 Biogas Production (scfd)	0 3,004,703	0 2,919,833 Tabl	0 2,894,003 e X-X: Nutrient Loading - Ammonia-N Estimat	0 2,857,103	0	Assumes a ungas yrend oʻi 10 sci/ ia-45d Notes
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	0 3,004,703 Annual Average 0.063 165,779	0 2,919,833 Tabl Peak Month 0.063 148,411	0 2,894,003 e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143,125	0 2,857,103 es Peak 7 day 0.063 135,574	0 2,783,303 Peak day 0.063 120,472	
HSOW No.2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Totalic Solids Load (Ib-TS/d) SSO Votatile Solids Load (Ib-TS/d)	0 3,004,703 Annual Average 0.063 165,779 140,912	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150	0 2,894,003 e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143,125 121,667	0 2,857,103 es Peak 7 day 0.063 135,574 115,238	0 2,783,303 Peak day 0.063 120,472 102,401	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatilie Solids Load (Ib-TS/d) SSO Violatilie Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS)	0 3,004,703 Annual Average 0.063 165,779 140,912 0.063	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053	0 2894,003 2 X-X: Nutrient Loading = Aimonia-N Estimat Peak 14 day 0.063 143,125 121,657 0.053	0 2,857,103 25 Peak 7 day 0.063 135,574 115,238 0.053	0 2,783,303 Peak day 0.063 120,472 102,401 0.053	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) BSOW No. 1 SSO Total Solids Load (Ib-TS/) SSO Total Solids Load (Ib-TS/d) SSO Viotalis Solids Load (Ib-YS/d) SSO Mirogen Context (Ib-N/Ib-YS) SSO Amnonium-N Load (Ib-N/dsy)	0 3,004,703 Annual Average 0.063 165,779 140,912	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150	0 2,894,003 e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143,125 121,667	0 2,857,103 es Peak 7 day 0.063 135,574 115,238	0 2,783,303 Peak day 0.063 120,472 102,401	
HSOW No.2 Blogas Production (scfd) Total Blogas Production (scfd) HSOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Altimonium-N Load (Ib-N/day) HSOW No.2 HSOW No.2	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053 6,032	0 2,894,003 2 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.053 5,817	0 2,857,103 25 Peak 7 day 0.063 135,574 115,238 0.053 5,510	0 2,783,303 Peak day 0.063 120,472 102,401 0.053	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) Head We at 1 SSO Optimation (How Note: 10) SSO Total Solids Load (Ib-15/d) SSO Totalitie Solids Load (Ib-15/d) SSO Violatilie Solids Load (Ib-15/d) SSO Mannoulm-NL Load (Ib H/d/sy) HSOW No.2 (Topanic Nitrogen Content (Ib-1/lb-15) SSO Nano Soliman (Ib-1/lb-15)	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737 0,053 6,737	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053 6,032	0 2894,003 2 X-X: Nutrient Loading = Aimonia-N Estimat Peak 14 day 0.063 143,125 121,657 0.053	0 2,857,103 25 Peak 7 day 0.063 135,574 115,238 0.053	0 2,783,303 Peak day 0.063 120,472 102,401 0.053	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Nitralis Solids Load (Ib-Y/d) SSO Ammonium-N Load (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Solids Load (Ib-TS/d)	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053 6,032	0 2.284,003 2.X-X Nutrient Loading 2 Ammonia-N Estimati Peak 14 day 0.063 143,125 121,657 0.053 5,817 0.000	0 2,857,103 25 Peak 7 day 0.063 135,574 115,238 0.053 5,510	0 0 2,783,303 Peak day 0.063 120,472 102,401 0.053 4,896	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) Head We at 1 SSO Optimation (How Note: 10) SSO Total Solids Load (Ib-15/d) SSO Totalitie Solids Load (Ib-15/d) SSO Violatilie Solids Load (Ib-15/d) SSO Mannoulm-NL Load (Ib H/d/sy) HSOW No.2 (Topanic Nitrogen Content (Ib-1/lb-15) SSO Nano Soliman (Ib-1/lb-15)	0 3,004,703 Annual Average 0.063 165,779 140,912 0.053 6,737 0.000 0	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053 6,032 0.000 0	0 2,884,003 2 X.X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.667 0.053 5,817 0.000 0	0 2,857,103 es Peak 7 day 0.063 135,574 115,238 0.053 5,510 0.000 0	0 2,783,303 Peak day 0.063 120,472 102,401 0.053 4,896 0.000 0	
HSDW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) BKOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solida Call (Ib-TS/d) SSO Valat Solida Call (Ib-TS/d) SSO Nation Solida Call (Ib-TS/d) SSO Valat Solida Call (Ib-TS/d) SSO Nations Content (Ib-N/Jb-VS) SSO Nations Content (Ib-N/day) HSOW No.2 SSO No.2 Total Solida Call (Ib-TS/d) HSOW No.2 Nutrogen Content (Ib-V/Ib-VS)	0 3,004,703 Annual Average 0.063 166,779 140,912 0.053 6,737 0.000 0 0 0	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053 6,032 0.000 0 0	0 2.284.003 2.X-X Nutrient Loading 4 Ammonia-N Estimati Peak 14 day 0.063 143.125 121.657 0.053 5.817 0.000 0 0	0 2,857,103 25 Peak 7 day 0.063 135,574 115,238 0.053 5,510 0.000 0 0	0 2,783,303 Peak day 0.063 120,472 102,401 0.053 4,896 0.000 0 0	
HSW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) MBOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Viotalis Solids Load (Ib-TS/d) SSO Viotalis Solids Load (Ib-TS/d) SSO Sol Amonium- NL Load (Ib-N/Ib-TS) HSOW No.2 HSOW No.2 HSOW No.2 HSOW No.2 MSOW No.2 VIOL To Ciganic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 HSOW No.2 MSOW No.2 MSOW No.2 MSOW No.2 VIOL To Ciganic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 MSOW No.2 M	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053 6,032 0 0 0 0 0 0 0 0	0 2.894.003 2.894.003 2.XX. Nutrient Loading - Armmonia-N Estimat Peak 14 day 0.063 143.125 121.667 0.053 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 28 Peak 7 day 0.063 135,574 115,238 0.053 5,510 0.000 0 0 0 0.000	0 2,783,303 Peak day 0.063 120,472 102,401 0.053 4,896 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
HSDW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSDW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Valta Solid Lad (Ib-TS/d) HSOW No.2 StoW No.2 Torganic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Torganic Altrogen Content (Ib-S/d) HSOW No.2 Altrogen Content (Ib-S/d) HSOW No.2 Nitrogen Content (Ib-S/d) Primery State Primery State	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053 6,032 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,284,003 2 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.053 5,817 0.000 0 0 0 0 0 0 0 0	0 2,857,103 3 Peak 7 day 0,063 135,574 135,574 0,063 5,510 0,053 5,510 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.000 2,783,303 Peak day 0.063 120,472 102,401 0.053 4,896 0 0 0 0 0 0	
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HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 HSOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatils Solids Load (Ib-TS/d) SSO Nonson Ib-Norgen Content (Ib-N/Ib-TS) HSOW No.2 HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Contal Solids Load (Ib-TS/d) HSOW No.2 Contal Solids Load (Ib-TS/d) HSOW No.2 Volatile Solids Load (Ib-TS/d) HSOW No.2 Xingen Content (Ib-N/Ib-TS) HSOW No.2 Armonium -N Load (Ib-N/day) Petimery Studge Total Solids Load (Ib-TS/d) Primary Studge Total Solids Load (Ib-TS/d)	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tabl Peak Month 0.063 148,411 126,150 0.053 6,032 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,284,003 2 X.X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.667 0.053 5,817 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2 9ek 7 day 0.063 135,574 135,574 0.063 5,510 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.00 2,783,303 Peak day 0.063 120,472 102,401 0.053 4,896 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.0005 76,812	
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HSOW No. 2. Biogas Production (scfd) Total Biogas Production (scfd) Sto Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Vista Solids and (Ib-TS/d) ISOW No. 2. SSO Vista Solids and (Ib-TS/d) ISOW No. 2. ISOW No. 2. SSO Vista Solids Load (Ib-TS/d) ISOW No. 2. ISOW No. 2. <t< td=""><td>0 3,004,703 Annual Average 0.063 165,779 140,912 0.053 6,737 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0 2,919,833 Tebi Peak Month 0,063 148,411 128,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0 2.894.003 e X.X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.053 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0 2,857,103 2 ,957,103 3 Pesk 7 day 0,063 135,574 115,238 0,053 5,510 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>1000 0 2.783,303 2.783,303 Peak day 0.063 120,472 102,401 0.053 4.839 0.000 0 0 0.003 0.000 0 0 0.000 0 0 0 0.000 0 0.000 0 0.000 0.0065 68,876 0.0057 2,4711 0.0065 44,835 3.981 3.991 3.193 0.008 2.4 24</td><td></td></t<>	0 3,004,703 Annual Average 0.063 165,779 140,912 0.053 6,737 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tebi Peak Month 0,063 148,411 128,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2.894.003 e X.X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.053 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2 ,957,103 3 Pesk 7 day 0,063 135,574 115,238 0,053 5,510 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1000 0 2.783,303 2.783,303 Peak day 0.063 120,472 102,401 0.053 4.839 0.000 0 0 0.003 0.000 0 0 0.000 0 0 0 0.000 0 0.000 0 0.000 0.0065 68,876 0.0057 2,4711 0.0065 44,835 3.981 3.991 3.193 0.008 2.4 24	
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HSOW No. 2. Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Organic Nitrogen Content (Ib-H/Ib-TS) SSO Status Stells cand (Ib-Ts/d) SSO Intra Solids cand (Ib-Ts/d) SSO Status Stells cand (Ib-Ts/d) SSO Nator Solids cand (Ib-Ts/d) SSO Status Stells cand (Ib-Ts/d) SSO Nator Solids cand (Ib-Ts/d) SSO Nator Solids cand (Ib-Ts/d) SSO Nator Solids cand (Ib-Ts/d) SSO Nator Solids cand (Ib-Ts/d) SSO Nator Solids cand (Ib-Ts/d) SSO Nator Solids cand (Ib-Ts/d) SSO No. 2. Total Solids Load (Ib-Vs/d) SSO No.2. SSO No.2. Total Solids Load (Ib-Vs/d) SSO No.2. Primary Sudge Total Nitrogen Content (Ib-N/Ib-TS) SSO No.2. Primary Sudge Total Solids Load (Ib-Vs/d) SSO No.2. Primary Sudge Total Solids Load (Ib-Vs/d) SSO No.2. Primary Sudge Solids Load (Ib-Vs/d) SSO No.2. Primary Sudge Solids Load (Ib-Vs/d) SSO No.2. Stotal Solids Load (Ib-Vs/d) <td>0 3,004,703 Annual Average 0.063 165,779 140,912 0.053 6,737 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0 2,919,833 Tebi Peak Month 0,063 148,411 128,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0 2.894.003 e X.X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.053 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0 2,857,103 2 ,957,103 3 Pesk 7 day 0,063 135,574 115,238 0,053 5,510 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>1000 0 2.783,303 2.783,303 Peak day 0.063 120,472 102,401 0.053 4.839 0.000 0 0 0.003 0.000 0 0 0.000 0 0 0 0.000 0 0.000 0 0.000 0.0065 68,876 0.0057 2,4711 0.0065 44,835 3.981 3.991 3.193 0.008 2.4 24</td> <td></td>	0 3,004,703 Annual Average 0.063 165,779 140,912 0.053 6,737 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tebi Peak Month 0,063 148,411 128,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2.894.003 e X.X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.053 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2 ,957,103 3 Pesk 7 day 0,063 135,574 115,238 0,053 5,510 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1000 0 2.783,303 2.783,303 Peak day 0.063 120,472 102,401 0.053 4.839 0.000 0 0 0.003 0.000 0 0 0.000 0 0 0 0.000 0 0.000 0 0.000 0.0065 68,876 0.0057 2,4711 0.0065 44,835 3.981 3.991 3.193 0.008 2.4 24	
HSOW No. 2. Biogas Production (scfd) Total Biogas Production (scfd) SSO Total Biogas Production (scfd) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Violatile Solids Ladd (Ib-Y5/d) SSO Violatile Solids Ladd (Ib-Y5/d) SSO Namonium-N Ladd (Ib-N/day) HSOW No.2 NESW No.2 NESW No.2 Net Solids Ladd (Ib-Y5/d) HSOW No.2 Net Solids Ladd (Ib-Y5/d) Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) HSOW Tol Al Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) HSOW Tol Al Nitrogen Content (0 3,004,703 Annual Average 0,063 166,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 1,511 Peak Month 0,063 148,411 128,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2.289.003 s X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.065 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2 3 Peak 7 day 0.063 135,574 0.063 135,574 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1000 0 2.783,303 2.783,303 9eak day 0.063 100,472 100,401 100,472 100,401 0.003 4,936 0.000 0 0.000 0 0.000 0 0.000 0 0.005 6,826 0.057 76,812 06,826 6,826 0.005 2,471 0.006 882 0.010 3,991 3,1991 3,193 3.9 7 9,45 9,45	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Maronian ^{AD} Load (Ib-Ys/d) HSOW No. 2 HSOW NO. 2 HSO	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tebi Pesk Month 0,063 146,411 126,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2.289.003 s X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.065 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2 ,957,103 3 Peak 7 day 0,063 135,574 115,238 0,053 0,053 0,050 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1000 2 2.783,303 2 2.783,303 2 0.063 120,472 102,401 0.053 120,472 102,401 0.063 4,836 0.000 0 0 0 0 0.000 0 0 0 0.000 0 0.000 0 0.000 0 0.000 0.005 66,826 0.0057 2,611 0.0058 882 0.010 3.991 3.193 2.24 399 7	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) SSO Total Biogas Production (scfd) SSO Total Biogas Production (scfd) SSO Total Biogas Production (scfd) SSO Total Biogas Load (b-Ys/d) SSO Noncolum-YN Load (b-N/d-Ys) SSO Namonium-YN Load (b-N/d-Ys) HSOW No. 2 Organic Nitrogen Content (b-N/b-TS) HSOW No. 2 Organic Nitrogen Content (b-Y/b-YS) HSOW No. 2 Annonium-N Load (b-N/day) Ethol 2 Nitrogen Content (b-Y/b-YS) HSOW No. 2 Annonium-N Load (b-Y/day) Ethol 2 Nitrogen Content (b-Y/b-YS) HSOW No. 2 Annonium-N Load (b-Y/day) Ethol 2 Nitrogen Content (b-Y/b-YS) Nitrogen Content (b-Y/b-YS) Ammonium-N Load (b-Yc/d) HSOW Total Nitrogen Content (b-Y/b-TS) HSOW Total Nitrogen Content (b-Y/b-YG) Ammonium-N Load (b-Y/day) Ethol 2 Nitrogen Content (b-Y/b-TS) HSOW Total Nitrogen Cont	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tebi Peak Month 0,063 148,411 126,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2.894.003 s X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 113.125 121.657 0.033 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2,857,103 3 Peak 7 day 0.063 135,574 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Dot Dot 2.783,303 2.783,303 Peak day 0.063 120,472 102,471 102,472 102,472 102,474 0.053 4,896 0.000 0 0 0 0.000 0 0 0 0.000 0 0.000 0 0.000 0 0.005 2,471 0.005 44,836 3.569 0.005 882 0.010 3.931 3.008 2.4 3 3.93 3.93 3.93 3.93 3.93 3.93 7 7 9.45 8.273 3.97	
HSOW No. 2 Blogas Production (scfd) Total Blogas Production (scfd) HSOW No. 1 SSO Dynamic Nitrogen Content (Ib-N/Ib-TS) SSO Volatile Solid at duft (Ib-YS/d) SSO Volatile Solid at duft (Ib-YS/d) SSO Volatile Solid at duft (Ib-YS/d) SSO Volatile Solid at duft (Ib-YS/d) HSOW No. 2 HSOW H	0 3,004,703 Annual Average 0,063 166,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2.919.833 (b): Peak Month 0.063 148.411 128.150 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2.289.003 e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143.125 121.657 0.053 5.817 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2 2,857,103 3 Peak 7 day 0.063 135,574 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1000 2.783,303 2.783,303 2.783,303 9eak day 0.063 100,401 102,401 0.053 4.984 0.000 0 0.000 0 0.0000 0 0.005 6.826 0.0057 76.812 0.0057 2.471 0.0065 2.471 0.0065 882 0.002 882 0.0010 3.991 3.193 3.991 7 9.45 8.8273 0.33 0.025 0.025	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) SSO Total Biogas Production (scfd) SSO Total Biogas Production (scfd) SSO Total Biogas Production (b-1/d) SSO Total Biogast Stad (b-1%/d) SSO Nonzolman VL add (b-1%/d) SSO Nonzolman VL add (b-1%/d) HSOW No.2 HSOW NO.2 HS	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tel3 Peak Month 0,063 148,411 126,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2.284.003 e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 113.125 121.657 0.053 5.517 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2,857,103 3 Peak 7 day 0.063 135,574 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Dot Dot 2.783,303 2.783,303 Peak day 0.063 120,472 102,401 102,472 102,401 0.053 4,896 0.000 0 0 0 0 0.000 0 0 0 0.000 0 0.000 0 0.000 0 0.005 2,471 0.005 48.85 0.052 0.005 0.391 3.193 0.008 24 7 9 5.8,713 3.025 0.32 3.025 0.27	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Optimic Nitrogen Content (Ib-N/Ib-TS) SSO Optimic Solids Load (Ib-TS/d) SSO Viotalie Solids Load (Ib-TS/d) HSOW No.2 HSOW	0 3,004,703 Annual Average 0,063 168,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2.919.833 1.919 Peak Month 0.063 1.48,411 128,150 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2.284,003 s X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 143,125 121,657 0.053 5,817 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2,857,103 3 Peak 7 day 0,063 135,574 115,238 0,053 5,510 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1000 2.783,303 2.783,303 2.783,303 9eak day 0.063 120,472 102,401 100,472 102,401 0.053 4,896 0.000 0 0.000 0 0.005 66,826 0.0057 2,471 0.0065 2,471 0.0065 882 0.0065 882 0.0065 882 0.010 3.993 3.193 0.008 9 45 9.45 8,273 0.33 3.025 0.23 3.07	
HSOW No. 2 Blogas Production (scfd) Total Blogas Production (scfd) HSOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-Ts/d) SSO Viotalis Solids Load (Ib-Ts/d) SSO Monoulow HLoad (Ib-N/dwy) HSOW No.2 HSOW NO.	0 3,004,703 Annual Average 0,063 165,779 140,912 0,053 6,737 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,919,833 Tel3 Peak Month 0,063 148,411 126,150 0,053 6,032 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2.284.003 e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 113.125 121.657 0.053 5.517 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,857,103 2,857,103 3 Peak 7 day 0.063 135,574 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Dot Dot 2.783,303 2.783,303 Peak day 0.063 120,472 102,401 102,472 102,401 0.053 4,896 0.000 0 0 0 0 0.000 0 0 0 0.000 0 0.000 0 0.000 0 0.005 2,471 0.005 48.85 0.052 0.005 0.391 3.193 0.008 24 7 9 5.8,713 3.025 0.32 3.025 0.27	

Brown AND Caldwell

Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-002
	Pro	ect			Subject
Encina Biosolids, Energy, and Emiss	ions		2030 Year - Service Co	ndition	

Mesophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter Input Values Reference		Parameter	Input Values	Reference	
Number of Primary Digesters	3	1	Minium HRT (days) 15 Assumed			Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d) 0.18 Assumed			Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	97	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS) 22%		1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable)		e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SSO	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

Primary Slud	ge		TWAS			Existing HSOW (if applicable)			
Parameter	Input Values	Reference	Parameter Input Values Refe		Reference	Parameter		Reference	
Nitrogen Specia	Nitrogen Speciation			Nitrogen Speciation			Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)	
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (lb-N/lb-TS)			Existing HSOW Org. Nitrogen (lb-N/lb-TS)			
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)			

Nutrients Speciation for HSOW

Numents Speciation for HSOW		
Parameter	Input Values	Reference
Nitrogen Specia	ation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (lb-N/lb-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

		Table X-	-X: Existing Mesophilic Digestion Feed Asses	sment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	3.90	3.90	3.90	3.90	3.90	Service condition assumes largest digester is out of service with the a
Primary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299	
WAS Total Solids Load (lb-TS/d)	37,020	45,534	48,125	51,827	59,231	
OG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
otal Digester Feed, Total Solids Load (lb-TS/d)	101,822	124,324	131,172	140,955	160,521	
rimary Sludge Volatile Solids Load (lb-VS/d)	52,906	65,075	68,778	74,069	84,650	
WAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
OG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
tal Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228	
rimary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
/AS percent of VS Load (%)	35%	35%	35%	35%	35%	
OG percent of VS Load (%)	4%	3%	3%	3%	2%	
fotal Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
otal Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
otal Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
ase HRT (days)	15	12	11	11	9	
ase OLR (lbsVS/d-cf)	0.16	0.20	0.21	0.23	0.26	
lydraulic Capacity (HC) (gpd)	-6.142	-65.277	-83.274	-108.985	-160.407	Assumes the minimum allowable HRT 15 days
C as Equivalent VS Load (Ib-VS/day)	-5.225	-55,530	-70.840	-92.711	-136,455	Equivalent load of HSOW, based on hydraulic capacity
rganic Load Capacity (Ib-VS/day)	8.015	-10.965	-16.741	-24,994	-41.498	Difference between max OLR (0.18 lbs-VS/cf-d) and current load
rocess Limitation	No Capacity	No Capacity	No Capacity	No Capacity	No Capacity	
		Table	X-X: Mesophilic Co-digestion Feed Assessm	ent		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
otal HSOW Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	Calculated available organic load, based on defined limit
SO Volatile Solids Load (lb-VS/day)	0	0	0	0	0	
SOW No. 2 Volatile Solids Load (lb-VS/day)	0	0	0	0	0	
otal HSOW Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	
SO Total Solids Load (Ib-TS/day)	0	0	0	0	0	Conversion to Total Solids load based on SSO %VS
ISOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SO Total Solids Load (lb-TS/day)	0	0	0	0	0	
SO (lb-wet/day)	0	0	0	0	0	Conversion to Wet Solids load based on SSO %TS
ISOW No. 2 Total Load (Ib-wet/day)	0	0	0	0	0	
SO (lb-wet/day)	0	0	0	0	0	
SSO (wtpd)	0	0	0	0	0	
ISOW No. 2 (wtpd)	0	0	0	0	0	
iSO (wtpd)	0	0	0	0	0	
SO (gpd)	0	0	0	0	0	
ISOW No. 2 (gpd)	0	0	0	0	0	
SO (gpd)	0	0	0	0	0	
otal Solids, Total Solids Load (lb-TS/d)	101.822	124.324	131.172	140.955	160.521	
otal Solids, Volatile Solids Load (Ib-VS/d)	85.715	104.695	110.471	118,724	135.228	
otal Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
OG percent of VS Load (%)	4%	3%	3%	3%	2%	

SSO percent of VS Load (%)	0%	0%	0%	0%	0%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	15	12	11	11	9	
Co-Digestion OLR (lbs-VS/d-cf)	0.16	0.20	0.21	0.23	0.26	
Process Check	OK	No Capacity	No Capacity	No Capacity	No Capacity	
		Table X-2	K: Existing Mesophilic Solids and Biogas Proc	luction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48.145	55.023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18.095	19.487	22.271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2.873	2.873	2.873	2 873	2 873	
Total Volatile Solids Destroyed (Ib-VSd/ day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265 808	324 943	342.941	368 652	420.073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50.640	62.021	65,497	70.450	90.254	Assumes that volume in equals volume out
Volatile Solids Effluent (Lbs-VS/d)	34,533	42,402	44,797	48.218	55,061	
	24,000	2 3%	44,151	40,210	0.0%	
Total Solids (% TS)	68%	68%	68%	68%	2.3%	
Volatile Solids (% VS)	48.108	08%	68%	08%	69%	Dewatered cake assumes 95% capture rate
Dewatered Solids (Lbs-TS/d)		58,929	62,222	66,927	/6,337	
Biosolids Cake (wtpd)	109		141	102	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
			Mesophilic Co-digestion Solids and Biogas P			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (lb-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808	324,943	342.941	368.652	420.073	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	50.640	62,031	65,497	70,450	80,354	
Volatile Solids (Lbs-VS/d)	34.533	42,402	44,797	48.218	55.061	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Ja VS)	48.108	58.929	62,222	66.927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	100	134	141	150	173	Assumes biosolids cake has a solids content of 22% TS
	612 128	752.917	795 766	856 979	979 404	
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	247.765		322.094	346.871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	-	0	0	0	-	Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
Total Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
		Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat	es		
HSOW No 1	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS)	0.063	0.063	0.063	0.063	0.063	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d)	0.063	0.063 0	0.063 0	0.063	0.063	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d)	0.063	0.063 0 0	0.063	0.063	0.063 0 0	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	0.063 0 0 0.000	0.063 0	0.063 0	0.063	0.063 0 0 0.000	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d)	0.063	0.063 0 0	0.063 0	0.063	0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-VS/d) SS0 Vitrogen Content (Ib-N/Ib-VS) SS0 Ammonium-N Load (Ib-N/day) HSOW No 2	0.063 0 0 0.000	0.063 0 0	0.063 0 0 0.000	0.063	0.063 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Totaf Solid A and (b-TS/d) SS0 Violatile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Amonum-N Load (b-V/day) HSOV No.2 HSOV No.2 SV Ansatz	0.063 0 0 0.000	0.063 0 0	0.063 0 0 0.000	0.063	0.063 0 0 0.000	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-VS/d) SS0 Vitrogen Content (Ib-N/Ib-VS) SS0 Ammonium-N Load (Ib-N/day) HSOW No 2	0.063 0 0 0.000 0	0.063 0 0 0.000 0	0.063 0 0 0.000 0	0.063 0 0 0.000 0	0.063 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Totaf Solid A and (b-TS/d) SS0 Violatile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Amonum-N Load (b-V/day) HSOV No.2 HSOV No.2 SV Ansatz	0.063 0 0 0.000 0 0	0.063 0 0 0.000 0	0.063 0 0 0.000 0	0.063 0 0 0.000 0	0.063 0 0.000 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solid call (Ib-TS/d) SS0 Valatile Solid call (Ib-TS/d) SS0 Valatile Solid Call (Ib-TS/d) SS0 Sol Total Solid (Ib-TS/d) IBOW No 2 ISOW No.2 (Toganic Nitrogen Content (Ib-Y/b-TS) ISOW No.2 (Toganic Altrogen Content (Ib-Y/b) ISOW No.2 (Toganic Nitrogen Content (Ib-Y/d) ISOW No.2 (Toganic Nitrogen Content (Ib-Y/d) ISOW No.2 (Toganic Nitrogen Content (Ib-Y/d) ISOW No.2 (Toganic Solid Solid (Ib-TS/d) ISOW No.2 (Toganic Solid Solid (Ib-TS/d)	0.063 0 0.000 0 0 0	0.063 0 0.000 0 0 0 0.000 0	0.063 0 0.000 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Total Solid call (b-TS/d) SS0 Vitalis Solid call (b-TS/d) SS0 Nitrogic Content ((b-N/b-YS)) ISOW No.2 SS0 No.2 Total Solid Solid Coll (b-TS/d) ISOW No.2 Total Solid Solid (b-TS/d) ISOW No.2 Nitrogen Content ((b-N/b-YG)) ISOW No.2 Nitrogen Content ((b-N/d))	0.063 0 0.000 0 0 0	0.063 0 0.000 0 0 0 0.000 0	0.063 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0.000 0	Notes
SS0 Organic Nithogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) SS0 Normanite-NL Load (Ib-N/Jb-TS) MSOW No.2 MSOW N	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0.000 0	0.063 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Total Solida and (b-TS/d) SS0 Vitrogic Octal and (b-TS/d) SS0 Vitrogic Octal (b-N/b/S) SS0 Nitrogic Octal (b-N/b/S) SS0 Nitrogic Octal (b-N/b/S) SS0 Nitrogic Octal (b-N/b/S) SS0 Nitrogic Octagatic Nitrogen Content (b-N/lb-TS) ISOW No.2 ISOW No.2 SS0 And (b-N/b/G) ISOW No.2 ISOW No.2 <	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Totaf Solid Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-VS/d) SS0 Nitrogen Content (Ib-N/Ib-VS) SS0 Nitrogen Content (Ib-N/Ib-VS) HSOW No.2 HSOW No.2 Stol Solids Load (Ib-TS/d) HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Notal Solids Load (Ib-N/Ib-VS) HSOW No.2 Hord (Ib-N/Ib-VS) HSOW No.2 HIT (Ib-N/Ib-VS) HIT (Ib	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0.000 0	0.063 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solids and (b-TS/d) SS0 Viralia Solids and (b-TS/d) SS0 Viralia Solids and (b-TS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Nitrogen Content (b-N/b-VS) SS0 Nitrogen Content (b-N/b-TS) MSOW No.2 Vision No.2 SS0 Nitrogen Content (b-N/b-TS) MSOW No.2 Vision No.2 SS0 Nitrogen Content (b-N/b-TS) MSOW No.2 MSOW No.2 SS0 Nitrogen Content (b-N/b-TS) MSOW No.2 MSOW No.2 <td< td=""><td>0.063 0 0.0000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0 0.005 74,799</td><td>0.065 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Notes</td></td<>	0.063 0 0.0000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0 0.005 74,799	0.065 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS). SS0 Total Solids and (Ib-TS/0). SS0 Vitrogin Content (Ib-N/Ib-YS). SS0 Nitrogin Content (Ib-N/Ib-YS). SS0 Nitrogin Content (Ib-N/Ib-YS). SS0 Nitrogin Content (Ib-N/Ib-YS). SS0 Nitrogin Content (Ib-N/Ib-TS). MSOW No. 2. Organic Nitrogen Content (Ib-N/Ib-TS). MSOW No. 2. Vitrogen Content (Ib-N/Ib-TS). MSOW No. 2. Nitrogen Content (Ib-N/Ib-YS). Missow No. 2. Nitrogen Content (Ib-N/Ib-YS). Primary Sudge Total Solids Load (Ib-N/Zol). Primary Sudge Total Solids Load (Ib-N/Zol).	0.063 0 0.0000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Varialis Solida cald (Ib-TS/d) SS0 Visitile Solida cald (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-TS) IBS0W No.2 Crapanic Nitrogen Content (Ib-N/Ib-TS) IBS0W No.2 Crapanic Nitrogen Content (Ib-N/Ib-TS) IBS0W No.2 Crapanic Nitrogen Content (Ib-N/Ib-TS) IBS0W No.2 Nitrogen Content (Ib-N/Ib-TS) IBS0W No.2 Nitrogen Content (Ib-N/Ib-TS) IBS0W No.2 Nitrogen Content (Ib-N/Ib-TS) IBS0W No.2 Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Volatile Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Volatile Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) HSW VI Call Nitrogen Content (Ib-N/Ib-TS) HSW VI Call Solids Load (Ib-TS/d) HSW VI Call Nitrogen Content (Ib-N/Ib-TS) HSW VI C	0.063 0 0 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes -
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SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Viatalis Solida add (b-TS/d) SS0 Viatalis Solida add (b-TS/d) SS0 Viatalis Solida add (b-TS/d) SS0 Add (b-N/2 Add) SS0 Add (b-N	0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Varialiti Solida cod (Ib-TS/d) SS0 Varialiti Solida cod (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Ammonium-N Load (Ib-N/day) HSW No. 2 Nitrogen Content (Ib-N/Ib-TS) HSW No. 2 Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solida Load (Ib-YS/d) Primary Sludge Total Solida Load (Ib-YS/d) Primary Sludge Total Solida Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solida Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) PriMaS Viatali Solida Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) HSW Total Nitrogen Content (Ib-N/Ib-TS) HSW Total Nitrogen Content (Ib-N/Ib-TS) HSW Total Solida Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) HSW Total Solidis Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) HSW Total Solidis Load (Ib-N/do) Primary Sludge Vidf epilcabb) HSW Total Solidis Load (Ib-N/b) HSW Total Nitrogen (Ib-N/d) Primary HSW (Ib-N/Ib-NS) Ammonium N Load (Ib-N/do) HSW Total Nitrogen (Ib-N/d) HSW Total Ni	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0.000 0 0 0.005 0 0.065 74.799 0.065 2,407 2,407 0.057 2,407 0.057 2,407 0.057 2,407 0.055 36.427 0.052 8.96 0.010 0.3,991 3,193 0.008 2,407 0.000 0.005 0.0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0.0000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes

ed to account for process inefficiencies.

		Date Checked Checked By		Job Number	By	Date	Calc No	
Brown		9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-002	
Caldwall			Project		Subject			
Caldwell		Encina Biosolids, Energy, and Emissions 2030 Year - Service Condition						

Mesophilic Digestion with Digesters 1-6

Digester and Process Information

Parameter	Input Values	Reference	Parameter Input Values Reference		Parameter	Input Values	Reference	
Number of Primary Digesters	3	1	Minium HRT (days) 15 Assumed Peaking Factors					
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d) 0.18 Assumed		Annual Average	1	2	
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	97	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS) 22% 1		Peak 7 day	1.4	2	
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSO	W (blank if not applicable)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

Primar	y Sludge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen	Speciation		Nitrogen Spe	ciation		Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		
	_							

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3.000	

		Table X-X: Existing M	esophilic Digestion with Digesters 1-6 Feed	d Assessment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	4.75	4.75	4.75	4.75	4.75	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299	
TWAS Total Solids Load (Ib-TS/d)	37,020	45,534	48,125	51,827	59,231	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	101,822	124,324	131,172	140,955	160,521	
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650	
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
Total Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
Base HRT (days)	18	15	14	13	11	
Base OLR (IbsVS/d-cf)	0.13	0.16	0.17	0.19	0.21	
Hydraulic Capacity (HC) (gpd)	50,858	-8,277	-26,274	-51,985	-103,407	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (Ib-VS/day)	43,264	-7,041	-22,351	-44,223	-87,966	Equivalent load of HSOW, based on hydraulic capacity
Drganic Load Capacity (Ib-VS/day)	28,590	9,610	3,834	-4,419	-20,923	Difference between max OLR (0.18 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	No Capacity	No Capacity Mesophilic Co-digestion Feed Assessmen	No Capacity	No Capacity	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/dav)	28.590	0	0	0	0	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (Ib-VS/day)	28,590	0	0	0	0	calculated available organic load, based on defined mint
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	ő	ŏ	
Total HSOW Volatile Solids Load (Ib-VS/day)	28,590	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	33,635	0	0	0	0	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	33.635	0	0	0	0	
SSO (lb-wet/day)	280,295	0	0	0	0	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	280.295	0	0	0	0	
SSO (wtpd)	140	0	0	0	0	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	140	0	0	0	0	
SSO (gpd)	33.609	0	0	0	0	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	33.609	0	0	0	0	
Fotal Solids, Total Solids Load (lb-TS/d)	135,458	124,324	131,172	140,955	160,521	
Total Solids, Volatile Solids Load (Ib-VS/d)	114,305	104,695	110,471	118,724	135,228	
Fotal Flow (gpd)	299,417	324,943	342,941	368,652	420,073	
Primary sludge percent of VS Load (%)	46%	62%	62%	62%	63%	
WAS percent of VS Load (%)	26%	35%	35%	35%	35%	
FOG percent of VS Load (%)	3%	3%	3%	3%	2%	
SSO percent of VS Load (%)	25%	0%	0%	0%	0%	
	25%	0%	0%	0%	0%	
SSO percent of VS Load (%) HSOW No. 2 percent of VS Load (%) Check						

Co-Digestion OLR (lbs-VS/d-cf) Process Check	0.18 OK	0.16 OK	0.17	0.19	0.21	
Process Check	UK	Table X-X- Fristi	ing Mesophilic Solids and Biogas Production	No Capacity	No Capacity	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (lb-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (Ib-VSd/day) Total Sludge Effluent (gpd)	51,182 265,808	62,293	65,674	70,505 368,652	80,167 420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50.640	62,031	65.497	70,450	80.354	
Volatile Solids Effluent (Lbs-VS/d)	34,533	42,402	44,797	48,218	55,061	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68% 48.108	68% 58.929	68% 62.222	68% 66.927	69% 76.337	Dewatered cake assumes 95% canture rate
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	48,108	134	62,222	152	173	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612.128	752,917	795.766	856.979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
	Annual Avenue de	Table X-X: Mesoph Peak Month		tion Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	Annual Average	42.299	Peak 14 day 44,706	48.145	55 023	Notes
WAS Volatile Solids Destroyed (Ib-VSd/day)	13.919	17.121	18.095	19,487	22.271	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (lb-VSd/day)	25,731	0	0	0	0	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (lb-VSd/day) Total Sludge Effluent (gpd)	76,913	62,293	65,674	70,505	80,167 420.073	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	58,545	62,031	65,497	70,450	80,354	sounde that folume in equals folulite but
Volatile Solids (Lbs-VS/d)	37,392	42,402	44,797	48,218	55,061	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	64%	68%	68%	68%	69%	Demotrand active accuracy OFW accelure activ
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	55,618 126	58,929 134	62,222 141	66,927 152	76,337 173	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scl/lb-VSd
WAS Volatile Solids Destroyed (lb-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	463,160	0	0	0	0	Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	1 160 005		1 426 072	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)	0 1,374,197	1,108,812	1,169,005 Autrient Loading - Ammonia-N Estimates	1,254,994	1,426,972	
Total Biogas Production (scfd) HSOW No 1	0	1,108,812	1,169,005 Iutrient Loading - Ammonia-N Estimates Peak 14 day		1,426,972 Peak day	Notes
Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (lb-N/lb-TS)	1,374,197 Annual Average 0.063	1,108,812 Table X-X: N Peak Month 0.063	Autrient Loading - Ammonia-N Estimates Peak 14 day 0.063	1,254,994 Peak 7 day 0.063	Peak day 0.063	Notes
Total Biogas Production (scfd) HSOW No 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d)	1,374,197 Annual Average 0.063 33,635	1,108,812 Table X-X: N Peak Month 0.063 0	Autrient Loading - Ammonia-N Estimates Peak 14 day 0.063 0	1,254,994 Peak 7 day 0.063 0	Peak day 0.063 0	Notes
Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-TS/d)	1,374,197 Annual Average 0.063 33,635 28,590	1,108,812 Table X-X: N Peak Month 0.063 0 0	Autrient Loading - Ammonia-N Estimates Peak 14 day 0.063 0 0	1,254,994 Peak 7 day 0.063 0 0	Peak day 0.063 0 0	Notes
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Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-002
	Project				Subject
Encina Biosolids, Energy, and Er	nissions		2030 Year - Service Co	ndition	

15 day Thermophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable)		e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production vield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

	Parameter	Input Values	Reference	Parameter	Input Values	Reference
HS	DW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HS	DW No. 2 Name			Percent of (%)	0%	
SSC	Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO	/olatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW M	o. 2 Total Solids (%)					
HSOW No	. 2 Volatile Solids (%)					

Dof

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Sludge		TWAS			Existing HSOW (if applicable)			
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speciation		Nitrogen Speciation			Nitrogen Speciation			
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

		Table X-X: E	isting 15 day Thermophilic Digestion Feed	Assessment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
						Service condition assumes largest digester is out of service with the
Digester Volume (MG)	3.90	3.90	3.90	3.90	3.90	active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299	
TWAS Total Solids Load (Ib-TS/d)	37,020	45,534	48,125	51,827	59,231	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	101,822	124,324	131,172	140,955	160,521	
Primary Sludge Volatile Solids Load (lb-VS/d)	52,906	65,075	68,778	74,069	84,650	
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
Total Digester Feed Flow (gpd)	265.808	324,943	342,941	368.652	420.073	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
Base HRT (days)	15	12	11	11	9	
Base OLR (lbsVS/d-cf)	0.16	0.20	0.21	0.23	0.26	
Hydraulic Capacity (HC) (gpd)	-6.142	-65.277	-83.274	-108.985	-160.407	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (Ib-VS/day)	-5.225	-55.530	-70.840	-92.711	-136,455	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (lb-VS/day)	96,538	77.558	71.781	63.529	47.025	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	No Capacity	No Capacity	No Capacity	No Capacity	No Capacity	
			X-X: Mesophilic Co-digestion Feed Assessr			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (Ib-VS/dav)	0	0	9	0	0	
HSOW No. 2 Volatile Solids Load (lb-VS/dav)	0	0	0	0	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	ŏ	0	0	Ö	ŏ	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	Ŭ 0	0	0	ŏ	ŏ	
SSO Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO (lb-wet/day)	ů	0	0	0	0	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (Ib-wet/day)	0	0	0	0	0	contension to their donus load based on door loto
SSO (lb-wet/day)	0	0	0	0	0	
SSO (wtpd)	0	0	ů	0	0	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	0	0	0	0	0	
SSO (wpd) SSO (gpd)	0	0	0	0	0	
HSOW No. 2 (gpd)	0	0	0	0	0	
HSUW NO. 2 (gpd) SSO (gpd)	0	0	0	0	0	
SSO (gpd) Total Solids, Total Solids Load (lb-TS/d)	101.822	124.324	131.172	140.955	160.521	
Total Solids, Volatile Solids Load (Ib-VS/d)	85,715	104,695	110,471 342,941	118,724 368,652	135,228 420.073	
Total Flow (gpd) Primary sludge percent of VS Load (%)	265,808	324,943	62%	62%	420,013	

WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
SSO percent of VS Load (%)	0%	0%	0%	0%	0%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	15	12	11	11	9	
Co-Digestion OLR (lbs-VS/d-cf)	0.16	0.20	0.21	0.23	0.26	
Process Check	OK	No Capacity	No Cepacity	No Capacity	No Capacity	
		Table X-)	(: Existing Mesophilic Solids and Biogas Proc	luction	1	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)			2,873			
Total Volatile Solids Destroyed (Ib-VSd/day) Total Sludge Effluent (god)	51,182	62,293 324,943	65,674 342,941	70,505	80,167 420.073	Annual that is formed to an information of
Total Solids Effluent (Lbs-TS/d)	200,808	62.031	65,497	308,052	420,073	Assumes that volume in equals volume out
Volatile Solids Effluent (Lbs-15/d)	34 533	42,402	65,497 44,797	48 218	55.061	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	69%	68%	68%	68%	2.3 %	
Dewatered Solids (Lbs-TS/d)	48,108	58.929	62,222	66.927	76.337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612 128	752.917	795 766	856 979	979 404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247.765	304.751	322.004	346.871	396 424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51.145	51,145	51.145	51.145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911.037	1.108.812	1,169,005	1,254,994	1.426.972	
			Mesophilic Co-digestion Solids and Biogas P	roduction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	50,640	62,031	65,497	70,450	80,354	
Volatile Solids (Lbs-VS/d)	34,533	42,402	44,797	48,218	55,061	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145 0	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd)	0	U	0	U	0	Assumes a biogas yield of 18 scf/lb-VSd
Total Biogas Production (scfd)	U	V	U	U	U	
				1 254 004		
Total Diogas Floudcuoli (Sciu)	911,037	1,108,812	1,169,005 • Y-Y: Nutrient Loading - Ammonia-N Ectimat	1,254,994	1,426,972	
		Table	e X-X: Nutrient Loading - Ammonia-N Estimat	es		Notes
HSOW No 1	911,037 Annual Average				1,426,972 Peak day	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)		Table	e X-X: Nutrient Loading - Ammonia-N Estimat	es		Notes
HSOW No 1	Annual Average 0.063	Table	e X-X: Nutrient Loading - Ammonia-N Estimat	es		Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	Annual Average 0.063 0	Table Peak Month 0.063 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0	es Peak 7 day 0.063 0	Peak day 0.063 0	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	Annual Average 0.063 0 0	Table Peak Month 0.063 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0 0	es Peak 7 day 0.063 0 0	Peak day 0.063 0 0	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solidis Load (Ib-TS/d) SSO Violatile Solidis Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	Annual Average 0.063 0 0	Table Peak Month 0.063 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0 0	es Peak 7 day 0.063 0 0	Peak day 0.063 0 0	Notes
HEOW No. 5 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotalie Solids Load (Ib-YS/d) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Amonoium-N Load (Ib-N/day)	Annual Average 0.063 0 0	Table Peak Month 0.063 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0 0	es Peak 7 day 0.063 0 0	Peak day 0.063 0 0	Notes
RSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Notalite Solids Load (Ib-TS/d) SSO Notalite Solids Load (Ib-N/Ib-TS) SSO Ammonium-N Load (Ib-N/dw) MeVM No 2 Storman Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063 0 0 0.000 0 0 0 0 0 0	Table Peak Month 0.063 0 0.000 0 0.000 0 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.0663 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0.000 0 0 0.000 0	Notes
HOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Volatile Solids Land (Ib-TS/d) SSO Volatile Solids Land (Ib-Yd/g) SSO Noncolima- NL Land (Ib V/dy) HBOW No 2 HSOW No 2	Annual Average 0.063 0 0 0.000 0 0 0.000	Table Peak Month 0.063 0 0 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.0653 0 0 0.000 0 0	es Peak 7 day 0.063 0 0 0.000 0	Peak day 0.063 0 0 0 0.000 0	Notes
HSOW No 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Valatil Solids Load (Ib-Y/d) SS0 Mannic Solids Load (Ib-Y/d) SS0 Ammonium-RL Load (Ib-N/day) HSOW No 2 HSOW No 2. Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2. Valatile Solids Load (Ib-TS/d)	Annual Average 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0.000 0 0.000 0 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.0663 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0.000 0 0 0.000 0	Notes
HOW No 1 SSO Organic Nitrogen Content (Ib: N/Ib-TS) SSO Totali Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Namonium-N Load (Ib N/dov) HSOW No 2 HSOW No 2 HSOW No 2 Totalic Solids Load (Ib-TS/d) HSOW No 2 HSOW No 2 Totalic Solids Load (Ib-TS/d) HSOW No 2 HSOW NO 4	Annual Average 0.063 0 0 0.000 0 0 0 0 0 0	Table Peak Month 0.063 0 0.000 0 0.000 0 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.0663 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0.000 0 0 0.000 0	Notes
HSOW No. 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Visatile Solids Load (Ib-TS/d) SS0 Namoulam- NL Load (Ib-N/Ib-TS) HSOW No. 2	Annual Average 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0.000 0 0.000 0 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.0663 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0.000 0 0 0.000 0	Notes
HOW No 1 SSO Organic Nitrogen Content (Ib: N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Namonium-N Load (Ib-TA/day) HSOW No 2 HSOW No 3 HSOW No 3 HSOW No 4	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	8 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Onganic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotalie Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 HSOW NO. 4	Annual Average 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0.000 0 0.000 0 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.0663 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0.000 0 0 0.000 0	Notes
HOW No 1 SSO Organic Nitrogen Content (Ib. N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Namonium-N Load (Ib-T/dov) HSOW No 2 HSOW No 3 HSOW No 4	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	8 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No. 5 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Noracian - Norac	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Totalis Golds Load (Ib-Ts/d) SSO Totalis Golds Load (Ib-Ts/d) SSO Notalis Golds Load (Ib-Ts/d) SSO Notalis Golds Load (Ib-Ts/d) HSOW No 2. HSOW No 2. SSO Notalis Golds Load (Ib-Ts/d) HSOW No 2. HSOW No 2. SSO Notalis Golds Load (Ib-Ts/d) HSOW No 2. HSOW No 2. Notalis Golds Load (Ib-Ts/d) HSOW No 2. HSOW No 2. Notalis Golds Load (Ib-Ts/d) HSOW No 2. HSOW No 2. Notalis Golds Load (Ib-Ts/d) HSOW No 2. HSOW No 2. <	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	8 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No. 5 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solito Load (Ib-TS/d) SSO Notalite Solito Load (Ib-TS/d) SSO Nitrolite Solito Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Nota Solito Load (Ib-TS/d) HTmary Sudge Total Nitrogen Content (Ib-N/(b-TS) Primary Sudge Total Solito Load (Ib-TS/d) Nitrogen Content (Ib-N/(b-YS) Ammonium+ Load (Ib-N/day)	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.663 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotalite Solids Load (Ib-TS/d) SSO Niotalite Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Statistic Solids Load (Ib-TS/d) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Notalite Solids Load (Ib-TS/d) HSOW No. 2 Notage Content (Ib-N/Ib-TS) Himary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-YS)	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.663 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
Horov Ho 5 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitrotills Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No 2	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0	e X-X: Nutrient Loading: Ammonia-N Estimat Peak 14 day 0.663 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	65 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Notestille Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Notestille Solids Load (Ib-TS/d) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0	* X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Onganic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotalie Solids Load (Ib-TS/d) SSO Mononilar-NIL Noad (Ib-N/Ib-TS) SSO Mirogen Content (Ib-N/Ib-TS) HSOW No 2 SSO Manonium-NIL Noad (Ib-N/Ib-TS) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Noad (Ib-N/Ib-TS) Homary Sludge Total Solids Load (Ib-TS/d) Himary Sludge Total Solids	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Tably Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	e5 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (U-N/Ib-TS) SSO Organic Nitrogen Content (U-N/Ib-TS) SSO Volatile Solids Laad (U-Y5/d) SSO Namonium-N Laad (U-N/dy) BSOW No 2 SSO Namonium-N Laad (U-N/dy) BSOW No 2 Total Solids Laad (U-Y5/d) SSO Namonium-N Laad (U-N/dy) BSOW No 2 Store Solids Laad (U-Y5/d) SSO Namonium-N Laad (U-N/dy) BSOW No 2 Solids Laad (U-Y5/d) SSO Namonium-N Laad (U-N/dy) BSOW No 2 Solids Laad (U-Y5/d) SSO Namonium-N Laad (U-N/dy) BSOW No 2 Solids Laad (U-Y5/d) SSO Namonium-N Laad (U-N/dy) BOW No 2 Solids Laad (U-Y5/d) Solids Laad (U-Y5/d) Solids Laad (U-V5/d) Solids Laad (U-V5/d) Nitrogen Content (U-N/U-TS) WNAS Total Solids Laad (U-V5/d) WNAS Volatile Solids Laad (U-V5/d) WNAS Total Solids Laad (U-V5/d) WNAS Solids Laaad (U-V5/d) WNAS Solids Laad (U-V5/d) WNAS Solids Laad (U-V	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Tably Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	e5 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HEOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotalie Solids Load (Ib-TS/d) SSO Monoulina-VI. Load (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Anoto (Ib-TS/d) HTMay Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Winds Total Solids Load (Ib-TS/d) Winds Total Solids Load (Ib-TS/d) Winds Total Solids Load (Ib-TS/d) WAS Total Solids Load (Ib-TS/d) WAS Total Horgen Content (Ib-N/Ib-TS) Mas Total Hor	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.0633 0.065 74,799 65,075 0.065 45,534 36,427 0.052 896	e X-X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0,063 0 0,000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
Horv No 1 SSO Organic Nitrogen Content (Ib. N/Ib-TS) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) HSOW No 2 HSOM NO 2	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table 0.063 0.063 0 0.063 0 0.063 0 0.060 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 74.799 0.055 2,407 0.055 45,534 36.427 0.052 886 0.010 0.010	X-X: Nutrient Loading - Amonie-№ Estimat Peak 14 day 0.063 0.000 0.000 0.000 0 0.000 0 0.000 0 0 0.000 0	63 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes Notes
BOW No. 5 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Mirosenic Anticol Load (Ib-TS/d) SSO Mirosenic Anticol Load (Ib-TS/d) HSOW No. 2 Nota Zinta Solids Load (Ib-TS/d) HTMary Studge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Studge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) TWAS Total Nitrogen Content (Ib-N/Ib-TS) TWAS Solids Ibodie Load (Ib-TS/d) TWAS Total Ibodie Load (Ib-TS/d) TWAS Solids Ibodie Load (Ib-TS/d) TWAS Total Ibodie Load (Ib-TS/d) TWAS Total Ibodie Load (Ib-TS/d)	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.0633 0.065 74,799 65,075 0.065 45,534 36,427 0.052 896	e X-X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0,063 0 0,000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HOW No 1 SSD Organic Nitrogen Content (Ib. N/Ib-TS) SSD Totalis Boldis Load (Ib-TS/d) SSD Violatile Solidis Load (Ib-TS/d) SSD Violatile Solidis Load (Ib-TS/d) SSD Violatile Solidis Load (Ib-TS/d) ISSD Warden Content (Ib-N/Ib-TS) ISSO Naco (Ib-TS/d) ISSO No. 2 ISSO No.2	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 74.790 0.057 2,407 0.052 896 0.052 891 3,193	X-X. Nutrient Loading - A monoie-N Estimat Peak 14 day 0.063 0.055 0.65 48,125 3.850 0.052 947 0.010 3.991 3.193	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No. 5 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Noralian Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Noral Solids Load (Ib-TS/d) HTMAS Solids Folds Load (Ib-TS/d) HTMAS Solids Folds Load (Ib-TS/d) HTMAS Solids Ib-SId (Ib-N/Ib-TS) Primary Sudge Total Solids Load (Ib-TS/d) HTMAS HTMAS Load (Ib-TS/d)	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table 0.063 0.063 0 0.063 0 0.063 0 0.060 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 74.799 0.055 2,407 0.055 45,534 36.427 0.052 886 0.010 0.010	X-X: Nutrient Loading - Amonie-№ Estimat Peak 14 day 0.063 0.000 0.000 0.000 0 0.000 0 0.000 0 0 0.000 0	63 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No. 5 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Noralian Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Noral Solids Load (Ib-TS/d) HTMAS Solids Folds Load (Ib-TS/d) HTMAS Solids Folds Load (Ib-TS/d) HTMAS Solids Ib-SId (Ib-N/Ib-TS) Primary Sudge Total Solids Load (Ib-TS/d) HTMAS HTMAS Load (Ib-TS/d)	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 74.790 0.057 2,407 0.052 896 0.052 891 3,193	X-X. Nutrient Loading - A monoie-N Estimat Peak 14 day 0.063 0.055 0.65 48,125 3.850 0.052 947 0.010 3.991 3.193	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HOW No. 5 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Notalitie Solids Load (Ib-TS/d) SSO Notalitie Solids Load (Ib-TS/d) HSOW No. 2 HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 HSOW	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 74.790 0.057 2,407 0.052 896 0.052 891 3,193	X-X. Nutrient Loading - A monoie-N Estimat Peak 14 day 0.063 0.055 0.65 48,125 3.850 0.052 947 0.010 3.991 3.193	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HOW No 1 SSD Optimic Nitrogen Content (Ib: N/Ib: TS) SSD Total Solids Load (Ib: TS/d) SSD Violatile Solids Load (Ib: TS/d) HSOW No 2	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 74.790 0.057 2,407 0.052 896 0.052 891 3,193	X-X. Nutrient Loading - A monoie-N Estimat Peak 14 day 0.063 0.055 0.65 48,125 3.850 0.052 947 0.010 3.991 3.193	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Totalis Solids Load (Ib-TS/d) SSO Intella Solids Load (Ib-TS/d) SSO Nitrolis Solids Load (Ib-TS/d) SSO Nitrolis Solids Load (Ib-TS/d) HSOW No 2 Sto Manoniam-N. Load (Ib-N/Lo-TS) HSOW No 2 Totalis Solids Load (Ib-TS/d) HSOW No 2 HSOW No 4 HNOgen Content (Ib-N/Ib-TS) HYDS Solal Hitrogen Content (Ib-N/Ib-TS) HSOW No Load (Ib-N/G /G) HITROGEN CONTENT (Ib-N/Ib-TS) HSOW No Load (Ib-N/G /G) HITROGEN CONTENT (Ib-N/Ib-TS) HSOW Notal Solad Load (Ib-N/G /G) HITROGEN CONTENT (Ib-N/Ib-TS) HSOW Total Isolad Load (Ib-N/G /G) HSOW Total Isolad Load (Ib-N/G /G) HSOW Notatie Solad Load (Ib-N/G /G) HSOW Total Isolad	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 74.790 0.057 2,407 0.052 896 0.052 891 3,193	X-X. Nutrient Loading - A monoie-N Estimat Peak 14 day 0.063 0.055 0.65 48,125 3.850 0.052 947 0.010 3.991 3.193	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Natellia Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Stormanicum-Y Load (Ib-N/Ib-TS) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Not 2 Antonicum (Ib-N/Ib-TS) HSOW No 2 HSOW NO 4 HSOM NO	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	2 X-X Nutrient Loading - A monoia-N Estimat Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solifs Load (Ib-TS/d) SSO Total Solifs Load (Ib-TS/d) SSO Notes (Ib-SIG) Load (Ib-TS/d) SSO Notes (Ib-SIG) Load (Ib-TS/d) HSOW No 2 Total Solifs Load (Ib-TS/d) HSOW No 2 HSOW No 4	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 74.790 0.057 2,407 0.052 896 0.052 891 3,193	2 XX. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 0.000 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Totalis Solids Load (Ib-TS/d) SSO Nate Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Not 2 N	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	2 X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Notacille Solids Load (Ib-TS/d) SSO Notacille Solids Load (Ib-TS/d) BSO No 2 SSO Amonium-N Load (Ib-N/day) Bethog Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-N/day) Bethog Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Winsgen Content (Ib-N/Ib-TS) Winsgen Content (Ib-N/Ib-TS) Wins Stotal Solids Load (Ib-N/day) TWAS Total Solids Load (Ib-N/day) EMBOD SSO Notent (Ib-N/Ib-TS) Wins Stotal Solids Load (Ib-N/day) EMBOD SSO Notent (Ib-N/Ib-TS) Winsgen Content (Ib-N/I	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.005 2,407 0.065 0.052 896 0.010 3,193 0.008 24	2 XX. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 0.000 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Total Solids Load (Ib-TS/d) HTMAS Solids For Load (Ib-N/day) HTMAS Total Solids Load (Ib-TS/d) HTMAS Solids Ib-SIG (Ib-N/G) Nitrogen Content (Ib-N/Ib-TS) Primary Sudge Total Solids Load (Ib-TS/d) HTMAS Solids Load (Ib-NS/d)	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 74,799 65.075 0.057 2,407 0.065 36,427 0.052 896 0.013 3,991 3,991 3,193 0.008 24 9 2,3226 0.327	2 X: Nutrient Loading - Amonie-N Estimat Peak 14 dy 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Totatile Solids Laad (Ib-TS/d) SSO Notatile Solids Ladd (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) BSO Nitrogen Content (Ib-N/Ib-TS) BSOW No 2 Total Solids Ladd (Ib-TS/d) BOW No 2 Total Solids Ladd (Ib-TS/d) Thrasy Solidge Volatile Solids Ladd (Ib-TS/d) Primary Solidge Volatile Solids Ladd (Ib-TS/d) Primary Solidge Notal Ib-TS/d) Witrogen Content (Ib-H/Ib-TS) Witrogen Content (Ib-H/Ib-TS) Total Solids Ladd (Ib-TS/d) BSOW No 2 Solids Ladd (Ib-TS/d) Total Solids Ladd (Ib-H/Jb-TS) BSOW Total Nitrogen Content (Ib-H/Ib-TS) BSOW Total Solids Ladd (Ib-H/Jb-TS) B	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 2,407 0.065 0.065 36,427 0.065 3.991 3.193 0.008 2.40 0 0.010 3.991 3.193 0.008 0.67 9.22 3.326 0.32 1.207	2 XX. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 0.000 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
KOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Norealine Nitrogen Content (Ib-N/Ib-TS) KSOW No. 2 Norealite Solids Load (Ib-TS/d) HSOW No. 2 Norealite Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) Telas Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Nitrogen C	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 74,799 65.075 0.057 2,407 0.065 36,427 0.052 896 0.013 3,991 3,991 3,193 0.008 24 9 2,3226 0.327	2 X: Nutrient Loading - Amonie-N Estimat Peak 14 dy 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
Bergen A. B.	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table 1 7 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.057 2,407 0 0.55 36,427 36,427 36,427 36,427 36,427 36,427 36,991 3,193 0.0052 895 0.010 3,991 3,193 0.008 24 24 0 6 7 9,22 3,326 0.32 0.32 0.32 0.32 0.32 0.32 0.32 0.32 0.32 0.32 0.32 </td <td>X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 0.055 68,778 0.057 2,544 0 0.052 947 0 0.10 3,991 3,193 0.058 2 0.10 3,991 3,193 0.026 7 2 3,514 0.34 0.29<td>63 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Pesk day 0.063 0 0.000 0 0.000 0 0.000 0 0.005 9.7299 84.650 0.065 9.7231 47.385 0.065 9.231 47.385 0.065 9.231 0.065 9.231 0.065 9.231 0.065 9.231 0.065 9.231 0.057 0.057 0.059 0.057 0.059 0.057 0.059 0.009 0.008 0.059 0.008 0.008 0.042 0.0</td><td>Notes</td></td>	X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 0.055 68,778 0.057 2,544 0 0.052 947 0 0.10 3,991 3,193 0.058 2 0.10 3,991 3,193 0.026 7 2 3,514 0.34 0.29 <td>63 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Pesk day 0.063 0 0.000 0 0.000 0 0.000 0 0.005 9.7299 84.650 0.065 9.7231 47.385 0.065 9.231 47.385 0.065 9.231 0.065 9.231 0.065 9.231 0.065 9.231 0.065 9.231 0.057 0.057 0.059 0.057 0.059 0.057 0.059 0.009 0.008 0.059 0.008 0.008 0.042 0.0</td> <td>Notes</td>	63 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0 0.000 0 0.000 0 0.000 0 0.005 9.7299 84.650 0.065 9.7231 47.385 0.065 9.231 47.385 0.065 9.231 0.065 9.231 0.065 9.231 0.065 9.231 0.065 9.231 0.057 0.057 0.059 0.057 0.059 0.057 0.059 0.009 0.008 0.059 0.008 0.008 0.042 0.0	Notes
Head Provided Content (Ib-N/Ib-TS) SSO Granic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Visatils Solids Load (Ib-TS/d) SSO Namoulam-N Load (Ib-N/Ib-TS) HSOW No.2 Total Solids Load (Ib-TS/d) HSOW Notalit Solids Load (Ib-Yd) HSOW Notal	Annual Average 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 0.065 2,407 0.065 0.065 36,427 0.065 3.991 3.193 0.008 2.40 0 0.010 3.991 3.193 0.008 0.67 9.22 3.326 0.32 1.207	2 X: Nutrient Loading - Amonie-N Estimat Peak 14 dy 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes

	Date Checked	Checked By	Job Number	Ву	Date	Calc No
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-002
Caldwall		Project				Subject
Caldwell	Encina Biosolids, Energy, and Emissio	ons		2030 Year - Service Con	dition	
the second se						

15 day Thermophilic Digestion with All digesters in service

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable))
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SS0 Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

	Parameter	Input Values	Reference	Parameter	Input Values	Reference
ſ	Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
ſ	TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
ſ	FOG VSR (%)	90%	3			
ſ	SSO VSR (%)	90%	3			
ſ	Do not use this row					

Nutrients Speciation for Existing Conditions

Primar	y Sludge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speciation			Nitrogen Spe	ciation	Nitrogen Speciation			
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		
	_							

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3.000	

	Table	X-X: Existing 15 day Ther	mophilic Digestion with All digesters in serv	vice Feed Assessment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	4.75	4.75	4.75	4.75	4.75	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (Ib-TS/d)	60,812	74,799	79,056	85,137	97,299	
TWAS Total Solids Load (lb-TS/d)	37,020	45,534	48,125	51,827	59,231	
FOG Total Solids Load (lb-TS/d)	3.991	3.991	3,991	3.991	3.991	
Total Digester Feed, Total Solids Load (Ib-TS/d)	101,822	124,324	131,172	140,955	160,521	
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650	
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
Total Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
Base HRT (days)	18	15	14	13	11	
Base OLR (IbsVS/d-cf)	0.13	0.16	0.17	0.19	0.21	
Hydraulic Capacity (HC) (gpd)	50.858	-8.277	-26.274	-51.985	-103.407	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (Ib-VS/day)	43.264	-7.041	-22.351	-44,223	-87,966	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	136.545	117.565	111.788	103.536	87.031	Difference between max OLR (0.35 Ibs-VS/cf-d) and current load
Process Limitation	Hydraulic	No Canadity	No Cenacity	No Capacity	No Capacity	· · · · · · · · · · · · · · · · · · ·
		Table X-X:	Mesophilic Co-digestion Feed Assessment			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (lb-VS/day)	43,264	0	0	0	0	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (Ib-VS/day)	43,264	0	0	0	0	
HSOW No. 2 Volatile Solids Load (lb-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (lb-VS/day)	43,264	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	50,899	0	0	0	0	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (lb-TS/day)			U	U		
	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	0 50,899					
SS0 Total Solids Load (lb-TS/day) SS0 (lb-wet/day)		0	0	0	0	Conversion to Wet Solids load based on SSO %TS
	50,899	0	0	0	0	
SSO (lb-wet/day)	50,899 424,158	0 0 0	0 0 0	0 0 0	0 0 0	
SSO (lb-wet/day) HSOW No. 2 Total Load (lb-wet/day) SSO (lb-wet/day)	50,899 424,158 0	0 0 0	0 0 0 0	0 0 0	0 0 0 0	
SSO (lb-wet/day) HSOW No. 2 Total Load (lb-wet/day) SSO (lb-wet/day)	50,899 424,158 0 424,158	0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 0 0	
SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) SSO (Ib-wet/day) SSO (wtpd)	50,899 424,158 0 424,158 212	0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0	
SS0 (lb-wet/day) HSOW No. 2 Total Load (lb-wet/day) SS0 (lb-wet/day) SS0 (wtpd) HSOW No. 2 (wtpd)	50,899 424,158 0 424,158 212 0	0 0 0 0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0	
SS0 (b-wet/day) HSOW No. 2 Total Load (b-wet/day) SS0 (b-wet/day) SS0 (b-wet/day) SS0 (b-wet/day) HSOW No. 2 (wtpd) HSOW No. 2 (wtpd) HSOW No. 2 (wtpd) HSOW No. 2 (wtpd)	50,899 424,158 0 424,158 212 0 212	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0	
SS0 (b-wet/day) HSOW No. 2 Total Load (b-wet/day) SS0 (b-wet/day) SS0 (b-wet/day) SS0 (wtpd) HSOW No. 2 (wtpd) SS0 (wtpd) SS0 (wtpd) SS0 (wtpd) HSOW No. 2 (wtpd) SS0 (wtpd) SS0 (wtpd) HSOW No. 2 (wtpd) SS0 (wtpd) SS0 (gtpd) HSOW No. 2 (gtpd)	50,899 424,158 0 424,158 212 0 212 50,858	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 (D-wet/day) HSDW No. 2 Total Load (Ib-wet/day) SS0 (Ib-met/day) SS0 (Ib-met/day)	50.899 424,158 0 424,158 212 0 212 50,858 0 50,858 152,721	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 140,955	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SSO (B-wet/day) SSO (B-wet/day) SSO (Ib-wet/day) ISSW No. 2 (gad) SSO (Ib-wet/day) Total Solids, Iotal Solids Load (Ib-TS/d) Total Solids, Iotal Solids Load (Ib-TS/d)	50,899 424,158 0 424,159 212 0 212 50,858 0 50,858 152,721 128,979	0 0 0 0 0 0 0 0 0 0 124,324 104,695	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 140,955 118,724	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 160,521 135,228	
SSO (B-wet/day) HSOW No. 2. Total Load (Ib-wet/day) SSO (Ib-wet/day) SSO (Ib-wet/day) SSO (Ibrod) ISOW No. 2. (ptpd) SSO (gaod) HSOW No. 2. (ptpd) SSO (gaod) HSOW No. 2. (ptpd) SSO (gaod) Total Solids, Total Solids Load (Ib-TS/d) Total Solids, Total Solids Load (Ib-TS/d) Total Solids, Volatile Solids Load (Ib-TS/d) Total Solids, Total Solids Load (Ib-TS/d)	50,899 424,158 0 424,158 212 50,858 0 50,858 152,721 128,979 316,667	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 140,955	0 0 0 0 0 0 0 0 0 160,521 135,228 420,073	
SSO (B-wet/day) SSO (B-wet/day) SSO (Ib-wet/day) ISSW No. 2 (gad) SSO (Ib-wet/day) Total Solids, Iotal Solids Load (Ib-TS/d) Total Solids, Iotal Solids Load (Ib-TS/d)	50,899 424,158 0 424,159 212 0 212 50,858 0 50,858 152,721 128,979	0 0 0 0 0 0 0 0 0 0 124,324 104,695	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 140,955 118,724	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 160,521 135,228	
SSO (B-wet/day) HSOW No. 2. Total Load (Ib-wet/day) SSO (Ib-wet/day) SSO (Ib-wet/day) SSO (Ibrod) ISOW No. 2. (ptpd) SSO (gaod) HSOW No. 2. (ptpd) SSO (gaod) HSOW No. 2. (ptpd) SSO (gaod) Total Solids, Total Solids Load (Ib-TS/d) Total Solids, Total Solids Load (Ib-TS/d) Total Solids, Volatile Solids Load (Ib-TS/d) Total Solids, Total Solids Load (Ib-TS/d)	50,899 424,158 0 424,158 212 50,858 0 50,858 152,721 128,979 316,667	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 131,172 110,471 342,941	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 160,521 135,228 420,073	
SSO (B-wet/day)	50,899 424,158 0 424,159 212 0 212 50,858 0 50,858 152,721 1228,979 316,667 415	0 0 0 0 0 0 0 0 0 0 124.324 104,695 324.943 62%	0 0 0 0 0 0 0 0 0 0 131,172 110,471 342,941 6235	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 160,521 135,228 420,073 63%	
SSO (B-wet/day) SSO (D-wet/day) SSO (D-barent of VS (D-bar(%) SSO (D-barent of VS (D-bar(%)	50,899 424,158 0 424,158 212 50,858 0 50,858 152,721 128,979 316,667 415 235	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 131,172 110,471 342,941 62% 35%	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SSO (B-wet/ day) SSO (b-we	50,899 424,158 0 212 0 212 50,858 0 50,858 152,721 128,979 316,667 415 23%	0 0 0 0 0 0 0 0 0 124,324 104,695 324,943 62% 35% 35%	0 0 0 0 0 0 0 0 0 0 0 131,172 110,471 10,471 342,941 6,245 35% 35%	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 (Di-wet/day) SS0 (Di-wet/day) SS0 (Di-wet/day) SS0 (Di-wet/day) SS0 (Di-wet/day) SS0 (Di-wet/day) SS0 (pd) Total Solids, Total Solids Load (Di-YS/d) Total Solids, Solids Load (Di-YS/d) Total Solids, Solids Load (Di-YS/d) Total Solids, Solids Load (b) Total Solids, Total Solids Load (b) Total Solids, Total Solids, Load (b) Finans (stage) gencent of VS Load (%) WAS percent of VS Load (%) FOS percent of VS Load (%) SD So percent of VS Load (%)	50,899 424,158 0 424,158 212 50,858 0 50,858 152,721 128,979 316,667 41% 23% 2% 34%	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	

	0.00	0.40		0.40		
Co-Digestion OLR (lbs-VS/d-cf) Process Check	0.20 OK	0.16 OK	0.17 No Capacity	0.19 No Capacity	0.21 No Capacity	
		Table X-X: Exis	ting Mesophilic Solids and Biogas Producti			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (lb-VSd/day) FOG Volatile Solids Destroyed (lb-VSd/day)	13,919	17,121	18,095 2.873	19,487	22,271 2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50,640	62,031	65,497	70,450	80,354	
Volatile Solids Effluent (Lbs-VS/d)	34,533	42,402	44,797	48,218	55,061	
Total Solids (% TS) Volatile Solids (% VS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145 911.037	51,145 1,108,812	51,145 1,169.005	51,145 1,254,994	51,145 1,426,972	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037		hilic Co-digestion Solids and Biogas Produ		1,426,972	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	38,938	0	0	0	0	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day) Total Volatile Solids Destroyed (Ib-VSd/day)	90,120	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	316,667	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	62,602	62,031	65,497	70,450	80,354	
Volatile Solids (Lbs-VS/d)	38,859	42,402	44,797	48,218	55,061	
Total Solids (% TS)	2.4%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS) Dewatered Solids (Lbs-TS/d)	62% 59.472	68% 58,929	68% 62,222	68% 66,927	69% 76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	135	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
			51.145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145				
SSO Biogas Production (scfd)	700,879	0	0	0	0	Assumes a biogas yield of 18 scf/lb-VSd
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd)	700,879 0	0	0	0	0	Assumes a biogas yield of 18 scl/lb-VSd
SSO Biogas Production (scfd)	700,879	0 0 1,108,812				Assumes a biogas yield of 18 scl/lb-VSd
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1	700,879 0 1,611,916 Annual Average	0 0 1,108,812 Table X-X: Peak Month	0 1,169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 day	0 1,254,994 Peak 7 day	0 1,426,972 Peak day	Assumes a biogas yield of 18 scl /lb-VSd Notes
SSD Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)	700,879 0 1,611,916 Annual Average 0.063	0 0 1,108,812 Table X-X: Peak Month 0.063	0 1,169,005 Nutrient Loading - Ammonia- N Estimates Peak 14 day 0.063	0 1,254,994 Peak 7 day 0.063	0 1,426,972 Peak day 0.063	
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib TS) SSO Total Solids Load (Ib-TS/d)	700,879 0 1,611,916 Annual Average	0 0 1,108,812 Table X-X: Peak Month	0 1,169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 day	0 1,254,994 Peak 7 day	0 1,426,972 Peak day	
SSD Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) SSD W No 1 SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-TS/d)	700,879 0 1,611,916 Annual Average 0.063	0 0 1,108,812 Table X-X: Peak Month 0.063	0 1,169,005 Nutrient Loading - Ammonia- N Estimates Peak 14 day 0.063	0 1,254,994 Peak 7 day 0.063	0 1,426,972 Peak day 0.063	
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib TS) SSO Total Solids Load (Ib-TS/d)	700,879 0 1,611,916 Annual Average 0.063 50,899 43,264	0 0 1,108,812 Table X-X: Peak Month 0.063 0 0	0 1,168,005 Nutrient Loading - Ammonia-N Estimates Peak 14 day 0.063 0 0	0 0 1,254,994 Peak 7 day 0.063 0 0	0 1,426,972 Peak day 0.063 0 0	
SS0 Biogas Production (scid) SS0 Biogas Production (scid) Total Biogas Production (scid) SS0 Moral SS0 Magnich Withogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Vision Exercised (Ib-N/ds) SS0 Nitrogen Content (Ib-N/ds) SS0 Nitrogen Content (Ib-N/ds) SS0 Nitrogen Content (Ib-N/ds) SS0 Nitrogen Content (Ib-N/ds) SS0 Nitrogen Content (Ib-N/ds)	700,879 0 1,611,916 Annual Average 0.063 50,899 43,264 0.053 2,069	0 0 1,108,812 Table XX: Peak Month 0.063 0 0 0 0.000 0 0	0 1,169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 day 0,063 0 0 0,000 0	0 1,254,994 Peak 7 day 0.063 0 0 0.000 0	0 1,426,972 Peak day 0.063 0 0 0.000 0	
SSD Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd) Grad Biogas Production (scfd) SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Organic Content (Ib-N/Ib-TS) SSD Organic Content (Ib-N/Ib-TS) SSD Organic Content (Ib-N/Ib-TS) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Monoilmut - Nitrogen Content (Ib-N/Ib-TS)	700,879 0 1,611,916 Annual Average 0,063 50,899 43,294 0,053 2,069 0,000	0 0 1,108,812 Table X-X: Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,69,005 Nutrient Loading - Anmonia-N Estimates Peak 14 day 0.0653 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,254,994 Peak 7 day 0.063 0 0 0.000 0 0 0.000 0 0.000	0 1,426,972 Peak day 0.063 0 0 0.000 0 0	
SS0 Biogas Production (scid) SS0 Biogas Production (scid) Total Biogas Production (scid) SS0 Organic Nutogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatie Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Violatie Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS)	700,879 0 1,611,916 Annud Average 0,063 50,899 43,264 0,053 2,069 0,000 0	0 0 1,108,812 Table XX: Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,254,994 Peak 7 day 0,063 0 0 0 0 0 0 0 0 0	0 1,426,972 Peak day 0.063 0 0.000 0 0.000 0	
SSD Biogas Production (scfd) ISOW No.2 Biogas Production (scfd) Total Biogas Production (scfd) SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSD Notgan Content (Ib-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Nitrogen Content (Ib-SI/Ib-NITC)	700,879 0 1,611,916 Annual Average 0,063 50,899 43,294 0,053 2,069 0,000	0 0 1,108,812 Table X-X: Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1.169,005 1.169,005 Peak 14 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1,254,994 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,426,972 Peak day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 Biogas Production (scld) SS0 Biogas Production (scld) Total Biogas Production (scld) SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Vision (Ib-S) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Note (Ib-Solid Load (Ib-TS/d) SS0 Note (Ib-Solid Load (Ib-TS/d) SS0 Note (Ib-Solid Load (Ib-TS/d) SS0 Note (Ib-N/Ib-TS)	700,879 0 1,611,916 Annud Average 0,063 50,899 43,264 0,053 2,069 0,000 0	0 0 1,108,812 Table XX: Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,254,994 Peak 7 day 0,063 0 0 0 0 0 0 0 0 0 0	0 1,426,972 Peak day 0.063 0 0.000 0 0.000 0	
SS0 Biogas Production (scht) SS0 Biogas Production (scht) Total Biogas Production (scht) SS0 Total Solids Load (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-N/d) SS0 Valids ESolids Load (Ib-N/d) SS0 Antiogae Content (Ib-N/Ib-TS) SS0 Antiogae Content (Ib-N/Ib-TS) SS0 Antiogae Content (Ib-N/Ib-TS) SS0 Antiogae Content (Ib-N/Ib-TS) SS0 Mice Content (Ib-M/Ib-TS) SS0 Mic	700,879 0 1,611,916 0,063 50,689 43,264 0,053 2,069 0,000 0 0 0 0 0,000	0 0 1,108,812 Table XX Peak Month 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,169,005 1,169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1,254,994 Peak 7 day 0,003 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,426,972 Peak day 0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
SSD Biogas Production (scld) SSD Biogas Production (scld) Total Biogas Production (scld) SSD Variant (De Write) SSD Organic Status SSD Total Solids Load (Ib-TS/d) SSD Variant (Ib-W/Jb-TS) SSD Variant (Ib-W/Jb-TS) SSD Variant (Ib-W/Jb-TS) SSD Nitrogin Content (Ib-N/Jb-TS) SSD Nitrogin Content (Ib-N/Jb-TS) SSD Nitrogin Content (Ib-N/Jb-TS) SSD What Content (Ib-N/Jb-TS) SSD Mach Content (Ib-N/Jb-TS) SSD What Content (Ib-N/Jb-TS) <	700,879 0 1,611,916 Annual Average 0,063 50,899 43,264 0,053 2,069 0,000 0 0 0 0 0 0 0 0 0 0 0	0 0 1,108,812 Fesk Month 0,063 0 0 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1.69,005 Nutrient Loading - Ammonia-N Estimates Peak 14 Gay 0.663 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 1.254.994 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,426,972 Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	
SSD Biogas Production (scht) SSD Biogas Production (scht) Total Biogas Production (scht) SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD So Nitrogen Content (Ib-N/Ib-TS) SSD Nitrog	700,879 0 1,611,916 Annual Average 0,063 50,689 43,264 0,053 2,069 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1,108,812 Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,169,005 Nutrient Loading - Anmonia-N Estimates Peak 14 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,254,994 Pesk 7 day 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,426,972 Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	
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SS0 Biogas Production (scht) SS0 Biogas Production (scht) Total Biogas Production (scht) Total Biogas Production (scht) SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Worgen Content (Ib-N/Ib-TS) Phang Stadge Total Nitrogen Content (Ib-N/Ib-TS) Primary Studge Total Solids Load (Ib-TS/d) WNS Total Nitrogen Content (Ib-N/Ib-TS) MSW Total Solids Load (Ib-TS/d)	700.879 0 1,611,916 Annual Average 0.063 50.889 43.264 0.053 2.069 0.000 0 0.001 0 0.002 0.003 0.004 0 0.005 60.812 52.906 0.057 1.957 0.065 60.812 2.2061 0.052 2.2616 0.052 0.052 0.053 3.991 3.193 0.008 24 66 7 9.22 4,777 0.32	0 0 1,108,812 Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 Gy 0.063 0 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.254,994 Peak 7 day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 1,426,972 1,426,972 0.063 0 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 97,299 84,650 0.065 59,231 1.165 1.165 0.010 3.991 3.193 0.008 24 24 66 7 9.224 1.165	
SSO Biogas Production (scht) SSO Biogas Production (scht) Total Biogas Production (scht) SSO Tarai Nithogen Content (Ib-N/Ib-TS) SSO Tarai Nithogen Content (Ib-N/Ib-TS) SSO Tarai Nithogen Content (Ib-N/Ib-TS) SSO Nather Schtler Schtland (Ib-TS/d) SSO Nather Schtland (Ib-TS/d) Nather Schtland (Ib-TS/d) SSO Nather	700.879 0 1.611.916 Annual Average 0.063 50.809 43.224 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1108.812 1616.XX Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 Gy 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.254,994 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,426,972 1,426,972 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	
SSO Biogas Production (scht) SSO Biogas Production (scht) Total Biogas Production (scht) SSO Total Solids Load (Ib-15/d) SSO Total Solids Load (Ib-15/d) SSO Total Solids Load (Ib-15/d) SSO Annonium N Load (Ib-4/(b-15) SSO Annonium N Load (Ib-4/(b-15) SSO Annonium N Load (Ib-16/d) SSO Nove 2. Consolis Load (Ib-15/d) SSO Nove 2. Consolis Load (Ib-15/d) SSO Nove 2. Consolis Load (Ib-15/d) SSO Nove 2. Solis Load (I	700,879 0 1,611,916 Annual Average 0,063 50,6899 43,264 0,055 2,069 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1,108,812 1,108,812 1,108,252 Peak Month 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.169,005 Nutrient Loading: - Ammonia-N Estimates Peak 14 Gy 0.063 0 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.254,994 Peak 7 day 0.063 0 0 0 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 2,739 0.005 2,739 0.005 1,827 41,462 0.005 3,193 0.006 3,991 3,193 0.008 66 7 9.22 3,783 0.37 1,230	0 1,426,972 1,426,972 0.063 0 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.005 97,299 84,650 0.005 92,23 10 0.065 92,23 1,165 0.005 92 24 24 26 66 7 9,22 4,320 0.42 20,042 1.239	
SSO Biogas Production (scld) SSO Biogas Production (scld) Total Biogas Production (scld) SSO Total Solds Load (b-17;d) SSO Total Solds Load (b-17;d) SSO Total Solds Load (b-17;d) SSO Internation (SSO Biogas) SSO Internation (SSO Biogas) S	700.879 0 1.611.916 Annual Average 0.063 50.809 43.264 0.063 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 1108.812 1616.XX Peak Month 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.169,005 Nutrient Loading - Ammonia-N Estimates Peak 14 Gay 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.254,994 Peak 7 day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1,426,972 Pask day 0.063 0 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.005 97.299 97.299 97.299 0.055 59.231 1.105 0.005 1.1105 0.010 3.991 3.183 0.002 1.105 0.010 3.991 3.193 0.04 24 66 7 9.22 66 7 1.233 0.04 24 3.20 0.42 1.233	
SSO Biogas Production (scht) SSO Biogas Production (scht) Total Biogas Production (scht) SSO Total Solids Load (Ib-15/d) SSO Total Solids Load (Ib-15/d) SSO Total Solids Load (Ib-15/d) SSO Annonium N Load (Ib-4/(b-15) SSO Annonium N Load (Ib-4/(b-15) SSO Annonium N Load (Ib-16/d) SSO Nove 2. Consolis Load (Ib-15/d) SSO Nove 2. Consolis Load (Ib-15/d) SSO Nove 2. Consolis Load (Ib-15/d) SSO Nove 2. Solis Load (I	700,879 0 1,611,916 Annual Average 0,063 50,6899 43,264 0,055 2,069 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1,108,812 1,108,812 1,108,252 Peak Month 0,063 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.169,005 Nutrient Loading: - Ammonia-N Estimates Peak 14 Gy 0.063 0 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1.254,994 Peak 7 day 0.063 0 0 0 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 2,739 0.005 2,739 0.005 1,827 41,462 0.005 3,193 0.006 3,991 3,193 0.008 66 7 9.22 3,783 0.37 1,230	0 1,426,972 1,426,972 0.063 0 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.005 97,299 84,650 0.005 92,23 10 0.065 92,23 1,165 0.005 92 24 24 26 66 7 9,22 4,320 0.42 20,042 1.239	

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Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-002
	Pro	ject			Subject
Encina Biosolids, Energy, and Emiss	ions		2030 Year - Service Co	ndition	

10 day Thermophilic Digestion

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days) 10 Assumed Peaking Factors					
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference	
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable)			
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1	
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1	
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1	
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2	
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No		
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1	

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SSO	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

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Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Slud	ge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speci	ation		Nitrogen Spec	iation		Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (lb-N/lb-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

		Table X-X: E	isting 10 day Thermophilic Digestion Feed A	ssessment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	3.90	3.90	3.90	3.90	3.90	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299	
TWAS Total Solids Load (Ib-TS/d)	37,020	45,534	48,125	51,827	59,231	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	101,822	124,324	131,172	140,955	160,521	
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650	
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
Total Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
Base HRT (days)	15	12	11	11	9	
Base OLR (lbsVS/d-cf)	0.16	0.20	0.21	0.23	0.26	
Hydraulic Capacity (HC) (gpd)	123,692	64,557	46,559	20,848	-30,573	Assumes the minimum allowable HRT 10 days
HC as Equivalent VS Load (lb-VS/day)	105,222	54,917	39,607	17,735	-26,008	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (lb-VS/day)	96,538	77,558	71,781	63,529	47,025	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Hydraulic	Hydraulic	Hydraulic	No Capacity	
			X-X: Mesophilic Co-digestion Feed Assessm			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	96,538	54,917	39,607	17,735	0	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/day)	96,538	54,917	39,607	17,735	0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	96,538	54,917	39,607	17,735	0	
SSO Total Solids Load (Ib-TS/day)	113,574	64,608	46,596	20,865	0	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	113,574	64,608	46,596	20,865	0	
SSO (lb-wet/day)	946,451	538,403	388,303	173,875	0	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	946,451	538,403	388,303	173,875	0	
SSO (wtpd)	473	269	194	87	0	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	473	269	194	87	0	
SSO (gpd)	113,483	64,557	46,559	20,848	0	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	113,483	64,557	46,559	20,848	0	
Total Solids, Total Solids Load (Ib-TS/d)	215,396	188,932	177,768	161,820	160,521	
Total Solids, Volatile Solids Load (Ib-VS/d)	182.253	159.612	150,078	136,459	135,228	
Total Flow (gpd) Primary sludge percent of VS Load (%)	379,292	389,500 41%	389,500 46%	389,500 54%	420,073	

WAS percent of VS Load (%)	16%	23%	26%	30%	35%	
FOG percent of VS Load (%)	2%	2%	2%	2%	2%	
SSO percent of VS Load (%)	53%	34%	26%	13%	0%	
HSOW No. 2 percent of VS Load (%)	0% 0k	0%	0%	0%	0%	
Check	ок 10	ok 10	ok 10	0K 10	<u>ок</u> 9	
Co-digestion HRT (days) Co-Digestion OLR (lbs-VS/d-cf)	0.35	0.31	0.29	0.26	9	
Process Check	OK	OK	OK	OK	No Capacity	
		Table X-)	: Existing Mesophilic Solids and Biogas Proc	luction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808 50.640	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d) Volatile Solids Effluent (Lbs-VS/d)	50,640	62,031	65,497	70,450	80,354	
Total Solids (% TS)	2.3%	2.3%	2 3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247,765	304,751	322,094	346,871	396,424	Assumes a blogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145 911.037	51,145 1.108.812	51,145 1,169.005	51,145 1,254,994	51,145 1.426.972	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037		1,169,005 Mesophilic Co-digestion Solids and Biogas Pi		1,426,972	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42.299	44,706	48.145	55.023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	86,884	49,425	35,646	15,962	0	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	138,066	111,718	101,321	86,467	80,167	Annual that is formation and
Total Sludge Effluent (gpd) Total Solids (Lbs-TS/d)	3/9,292	389,500	389,500	389,500	420,073	Assumes that volume in equals volume out
Volatile Solids (Lbs-VS/d)	44,187	47.894	48,758	49,992	80,354 55,061	
Total Solids (% TS)	2.4%	2.4%	2.4%	2.3%	2.3%	
Volatile Solids (% VS)	57%	62%	64%	66%	69%	
Dewatered Solids (Lbs-TS/d)	73,464	73,353	72,625	71,585	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	167	167	165	163	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) SSO Biogas Production (scfd)	51,145 1,563,916	51,145 889.657	51,145 641.632	51,145 287,311	51,145 0	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	1,503,910	009,007	041,032	201,311	0	Assumes a biogas yield of 18 sci/ lo-vou
Total Biogas Production (scfd)	2.474.953	1.998.469	1.810.637	1.542.304	1.426.972	
					1,120,012	
HSOW No 1	Annual Average		e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day		Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS)	0.063	Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d)		Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day	es Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d)	0.063 113,574 96,538	Table Peak Month 0.063 64,608 54,917	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 46,596 39,607	es Peak 7 day 0.063 20,865 17,735	Peak day 0.063 0 0	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	0.063	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 113,574 96,538	Table Peak Month 0.063 64,608 54,917	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 46,596 39,607	es Peak 7 day 0.063 20,865 17,735	Peak day 0.063 0 0	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	0.063 113,574 96,538	Table Peak Month 0.063 64,608 54,917	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 46,596 39,607	es Peak 7 day 0.063 20,865 17,735	Peak day 0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-YS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Ammonium-N Load (Ib-N/Jb-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS)	0.063 113,574 96,538 0.053 4,616 0.000 0	Tabl Peak Month 0.063 64,608 54,917 0.053 2,626 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 46,596 39,607 0.053 1,894 0.000 0	es Peak 7 day 0.063 20,865 17,735 0.053 848 	Peak day 0.063 0 0.000 0 0 0.000 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solids Load (b-TS/d) SS0 Valati Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Annonium-Nt (ba/b/b-VS) SS0 Annonium-Nt Load (b-N/day) HSOW No.2 Corganic Nitrogen Content (b-N/b-TS) HSOW No.2 Total Solids Load (b-TS/d) HSOW No.2 Total Solids Load (b-TS/d) HSOW No.2 Total Solids Load (b-TS/d)	0.063 113,674 96,538 0.053 4,616 0.000	Table Peak Month 0.063 64,608 54,917 0.053 2,626	5.X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 46,596 39,607 0.053 1.894	es Peak 7 day 0.063 20,865 17,735 0.053 848	Peak day 0.063 0 0 0.000 0	Notes
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SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Total Solids and (b-TS/q) SS0 Viatal Solids and (b-TS/q) SSW No. 2 Viatal Solids Load (b-Yd/q) SSW No. 2 Viatal Solids Load (b-Yd/q) StoW No. 2 Viatal Solids Load (b-Yd/q) Primary Sudge Total Nitrogen Content (b-V/lb-TS) Windge Content (b-V/lb-YS) Primary Sudge Total Solids Load (b-YS/q) PMAS Total Solids Load (b-YS/q) PMAS Total Solids Load (b-YS/q) PMAS Solids Isolids Load (b-YS/q) PMAS Total Solids Load (b-YS/q) PMAS Solids Isolids Load (b-YS/q) PMAS Total Solids Load (b-YG/q) PMAS Total Solids Load (b-YG/q) PMAS Total Solids Load (b-YG/q) PMAS Total Solids Load (b-YG/q	0.063 112.574 96.538 0.053 4.616 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Teb! Peak Month 0.063 0.4,608 54,917 0.063 2,626 0.000 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 74,799 0.055 0.055 45,534 45,534 896 0.010 3,991	e X-X Nutrient Loading - A monoia - N Estimat Peak 14 day 0.063 46.596 33.607 0.053 1.894 0.000 0 0 0 0 0 0 0 0 0 0 0 0	65 Peak 7 day 0.063 20.865 17,735 0.053 848 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesit day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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Brown	Date Checked	Checked By	Job Number	Ву	Date	Calc No		
	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-002		
		Project				Subject		
Caldwell Encina Biosolids, Energy, and E	Encina Biosolids, Energy, and Emissi	ons		2030 Year - Service Con	dition			
and the second se								

10 day Thermophilic Digestion with All digesters in service

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	10	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable)		
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

- [Parameter	Input Values	Reference	Parameter	Input Values	Reference
ſ	Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
[TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
[FOG VSR (%)	90%	3			
	SSO VSR (%)	90%	3			
[Do not use this row					

Nutrients Speciation for Existing Conditions

Primary Sludge			TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen	Speciation		Nitrogen Speciation		Nitrogen Speciation			
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		
	_							

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3.000	

Table X-X: Existing 10 day Thermophilic Digestion with All digesters in service Feed Assessment							
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes	
Peaking Factors	1.00	1.23	1.30	1.40	1.60	1003	
Digester Volume (MG)	4.75	4.75	4.75	4.75	4.75	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.	
Primary Sludge Total Solids Load (Ib-TS/d)	60,812	74,799	79,056	85,137	97,299		
TWAS Total Solids Load (lb-TS/d)	37,020	45,534	48,125	51,827	59,231		
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991		
Total Digester Feed, Total Solids Load (Ib-TS/d)	101,822	124,324	131,172	140,955	160,521		
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650		
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385		
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193		
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228		
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%		
WAS percent of VS Load (%)	35%	35%	35%	35%	35%		
FOG percent of VS Load (%)	4%	3%	3%	3%	2%		
Total Digester Feed Flow (gpd)	265.808	324,943	342,941	368,652	420.073		
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%		
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%		
Base HRT (days)	18	15	14	13	11		
Base OLR (lbsVS/d-cf)	0.13	0.16	0.17	0.19	0.21		
Hydraulic Capacity (HC) (gpd)	209.192	150.057	132,059	106.348	54.927	Assumes the minimum allowable HRT 10 days	
HC as Equivalent VS Load (Ib-VS/day)	177.955	127,650	112,340	90,468	46,725	Equivalent load of HSOW, based on hydraulic capacity	
Organic Load Capacity (Ib-VS/day)	136,545	117,565	111,788	103,536	87.031	Difference between max OLR (0.35 Ibs-VS/cf-d) and current load	
Process Limitation	Organic Load	Organic Load	Organic Load	Hydraulic	Hydraulic		
	onganio coud		Mesophilic Co-digestion Feed Assessment		injuluano		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes	
Total HSOW Volatile Solids Load (Ib-VS/day)	136.545	117.565	111.788	90,468	46,725	Calculated available organic load, based on defined limit	
SSO Volatile Solids Load (Ib-VS/day)	136,545	117,565	111,788	90,468	46,725	calculated available organic load, based on denned mint	
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	0	0		
Total HSOW Volatile Solids Load (Ib-VS/day)	136.545	117.565	111.788	90,468	46,725		
SSO Total Solids Load (Ib-TS/day)	160,641	138.311	131,515	106,433	54,971	Conversion to Total Solids load based on SSO %VS	
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	conversion to Total Solids Ioad based on 550 %V5	
SSO Total Solids Load (Ib-TS/day)	160.641	138.311	131,515	106.433	54,971		
SSO (lb-wet/day)	1.338.673	1.152.594	1.095.961	886,945	458.088	Conversion to Wet Solids load based on SSO %TS	
HSOW No. 2 Total Load (Ib-wet/day)	0	0	0	0	0		
SSO (lb-wet/day)	1.338.673	1,152,594	1.095.961	886.945	458.088		
SSO (wtxd)	669	576	548	443	229		
HSOW No. 2 (wtpd)	0	0	0	0	0		
SSO (wtpd)	669	576	548	443	229		
SSO (wpc) SSO (gpd)	160.512	138.201	131.410	106.348	54.927		
HSOW No. 2 (gpd)	0	0	0	100,340	0		
SSO (gpd)	160.512	138.201	131,410	106.348	54.927		
Total Solids. Total Solids Load (Ib-TS/d)	262.463	262.635	262.687	247.388	215.492		
Total Solids, Volatile Solids Load (Ib-VS/d)	222.259	222,259	222,007	209.192	181.953		
Total Flow (gpd)	426,321	463,144	474,351	475,000	475,000		
Primary sludge percent of VS Load (%)	24%	29%	31%	35%	47%		
WAS percent of VS Load (%)	13%	16%	17%	20%	26%		
FOG percent of VS Load (%)	13.8	1%	1%	20%	20%		
SS0 percent of VS Load (%)	61%	53%	50%	43%	2%		
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	43%	0%		
Check	ok	0%	ok	ok	ok		
Co-digestion HRT (days)	0K 11	0K 10	0K 10	0K 10	0K 10		
CO-ulgesuoli nr.i (uays)	11	10	10	10	10		

Co-Digestion OLR (lbs-VS/d-cf)	0.35	0.35	0.35	0.33	0.29	
Process Check	0.35	0.35 OK	0.35 OK	0.33 OK	0.29 OK	
		Table X-X: Exi	sting Mesophilic Solids and Biogas Productio	n		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	34,389	42,299 17.121	44,706	48,145	55,023 22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2.873	2.873	2.873	2,873	2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50,640	62,031	65,497	70,450	80,354	
Volatile Solids Effluent (Lbs-VS/d) Total Solids (% TS)	34,533	42,402 2.3%	44,797 2.3%	48,218 2.3%	55,061 2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128 247,765	752,917 304,751	795,766	856,979 346.871	979,404 396.424	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd) FOG Biogas Production (scfd)	51.145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
			philic Co-digestion Solids and Biogas Produc		-	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706 18.095	48,145 19,487	55,023 22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2.873	2,873	2,873	2,873	2.873	
SSO Volatile Solids Destroyed (lb-VSd/day)	122,890	105,808	100,609	81,422	42,052	
HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	174,072	168,101	166,284 474,351	151,927	122,219	Assumes that values is aquals or free and
Total Sludge Effluent (gpd) Total Solids (Lbs-TS/d)	426,321 88,391	463,144 94,534	96.403	475,000 95,461	93.272	Assumes that volume in equals volume out
Volatile Solids (Lbs-VS/d)	48,187	54,158	55,976	57,265	59,733	
Total Solids (% TS)	2.5%	2.4%	2.4%	2.4%	2.4%	
Volatile Solids (% VS)	55%	57%	58%	60%	64%	Demotrand astronome OFN asstronome
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	83,971	89,807 204	91,583 208	90,688 206	88,609 201	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (lb-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd)	2,212,024	1,904,546	1,810,966	1,465,587	756,944	Assumes a biogas yield of 18 scf/lb-VSd
Total Biogas Production (scfd)	3,123,061	3,013,359	2,979,971	2,720,581	2,183,917	
		Table X-X	Nutrient Loading - Ammonia-N Estimates			
HSOW No 1	Annual Average					
		Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS)	0.063	0.063	0.063	0.063	0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)					0.063 54,971	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	0.063 160,641 136,545 0.053	0.063 138,311 117,565 0.053	0.063 131,515 111,788 0.053	0.063 106,433 90,468 0.053	0.063 54,971 46,725 0.053	NOUPS
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatlle Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 160,641 136,545	0.063 138,311 117,565	0.063 131,515 111,788	0.063 106,433 90,468	0.063 54,971 46,725	NULES
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viatali Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Atmonium-N Load (Ib-N/day) HSOW Ho 2	0.063 160,641 136,545 0.053 6,529	0.063 138,311 117,565 0.053 5,621	0.063 131,515 111,788 0.053 5,345	0.063 106,433 90,468 0.053 4,326	0.063 54,971 46,725 0.053 2,234	
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatlle Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 160,641 136,545 0.053	0.063 138,311 117,565 0.053	0.063 131,515 111,788 0.053	0.063 106,433 90,468 0.053	0.063 54,971 46,725 0.053	NOUES
SSO Organic Nitrogen Content (U-H/U-TS) SSO Total Solits: And (U-TS/Q) SSO Total Solits: And (U-TS/Q) SSO Nitrogen Content (U-H/U-YS) SSO Nitrogen Content (U-H/U-YS) SSO Annon(U-H-YL Load (U-H/Vday) SSO Marcollam-H-Load (U-H/Vday) SSOW No.2 Claganic Nitrogen Content (U-H/U-TS) HSOW No.2 Total Solids Load (U-TS/q) HSOW No.2	0.063 160,641 136,545 0.053 6,529 0.000 0 0 0	0.063 138,311 117,565 0.053 5,621 0.000 0 0	0.063 131.515 111.788 0.053 5.345 0.000 0 0	0.063 106,433 90,468 0.053 4,326 	0.063 54,971 46,725 0.053 2,234 0.000 0 0	NULES
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Total Solids Laad (Ib-TS/d) SS0 Volatils Solids Laad (Ib-YS/d) SS0 Nitrogen Content (Ib-H/Ib-VS) SS0 Nitrogen Content (Ib-H/Ib-VS) SS0 Annonium-N Laad (Ib-V/day) HSOW No.2 HSOW No.2 SKOW X0.2 FSOW No.2 SKOW No.2	0.063 160,641 136,545 0.053 6,529 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 138,311 117,565 0.053 5,621 0.000 0 0 0 0.000	0.063 131,515 111,78 0.053 5.345 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 106,433 90,468 0.053 4,326 0.000 0 0 0 0.000	0.063 54,971 46,725 0.053 2,234 0.000 0	
SSO Organic Nitrogen Content (U-H/U-TS) SSO Total Solits: And (U-TS/Q) SSO Total Solits: And (U-TS/Q) SSO Nitrogen Content (U-H/U-YS) SSO Nitrogen Content (U-H/U-YS) SSO Annon(U-H-YL Load (U-H/Vday) SSO Marcollam-H-Load (U-H/Vday) SSOW No.2 Claganic Nitrogen Content (U-H/U-TS) HSOW No.2 Total Solids Load (U-TS/q) HSOW No.2	0.063 160,641 136,545 0.053 6,529 0.000 0 0 0	0.063 138,311 117,565 0.053 5,621 0.000 0 0	0.063 131.515 111.788 0.053 5.345 0.000 0 0	0.063 106,433 90,468 0.053 4,326 	0.063 54,971 46,725 0.053 2,234 0.000 0 0	NUCES
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Total Solids Load (Ib-TS/0) SS0 Total Solids Load (Ib-TS/0) SS0 Nitrogen Content (Ib-H/Ib-YS) SS0 Armonium-HL Load (Ib-H/day) HSOW No. 2 HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 HSOW No. 2 StoW No. 2 StoW No. 2 StoW No. 2 HSOW No. 2 StoW No.2 StoW No.2 <td>0.063 160,641 136,545 0.053 6,529 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 138,311 117,565 0.053 5,621 0.000 0 0 0 0.000</td> <td>0.063 131,515 111,78 0.053 5.345 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>0.063 106,433 90,468 0.053 4,326 0.000 0 0 0 0.000</td> <td>0.063 54,971 46,725 0.053 2,234 0.000 0 0</td> <td>NULES</td>	0.063 160,641 136,545 0.053 6,529 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 138,311 117,565 0.053 5,621 0.000 0 0 0 0.000	0.063 131,515 111,78 0.053 5.345 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 106,433 90,468 0.053 4,326 0.000 0 0 0 0.000	0.063 54,971 46,725 0.053 2,234 0.000 0 0	NULES
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Valatilie Add (Ib-TS/d) SS0 Valatilie Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-H/Ib-TS) SS0 Nitrogen Content (Ib-H/Ib-TS) SS0 Nitrogen Content (Ib-H/Ib-TS)	0.063 100.041 136.545 6.529 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 138,311 117,565 0.053 5,621 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 131.515 111.788 0.053 5.345 0.000 0 0 0 0.000 0 0 0.000 0	0.063 106,433 90,468 0.053 4,326 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 54,971 46,725 0.053 2,234 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Veralisalities Acad (Ib-TS/d) SS0 Veralisalities Acad (Ib-TS/d) SS0 Veralisalities Acad (Ib-TS/d) SS0 Nitrogen Content (Ib-H/Ib-TS) SS0 Acad (Ib-TS/d) SS0 Mitrogen Content (Ib-H/Ib-TS) SS0 Acad (Ib-TS/d) SS0 Mitrogen Content (Ib-H/Ib-TS) SS0 Acad (Ib-TS/d) SS0 Wite 2. Stotatile Solids Load (Ib-TS/d) Stotatile Solids Load (Ib-TS/d) Stotatile Solids Load (Ib-TS/d) Stotatile Solids Load (Ib-TS/d) Stotatile Solids Load (Ib-TS/d) Stotatile Solids Load (Ib-TS/d) Stotatile Solids Load (Ib-TS/d) Phramery Studge Total Nitrogen Content (Ib-N/Ib-TS) Phramery Studge Total Nitrogen Content (Ib-N/Ib-TS)	0.083 160.641 136.845 6.529 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 138,311 117,565 0.053 5,621 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 131.515 111.788 0.053 5.345 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0	0.063 106,433 90,468 0.053 4,326 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 54,971 46,725 0.053 2,234 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
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SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids cand (Ib-TS/d) SS0 Total Solids cand (Ib-TS/d) SS0 Vitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) SSOW Total Solids Load (Ib-TS/d) SSOW Total So	0.083 100.041 136.545 0.053 6.529 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 138,311 117,565 0.053 5,621 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 131.515 111.788 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 00.643 00.463 00.053 4,326 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 5.4.971 46.725 0.053 2.234 0.000 0 0 0 0 0 0 0 0 0 0 0 0	NOUE Image: I

	Date Checked	Checked By	Job Number	By	Date	Calc No		
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-002		
Caldwall		ject	Subject					
Caldwell	Encina Biosolids, Energy, and Emissi	ons		2030 Year - Service Condition				

Thermal Hydrolysis with Mesophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	12	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.4	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1	Percent Solids Content of Digester Feed	9%	Assumed	Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	102	Assumed	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production vield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SSO	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dofo

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Sludge			TWAS			Existing HSOW (if applicable)		
Parameter	Parameter Input Values Reference		Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speciation			Nitrogen Speciation			Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

		e A-A: Existing I	hermal Hydrolysis with Mesophilic Digestion	Feed Assessment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	3.90	3.90	3.90	3.90	3.90	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (Ib-TS/d)	60,812	74,799	79,056	85,137	97,299	
TWAS Total Solids Load (lb-TS/d)	37,020	45,534	48,125	51,827	59,231	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (Ib-TS/d)	101,822	124,324	131,172	140,955	160,521	
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650	
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
Total Digester Feed Flow (gpd)	135,655	165,632	174,756	187,790	213,857	
Total Percent Solids Load (%)	9.0%	9.0%	9.0%	9.0%	9.0%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
Base HRT (days)	29	24	22	21	18	
Base OLR (lbsVS/d-cf)	0.16	0.20	0.21	0.23	0.26	
Hydraulic Capacity (HC) (gpd)	188,929	158,951	149,827	136,794	110,726	Assumes the minimum allowable HRT 12 days
HC as Equivalent VS Load (lb-VS/day)	160,718	135,217	127,455	116,368	94,192	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	122,574	103,594	97,817	89,565	73,061	Difference between max OLR (0.4 lbs-VS/cf-d) and current load
Process Limitation						
FIDUESS LIIIIILUUII	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load	
FIGUESS LIIIILAUOII	Organic Load		Organic Load X-X: Mesophilic Co-digestion Feed Assessm		Organic Load	
FIGUESS LIMITATION	Organic Load Annual Average				Organic Load Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)		Table	X-X: Mesophilic Co-digestion Feed Assessm	ent		Notes Calculated available organic load, based on defined limit
	Annual Average	Table Peak Month	X-X: Mesophilic Co-digestion Feed Assessm Peak 14 day	ent Peak 7 day	Peak day	
Total HSOW Volatile Solids Load (lb-VS/day)	Annual Average 122,574	Table Peak Month 103,594	X-X: Mesophilic Co-digestion Feed Assessm Peak 14 day 97,817	ent Peak 7 day 89,565	Peak day 73,061	
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day)	Annual Average 122,574 122,574	Table Peak Month 103,594 103,594	X-X: Mesophilic Co-digestion Feed Assessm Peak 14 day 97,817 97,817	ent Peak 7 day 89,565 89,565	Peak day 73,061 73,061	
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day)	Annual Average 122,574 122,574 0	Table Peak Month 103,594 103,594 0	X-X: Mesophilic Co-digestion Feed Assessm Peak 14 day 97,817 97,817 0	ent Peak 7 day 89,565 89,565 0	Peak day 73,061 73,061 0	
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day)	Annual Average 122,574 122,574 0 122,574	Table Peak Month 103,594 103,594 0 103,594	X-X: Mesophilic Co-digestion Feed Assessm Peak 14 day 97,817 97,817 0 97,817	ent Peak 7 day 89,565 89,565 0 89,565	Peak day 73,061 73,061 0 73,061	Calculated available organic load, based on defined limit
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day)	Annual Average 122,574 122,574 0 122,574 144,205	Table Peak Month 103,594 103,594 0 103,594 103,594 103,594 103,594	X-X: Mesophilic Co-digestion Feed Assessm Peak 14 day 97,817 0,817 0,97,817 0,97,817 115,079	ent Peak 7 day 89,565 89,565 0 89,565 105,371	Peak day 73,061 73,061 0 73,061 85,954	Calculated available organic load, based on defined limit
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Visitile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day)	Annual Average 122,574 122,574 0 122,574 0 122,574 144,205 0	Table Peak Month 103,594 103,594 0 103,594 103,594 0 103,594 0 103,594 0 103,594 0	XX: Mesophilic Qo-digention Feed Assessm Peak 14 day 97,817 0 97,817 0 97,817 115,079 0 0	ent Peak 7 day 89,565 0 89,565 0 89,565 105,371 0	Peak day 73,061 73,061 0 73,061 85,954 0	Calculated available organic load, based on defined limit
Total HSDW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSDW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSDW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day)	Annual Average 122,574 0 122,574 0 122,574 144,205 0 144,205	Table Peak Month 103,594 103,594 0 103,594 103,594 0 103,594 103,594 0 103,594 121,875 0 121,875	XX: Mesophilic Co-digestion Feed Assessm Peak 14 day 07,817 97,817 0 97,817 0 97,817 0 97,817 0 115,079 0 115,079	ent Peak 7 day 89,565 0 89,565 105,371 0 105,371	Peak day 73,061 73,061 0 73,061 85,954 0 85,954	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wt/day) SSO (Ib-wt/day) SSO (Ib-wt/day)	Annual Average 122,574 122,574 0 122,574 144,205 0 144,205 1,201,707	Table Peak Month 103,594 103,594 0 103,594 121,875 0 121,875 1,015,628	XX: Mesophilic Qo-digestion Feed Assessm Peak 14 day 97.817 0 97.817 0 97.817 115.079 0 115.079 958.995	ent Peak 7 day 89,565 0 89,565 105,371 0 105,371 878,091	Peak day 73,061 73,061 0 73,061 85,954 0 85,954 716,283	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO (Ib-wt/day) SSO (Ib-wt/day) SSO (Ib-wt/day) SSO (Ib-wt/day) SSO (Ib-wt/day)	Annual Average 122,574 122,574 0 122,574 144,205 0 144,205 1,201,707 0	Table Peak Month 103,594 103,594 103,594 121,875 0 121,875 121,875 0 1015,628 0	XX: Mesophilic Co-digestion Feed Assessm Peak 14 day 07,817 07,817 0 0 0 115,079 0 0 0 0 0 0 0 0 0 0 0 0 0	ent 89,565 89,565 0 89,565 105,371 0 105,371 105,371 0 0 0 0	Peak day 73,061 0 73,061 85,954 0 85,954 716,283 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day)	Annual Average 122,574 122,574 0 122,574 144,205 0 144,205 1,201,707 0 1,201,707	Table Peak Month 103,594 103,594 121,875 0 121,875 1,015,628 0 1,015,628 0 1,015,628 0	XX: Mesophilic Qodigestion Feed Assessm Peak 14 day 97,817 0 97,817 0 97,817 115,079 0 115,079 988,995 0 988,995	ent 89,565 89,565 0 89,565 105,371 0 105,371 878,091 0 878,091	Peak day 73,061 73,061 0 73,061 85,954 0 85,954 716,283 0 716,283	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SGO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) SGO Total Solids Load (Ib-VS/day) SGO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SGO Total Load (Ib-TS/day) SGO Total Load (Ib-TS/day) SSO (Ib-tay) SSO (Ib-tay) SSO (Ib-tay)	Annual Average 122,574 122,574 0 122,574 144,205 0 144,205 1,201,707 0 1,201,707 601	Table Peak Month 103,594 103,594 121,875 1,015,628 0 1,015,628 0 1,015,628 508	XX: Mesophilic Co-digestion Feed Assessm Peak 14 day 97,817 97,817 97,817 97,817 115,079 0 115,079 958,995 0 958,995 479	ent Peak 7 day 89,565 89,565 0 89,565 105,371 0 105,371 878,091 0 878,091 439	Peak day 73,061 73,061 0 73,061 0 73,061 85,954 0 85,954 716,283 0 716,283 358	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Volat Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO Ib-wet/day) SSO Ib-wet/day) SSO Ib-wet/day	Annual Average 122,574 122,574 122,574 122,574 144,205 0 144,205 1,201,707 0 1,201,707 601 0	Table Peak Month 103,594 103,594 121,875 0 121,875 1,015,628 0 1,015,628 0 1,015,628 0	XX: Mesophilic QC-digestion Feed Assessm Peak 14 day 97,817 0 97,817 0 97,817 115,079 0 115,079 958,995 0 958,995 479 0 0 0	ent Peak 7 day 89,565 0 89,565 105,371 0 105,371 878,091 0 878,091 439 0 0	Peak day 73,061 73,061 0 73,061 85,954 0 85,954 0 716,283 0 716,283 358 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS
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Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2V Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Load (Ib-TS/day) SSO Id-solids (Id-TS) SSO Id-Solids (Id-TS) SSO Id-Solids (Id-TS) SSO Id-Solids (Id-TS) SSO Id-TS) SSO Id-TS)	Annual Average 122,574 122,574 122,574 122,574 122,574 144,205 0 144,205 1,201,707 0 1,201,707 601 0 601 192,119	Table Peak Month 103,594 0 103,594 103,594 103,594 103,594 103,594 103,594 103,594 103,594 121,875 0 121,875 0 1,015,628 00 508 162,371	XX: Mesophilic QC-digestion Feed Assessm Peak 14 day 87,817 97,817 0 97,817 115,079 0 958,995 0 958,995 0 958,995 479 0 479 135,317	ent Peak 7 day 89,565 89,565 0 89,565 105,371 0 105,371 105,371 105,371 0 105,371 105,375	Peak day 73,061 73,061 0 73,061 85,954 0 88,954 716,283 0 716,283 358 0 716,283 358 114,514	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS Conversion to Wet Solids load based on SSO %TS Assume 9% TS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Volat Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Load (Ib-TS/day) SSO Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) SSO Ib-wet/day HSOW No. 2 (wpd) SSO Ib-wet/day) SSO Ib-wet/day HSOW No. 2 (wpd) SSO (mpd) HSOW No. 2 (wpd) SSO (mpd) HSOW No. 2 (wpd) SSO (mpd) HSOW No. 2 (mpd) SSO (mpd) HSOW No. 2 (mpd)	Annual Average 122,574 122,574 0 122,574 0 122,574 0 144,205 1,44,205 1,201,707 0 144,205 1,201,707 0 1,201,707 0 1,201,707 0 1,201,707 0 1,201,707 0 1,201,707 0 1,201,707 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 103,594 0 103,594 0 103,594 0 103,594 0 103,594 0 103,594 0 1015,628 0 1,015,628 0 508 0 508 0 508 0 508 0	XX: Mesophilic Qo-digestion Feed Assessm Peak 14 day 97.817 97.817 97.817 115.079 0 155.095 0 958.995 479 0 479 153.317 0	ent Peak 7 day 89,565 0 89,565 0 89,665 105,371 0 105,371 878,091 0 878,091 439 0 10,382 0 0	Peak day 73,061 73,061 0 73,061 85,954 0 716,283 0 716,283 358 0 716,283 358 0 358 114,514 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS Conversion to Wet Solids load based on SSO %TS Assume 9% TS Assume 9% TS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2V Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Load (Ib-TS/day) SSO Total Load (Ib-TS/day) SSO Ibert/day) SSO (Introd) SSO (Introd)<	Annual Average 122,574 122,574 122,574 122,574 122,574 122,574 122,574 122,574 122,574 122,574 122,574 0 122,574 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 0 122,574 122,574 0 122,574 0 122,574 122,574 122,574 122,574 0 122,574 122,574 0 122,574 0 122,574 0 122,574 122,574 0 122,574 122,574 0 122,574 0 122,574 0 122,574 122,574 122,574 0 122,574 122,574 0 122,574 0 122,574 122,574 122,574 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 103,594 104,595 104,5	XX: Mesophilic QC digestion Feed Assessm Peak 14 day 87,817 97,817 0 97,817 115,079 0 958,995 0 958,995 479 0 479 133,317 0 153,317	ent Peak 7 day 88,565 0 0 89,565 105,371 0 0 105,371 0	Peak day 73,061 73,061 0 73,061 85,954 0 73,061 85,954 0 716,283 358 0 716,283 358 0 114,514 0 114,514	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS Conversion to Wet Solids load based on SSO %TS Conversion to Wet Solids load based on SSO %TS Assume 9% TS Assume 9% TS
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wet/day)	Annual Average 122,574 122,574 0 122,574 122,574 144,205 0 144,205 1.201,707 0 144,205 1.201,707 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 103,594 103,594 103,594 121,875 0 121,875 1,015,628 0 508 508 162,371 121,778	XX: Mesophilic QC-digestion Feed Assessm Peak 14 day 97,817 97,817 0 97,817 0 97,817 115,079 958,995 0 958,995 0 958,995 479 153,317 14,987 114,987	ent Peak 7 day 89,565 0 89,565 0 89,565 105,371 0 105,371 878,091 439 0 439 140,382 0 140,382 105,287	Peak day 73,061 73,061 0 73,061 85,954 0 85,954 716,283 0 716,283 0 716,283 0 716,283 0 716,283 0 358 0 358 0 114,514 85,885	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS Conversion to Wet Solids load based on SSO %TS Conversion to Wet Solids load based on SSO %TS Assume 9% TS Assume 9% TS Assume 9% TS Assume 9% TS

Total Solids, Volatile Solids Load (Ib-VS/d)	208,289	208,289	208,289	208,289	208,289	
Total Flow (gpd) Primary sludge percent of VS Load (%)	327,774	328,003	328,072	328,172	328,371	
WAS percent of VS Load (%)	14%	17%	18%	20%	23%	
FOG percent of VS Load (%)	2%	2%	2%	2%	2%	
SSO percent of VS Load (%)	59%	50%	47%	43%	35%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	12	12 0.40	12	12	12	
Co-Digestion OLR (lbs-VS/d-cf) Process Check	0.40 OK	0.40 OK	0.40 OK	0.40 OK	0.40 OK	
	011		: Existing Mesophilic Solids and Biogas Proc	uction	0.0	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (lb-VSd/day) Total Volatile Solids Destroyed (lb-VSd/day)	2,873 51,182	2,873 62,293	2,873 65,674	2,873 70,505	2,873 80,167	
Total Sludge Effluent (gpd)	135,655	165,632	174,756	187,790	213,857	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50,640	62,031	65,497	70,450	80,354	
Volatile Solids Effluent (Lbs-VS/d)	34,533	42,402	44,797	48,218	55,061	
Total Solids (% TS)	4.5%	4.5%	4.5%	4.5%	4.5%	
Volatile Solids (% VS)	68% 48,108	68% 58,929	68%	68% 66,927	69% 76,337	Demoteration of a state of the second state of
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	48,108	134	141	152	173	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
			Mesophilic Co-digestion Solids and Biogas Pi		Dook dow	Notac
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	Annual Average 34,389	Peak Month 42,299	Peak 14 day 44,706	Peak 7 day 48,145	Peak day 55,023	Notes
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	42,235	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	110,317	93,235	88,036	80,609	65,755	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day) Total Sludge Effluent (gpd)	161,499 327,774	155,527 328,003	153,710 328,072	151,114 328,172	145,922 328,371	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	84,529	90,671	92,541	95,212	100,553	
Volatile Solids (Lbs-VS/d)	46,790	52,761	54,579	57,175	62,367	
Total Solids (% TS)	3.1%	3.3%	3.4%	3.5%	3.7%	
Volatile Solids (% VS)	55%	58%	59%	60%	62%	
Dewatered Solids (Lbs-TS/d)	80,302	86,138	87,914	90,451	95,526	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd) Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	183 612.128	196 752,917	200 795.766	206 856.979	217 979,404	Assumes biosolids cake has a solids content of 22% TS Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	1,985,700	1,678,223	1.584.643	1.450.957	1 183 585	Assumes a biogas yield of 18 scf/lb-VSd
				1,450,557	1,100,000	
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)	0 2,896,737	0 2,787,035 Tabl	0 2,753,648	0 2,705,951	0 2,610,558	
Total Biogas Production (scfd)	2,896,737		0	0 2,705,951 es		
		Tabl	0 2,753,648 e X-X: Nutrient Loading - Ammonia-N Estimat	0 2,705,951	0 2,610,558 Peak day 0.063	Notes
Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	2,896,737 Annual Average 0.063 144,205	Tabl Peak Month 0.063 121,875	0 2,753,648 2 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 115,079	0 2,705,951 es Peak 7 day 0.063 105,371	Peak day 0.063 85,954	
Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Voiatlis Golds Load (Ib-VS/d)	2,896,737 Annual Average 0.063 144,205 122,574	Tabl Peak Month 0.063 121,875 103,594	0 2,753,648 2 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 115,079 97,817	0 2,705,951 es Peak 7 day 0.063 105,371 89,565	Peak day 0.063 85,954 73,061	
Total Biogas Production (scfd) HSDW No. 1 SSO Organic Nitrogen: Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS)	2.896,737 Annual Average 0.063 1.44,205 1.22,574 0.053	Table Peak Month 0.063 121,875 103,594 0.053	0 2,753,648 2,753,648 2,753,648 9 2,753,648 9 2,753,754 9 2,753 9 7,817 0,053	0 2,705,951 es Peak 7 day 0.063 105,371 89,565 0.053	Peak day 0.063 85,954 73,061 0.053	
Total Biogas Production (scfd) HSOW No.1 SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solid Load (Ib-TS/d) SSD Total Solid Load (Ib-TS/d) SSD Voltalie Solids Load (Ib-TS/d) SSD Voltalies Content (Ib-N/day)	2,896,737 Annual Average 0.063 144,205 122,574	Tabl Peak Month 0.063 121,875 103,594	0 2,753,648 2 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 115,079 97,817	0 2,705,951 es Peak 7 day 0.063 105,371 89,565	Peak day 0.063 85,954 73,061	
Total Biogas Production (scfd) HSDW No. 1 SSO Organization (Ib-Nz/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS)	2.896,737 Annual Average 0.063 1.44,205 1.22,574 0.053	Table Peak Month 0.063 121,875 103,594 0.053	0 2,753,648 2,753,648 2,753,648 9 2,753,648 9 2,753,754 9 2,753 9 7,817 0,053	0 2,705,951 es Peak 7 day 0.063 105,371 89,565 0.053	Peak day 0.063 85,954 73,061 0.053	
Total Biogas Production (scfd) KBOW No 1 SSO Optain SUltogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Integin Content (Ib-N/Ib-TS) SSO Attegin Content (Ib-N/Ib-TS) SSO Attegin Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS)	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0	Table Peak Month 0.063 121,875 103,594 0.053 4,953 	0 2,753,648 2,753,648 2,753,648 Peak 14 day 0.063 115,079 97,817 0.053 4,677 0.000 0	0 2,705,951 es Peak 7 day 0.063 105,371 89,565 0.053 4,282 0.000 0	Peak day 0.063 85,954 73,061 0.053 3,493 0.000 0	
Total Biogas Production (scld) HSOW No 1 SSO Ofganic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solid Is Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 Total Solids Load (Ib-TS/d)	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0	Tabl Peak Month 0.063 121,875 103,594 0.053 4,953 0.000 0 0 0	0 2,753,648 2,753,648 9,302 Nutrient Loading 4 Annonia-N Estimeti Peak 14 day 0,063 97,817 0,053 4,677 0,000 0 0 0	0 2,705,951 es Peak 7 day 0.063 105,371 89,565 0.053 4,282 0.000 0 0 0 0	Peak day 0.063 85,954 73,061 0.053 3,493 0.000 0 0	
Total Biogas Production (scfd) HSOW No 1 SSO Orpains (Ntrogen Content (Ib-N/Ib-TS)) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Norpains (Ib-N/Ib-SQ) SSO Attraction Content (Ib-N/Ib-SQ) SSO Attraction Content (Ib-N/Ib-SQ) SSO Attraction Content (Ib-N/Ib-SQ) SSO Attraction Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Violatile Solids Load (Ib-TS/d) HSOW No. 2 Violatile Solids Load (Ib-TS/d) HSOW No. 2 Violatile Solids Load (Ib-TS/d) HSOW No.2 Violatile Solids Load (Ib-TS/d) HSOW No.2 Violatile Solids Load (Ib-TS/d)	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 121,875 103,594 0.053 4,953 0 0 0 0 0.000	0 2,753.648 2,753.648 2,753.648 2,753.648 0.063 115.079 97.817 0.053 4,677 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 es Peak 7 day 0.063 105,371 89,565 0.053 4,282 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85,954 73,061 0.053 3,493 0.000 0 0 0 0 0 0 0 0	
Total Biogas Production (scld) HSOW No.1 SSO Orbati Solid Load (Ib 15/d) SSO Total Solid Load (Ib 15/d) SSO Vibugas Content (Ib -N/b -S) SSO Nibugas Content (Ib -N/b VS) SSOW No.2 Orbatic Silod Load (Ib 15/d) HSOW No.2 Violatie Solids Load (Ib -VS/d) HSOW No.2 Violatie Solids Load (Ib -VS/d) HSOW No.2 Notatie Solids Load (Ib -VS/d)	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0	Tabl Peak Month 0.063 121,875 103,594 0.053 4,953 0.000 0 0 0	0 2,753,648 2,753,648 9,302 Nutrient Loading 4 Annonia-N Estimeti Peak 14 day 0,063 97,817 0,053 4,677 0,000 0 0 0	0 2,705,951 es Peak 7 day 0.063 105,371 89,565 0.053 4,282 0.000 0 0 0 0	Peak day 0.063 85,954 73,061 0.053 3,493 0.000 0 0	
Total Biogas Production (scfd) HSOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Vitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Valids Load (Ib-YS/d) HSOW No.2 Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Nitrogen Content (Ib-N/I	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 121,875 103,594 0.053 4,953 0 0 0 0 0.000	0 2,753.648 2,753.648 2,753.648 2,753.648 0.063 115.079 97.817 0.053 4,677 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 es Peak 7 day 0.063 105,371 89,565 0.053 4,282 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85,954 73,061 0.053 3,493 0.000 0 0 0 0 0 0 0 0	
Total Biogas Production (scld) HSOW No 1 SS0 Ofganic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solid Load (Ib-TS/d) SS0 Vitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 SSO No 2. Total Solids Load (Ib-TS/d) HSOW No 2. Notagen Content (Ib-N/Ib-YS) HSOW No 2. Nature Solids Load (Ib-TS/d) HSOW No 2. Nature Solids Load (Ib-TS/d) HSOW No 2. Nature Solids Load (Ib-TS/d) HSOW No 2. Nature Solids Load (Ib-N/day) Eventar Primary Sludge Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS)	2,896,737 Annual Average 0.063 144,205 122,574 0.053 5,861 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 121,875 103,594 0.053 4,953 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000	0 2.753.648 2.753.648 2.X.X.Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 115.079 9.7.817 0.053 4.577 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 c3 Peak 7 day 0.063 106,371 89,565 0.053 4,282 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85,954 73,061 0.053 3,493 	
Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-A/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Valatile Solids Load (Ib-YS/d) SSO Annonium-N Load (Ib-N/b-TS) HSOW No 2 HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Nitrogen Content (Ib-N/Ib-TS) HTmary Sludge Total Solids Load (Ib-N/G)	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 121,875 103,594 0.053 4,953 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,753,648 2 X X: Nutrient Loading - Armonia-N Estimat Peak 14 day 0.063 115,079 97,817 0.053 4,677 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 c3 Peak 7 day 0.063 105,371 89,565 0.053 4,282 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85.954 73.061 0.053 3.493 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
Total Biogas Production (scfd) HSOW No. 1 SSD Organic Nitrogen Content (U-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSD Variage Content (U-N/Ib-TS) SSD Nitrogen Content (U-N/Ib-VS) SSD Nitrogen Content (U-N/Ib-VS) SSD Nitrogen Content (U-N/Ib-TS) HSOW No. 2 HSOW No. 2 SSD And (U-S) SSO And (U-S) HSOW No. 2	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 121,875 103,594 0.053 4,953 0.065 74,799 65,075	0 2,753.648 2,XX: Nutrient Loading < Ammonia-N Estimat Peak 14 Gay 0.063 115.079 9.7.817 0.083 4,677 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 3 Peak 7 day 0.063 106,371 89,565 0.053 4,282 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85,954 73,061 0.053 3,493 	
Total Biogas Production (scld) HSOW No 1 SS0 Ofganic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solid Load (Ib-TS/d) SS0 Vitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 SSO No 2. Total Solids Load (Ib-TS/d) HSOW No 2. Notagen Content (Ib-N/Ib-YS) HSOW No 2. Nature Solids Load (Ib-TS/d) HSOW No 2. Nature Solids Load (Ib-TS/d) HSOW No 2. Nature Solids Load (Ib-TS/d) HSOW No 2. Nature Solids Load (Ib-N/day) Eventar Primary Sludge Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS)	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 121,875 103,594 0.053 4,953 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,753,648 2 X X: Nutrient Loading - Armonia-N Estimat Peak 14 day 0.063 115,079 97,817 0.053 4,677 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 c3 Peak 7 day 0.063 105,371 89,565 0.053 4,282 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85,954 73,061 0.053 3,493 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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Total Biogas Production (scld) HSDW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Variance Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nota Solids Load (Ib-VS/d) HSDW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSDW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSDW No. 2 Valite Solids Load (Ib-YS/d) HSDW No. 2 Anononium- N Load (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Primary Sludge Total Solids Load (Ib-TS/d) PMAS Total Solids Load (Ib-TS/d) TMSS TMAS Solida Load (Ib-TS/d) TMAS Solida Load (Ib-TS/d) TMAS Solida Load (Ib-TS/d) TMAS Solida Load (Ib-TS/d) Titogen Content (Ib-N/Ib-TS) Titogen Content (Ib-N/Ib-TS) Total Solida Load (Ib-TS/d) Titogen Content (Ib-N/Ib-TS)	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Table 1 0.063 1 21.875 1 21.875 1 0.053 4 953 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 2,407 2,407 45,534 36,427 0.065 896 0.010 0.010	0 2,753,648 2,52,54,845 Peak 14 day 0,063 115,079 97,817 0,053 4,677 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 3 Peak 7 day 0,063 1100,371 89,565 0,053 4,282 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0.063 0.065 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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Tetal Biogas Production (schd) HSOW No 1 SSO Organic Nitrogén Content (Ib-N/Ib-TS) SSO Organic Nitrogén Content (Ib-N/Ib-TS) SSO Voituige Content (Ib-N/Ib-YG) SSO Nitrogén Content (Ib-N/Ib-YG) SSO Annonium-N Load (Ib-N/Ib-YG) HSOW No 2. Organic Nitrogén Content (Ib-N/Ib-TS) HSOW No 2. Voital Solids Load (Ib-TS/d) HSOW No 2. Voital Solids Load (Ib-TS/d) HSOW No 2. Annonium-N Load (Ib-N/Ib-TS) HSOM No 2. Annonium-N Load (Ib-N/Ib-TS) HTMAS Studia Potal Solids Load (Ib-TS/d) HTMAS Studia Potal Solids Load (Ib-TS/d) HTMAS Total Solids Load (Ib-TS/d) HXAS Total Solids Load (Ib-TS/d) HXAS Total Solids Load (Ib-TS/d) HXAS Total Solids Load (Ib-TS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOM Notal E-Solids Load (Ib-TS/d) HXAS Total Solids Load (Ib-TS/d) HXAS Total Nitrogen Content (Ib-N/Ib-TS) HX	2,896,737 Annual Average 0,063 144,205 122,974 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Table 121,875 121,875 103,594 0.063 0 0 0	0 2,753,648 2,XX: Nutrient Loading - Ammonia-N Estimat Peak 14 Gay 0.063 115,079 9,7,817 0.083 4,677 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 2,705,951 3 Peak 7 day 0,063 106,371 89,565 0,053 4,282 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85.954 73.061 73.061 73.063 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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Total Biogas Production (scfd) HSOW No. 1 SSO Organic Nitrogen Content (Un-V/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-V/Ib-VS) SSO Nitrogen Content (Ib-V/Ib-VS) SSO Notes (Solids Load (Ib-VS/d) HSOW No. 2. Organic Nitrogen Content (Ib-V/Ib-TS) HSOW No. 2. Vanite Solids Load (Ib-VS/d) HYMAS Solids Total Solids Load (Ib-VS/d) Nitrogen Content (Ib-V/Ib-VS) Ammonium-N Load (Ib-V/day) TMAS TMAS TMAS Total Solids Load (Ib-VS/d) Nitrogen Content (Ib-V/Ib-VS) Ammonium-N Load (Ib-V/day) TMAS TMAS Total Solids Load (Ib-VS/d) Nitrogen Content (Ib-V/Ib-VS) Ammonium-N Load (Ib-V/day) TMAS TMAS Total Solids Load (Ib-VS/d) Nitrogen Content (Ib-V/Ib-VS) Ammonium-N Load (Ib-V/day) <	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabb 1 Tabb 0 0063 121.875 0.053 0 0.063 0 0.000 0 0 0 0 0 0.000 0 0 0 0 0 0 0 0.057 2,407 0.065 45,534 36,427 0.052 896 0 0.010 3,991 3.991 39 39	0 2,753,648 2,X2, Nutrient Loading < Ammonia-N Estimat Peak 14 day 0,063 115,079 9,7,817 0,065 4,677 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,005,951 3 Peak 7 day 0,063 106,371 89,565 0,053 4,282 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85.984 73.061 73.061 73.061 0.053 3.433 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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Total Biogas Production (scfd) HSOW No 1 SSO Organis (Biogan Content (Ib-A/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-YS/d) SSO Intragen Content (Ib-A/Ib-YS) SSO Norgan Content (Ib-A/Ib-YS) SSO Norgan Content (Ib-A/Ib-YS) SSO Norgan Content (Ib-A/Ib-YS) HSOW No 2 HSOW No 2. Organic Nitrogen Content (Ib-A/Ib-YS) HSOW No 2. Validite Solids Load (Ib-YS/d) HSOW No 2. Validite Solids Load (Ib-YS/d) HSOW No 2. Validite Solids Load (Ib-YS/d) HSOW No 2. Validite Solids Load (Ib-YG/s) HSOW No 2. Validite Solids Load (Ib-YS/d) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) HSOW No 2. Anomonium-N Load (Ib-N/A/GN) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) TMAS Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-YS) Ammonium-N Load (Ib-N/d) Nitrogen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-N/d) Nitrogen Content (Ib-N/Ib-TS) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-N/d) Nitrogen Content (Ib-N/Ib-TS) HSOW Total Nitrogen Content (Ib-N/Ib-TS)	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabb 1 Tabb 0 0063 121.875 0.053 0 0.063 0 0.000 0 0 0 0 0 0.000 0 0 0 0 0 0 0 0.057 2,407 0.065 45,534 36,427 0.052 896 0 0.010 3,991 3.991 39 39	0 2,753,648 2,XX,Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 115,079 97,817 0.053 4,877 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 2,705,951 3 Peak 7 day 0,063 105,371 89,565 0,053 4,282 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85.984 73.061 73.061 73.061 0.053 3.433 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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Total Biogas Production (scfd) HSW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Vitrage Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Notes (Ib-TS/d) SSO And Solids Load (Ib-YS/d) SSO Notes (Ib-TS/d) SSO Notes (Ib-TS/d) HSW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSW No. 2 Vitalite Solids Load (Ib-YS/d) HSW No. 2 Vitalite Solids Load (Ib-YS/d) HSW No. 2 Animonium N Load (Ib-N/Ib-TS) Primary Sudge Total Solids Load (Ib-TS/d) Primary Sudge Total Solids Load (Ib-TS/d) Primary Sudge Total Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) TMAS Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) TMAS Solids Load (Ib-TS/d) TMAS Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) Bistow Total	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Table 1 Peak Month 0.063 121.875 121.875 103.594 0.053 4,953 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 74,799 2,407 2,407 0.065 896 0.0065 36,427 0.052 896 0.010 3,991 3,991 3,93 7 9,45 8,279 0,33 0.33 3,027	0 2.753.648 2.X2.Nutrient Loading 4 Ammonia-N Estimat Peak 14 day 0.063 115.079 9.7.817 0.053 4.677 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 3 Peak 7 day 0,063 105,371 89,565 0,053 4,282 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85.954 0.063 0.060 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
Total Biogas Production (scfd) HSW No 1 SSO Drains (Ntrogen Content (Ib N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Antern (Ib N/Ib-YS) SSO Antern (Ib N/Ib-YS) SSO Antern (Ib N/Ib-YS) HSW No. 2 Organic Ntrogen Content (Ib-N/Ib-TS) HSW No. 2 Organic Ntrogen Content (Ib-N/Ib-TS) HSW No. 2 Organic Ntrogen Content (Ib-N/Ib-TS) HSW No. 2 Anternonium-N Load (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/	2,896,737 Annual Average 0.063 144,205 142,574 0.053 5,861 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Table 0.063 121.675 103.594 0.063 0.063 0.000 0 0 0.000 0.000 0.000 0.000 0.000 0.005 74.799 2.607 0.055 2.47 0.065 36.427 0.001 3.93 0.010 3.91 0.010 3.93 9.45 8.279 3.307 0.327	0 2,753,648 2,XX, Nutrient Loading < Ammonia-N Estimat Peak 14 fay 0.063 115,079 9,7,817 0.083 4,677 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,005,951 2,005,951 3 Peak 7 day 0,063 106,371 89,565 0,053 4,282 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 85.954 73.061 73.061 73.061 0.053 3.483 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
Total Biogas Production (scfd) HSW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Vitrage Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Notes (Ib-TS/d) SSO And Solids Load (Ib-YS/d) SSO Notes (Ib-TS/d) SSO Notes (Ib-TS/d) HSW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSW No. 2 Vitalite Solids Load (Ib-YS/d) HSW No. 2 Vitalite Solids Load (Ib-YS/d) HSW No. 2 Animonium N Load (Ib-N/Ib-TS) Primary Sudge Total Solids Load (Ib-TS/d) Primary Sudge Total Solids Load (Ib-TS/d) Primary Sudge Total Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) TMAS Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) TMAS Solids Load (Ib-TS/d) TMAS Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) TMAS Total Solids Load (Ib-TS/d) Bistow Total	2,896,737 Annual Average 0,063 144,205 122,574 0,053 5,861 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Table 1 Peak Month 0 0063 1 21.875 1 21.875 1 0.053 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.057 2,407 0.055 45,5534 36,427 0.052 896 0.010 3,991 3,991 3,9391 3,991 3,931 0.23 3,945 8,279 0.33 0.23 3,027 -3,07 12,05	0 2,753,648 2, X2, Nutrient Loading 4, Mamonia-N Estimat Peak 14 day 0,063 115,079 97,817 0,053 4,677 0,000 0 0 0 0 0 0 0 0 0 0 0 0	0 2,705,951 3 Peak 7 day 0,063 1106,371 89,545 0,053 0,053 4,282 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.061 285 954 73.061 0.053 3.483 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 97.299 84.690 0.0057 3,131 0.005 9.7235 0.052 1,165 0.010 3.991 3.991 3.931 0.008 245 7 9.45 7.781 0.33 2.45 3.020 3.020 3.020	
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Brown AND Caldwell

Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-003
	Pro	ject			Subject
Encina Biosolids, Energy, and Emiss	ons		Current Year - All Diges	sters in Service	

Mesophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.18	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	97	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dofo

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Slud	ge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speci	ation		Nitrogen Spec	ciation		Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

		Table X-	X: Existing Mesophilic Digestion Feed Asses	sment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	5.84	5.84	5.84	5.84	5.84	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process
						inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (Ib-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (lb-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	28	23	22	20	18	
Base OLR (lbsVS/d-cf)	0.09	0.11	0.11	0.12	0.14	
Hydraulic Capacity (HC) (gpd)	180,403	134,312	120,284	100,244	60,165	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (lb-VS/day)	153,465	114,256	102,323	85,276	51,181	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	73,218	58,456	53,963	47,544	34,707	Difference between max OLR (0.18 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load	
			X-X: Mesophilic Co-digestion Feed Assessm		1	<u>.</u>
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	73,218	58,456	53,963	47,544	34,707	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/day)	73,218	58,456	53,963	47,544	34,707	
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	73,218	58,456	53,963	47,544	34,707	
SSO Total Solids Load (Ib-TS/day)	86,139	68,771	63,486	55,935	40,832	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	86,139	68,771	63,486	55,935	40,832	
SSO (lb-wet/day)	717,824	573,095	529,047	466,121	340,269	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	717,824	573,095	529,047	466,121	340,269	
SS0 (wtpd)	359	287	265	233	170	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	359	287	265	233	170	
SSO (gpd)	86,070	68,716	63,435	55,890	40,800	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	86,070	68,716	63,435	55,890	40,800	
Total Solids, Total Solids Load (lb-TS/d)	166,159	166.279	166,315	166,367	166,471	
Total Solids, Volatile Solids Load (Ib-VS/d)	140,595	140,595	140,595	140,595	140,595	
Total Solids, Volatile Solids Load (Ib-VS/d) Total Flow (gpd) Primary sludge percent of VS Load (%)			140,595 332,651 39%	140,595 345,146 42%	140,595 370,135 48%	

WAS percent of VS Load (%)	16%	20%	21%	22%	26%	
FOG percent of VS Load (%)	2%	2%	2%	2%	2%	
SSO percent of VS Load (%)	52%	42%	38%	34%	25%	
HSOW No. 2 percent of VS Load (%) Check	0% ok	0%	0%	0%	0%	
Co-digestion HRT (days)	20	ok 18	ok 18	ok 17	ok 16	
Co-Digestion OLR (lbs-VS/d-cf)	0.18	0.18	0.18	0.18	0.18	
Process Check	OK	OK	OK	OK	OK	
	• •	Table X-2	K: Existing Mesophilic Solids and Biogas Prod	Juction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (lb-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	209,097	255,188	269,216	289,256	329,335	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	39,463	48,282	50,966	54,801	62,470	
Volatile Solids Effluent (Lbs-VS/d)	26,819	32,914	34,769	37,419	42,719	
Total Solids (% TS) Volatile Solids (% VS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Dewatered Solids (% VS)	37.489	45 868	48 418	52.061	59.346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	483.237	594.382	628.208	676.532	773.179	Assumes biosonas cane has a solida comen of 22% 15 Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	187,548	230,684	243.813	262,568	300.077	Assumes a biogas vield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	721,930	876,211	923,166	990,244	1,124,401	
			Mesophilic Co-digestion Solids and Biogas P			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	65,896	52,610	48,566	42,790	31,237	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day) Total Volatile Solids Destroyed (Ib-VSd/day)	0 106,454	101,835	100,430	98,422	0 94,405	
Total Volatile Solids Destroyed (Ib-VSd/day) Total Sludge Effluent (gpd)	295 167	323 905	332 651	98,422 345 146	370,135	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	59.705	64.443	65.885	67.945	72.065	sounds out round in equals round out
Volatile Solids (Lbs-VS/d)	34,141	38,759	40,165	42,173	46,190	
Total Solids (% TS)	2.4%	2.4%	2.4%	2.4%	2.3%	
Volatile Solids (% VS)	57%	60%	61%	62%	64%	
Dewatered Solids (Lbs-TS/d)	56,720	61,221	62,591	64,548	68,462	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	129	139	142	147	156	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd)	1,186,132	946,982	874,197	770,218	562,261	Assumes a biogas yield of 18 scf/lb-VSd
Total Biogas Production (scfd)	1,908,063	1.823.193	1,797,363	1,760,462	1,686,662	
		Tahl	e X-X ¹ Nutrient Loading - Ammonia-N Estimat	95		
HSOW No 1		Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat	es		Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063	Tabl Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)		Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat	es	Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	Annual Average 0.063 86,139 73,218	Peak Month 0.063 68,771 58,456	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 63,486 53,963	es Peak 7 day 0.063 55,935 47,544	Peak day 0.063 40,832 34,707	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	Annual Average 0.063	Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es	Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	Annual Average 0.063 86,139 73,218	Peak Month 0.063 68,771 58,456	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 63,486 53,963	es Peak 7 day 0.063 55,935 47,544	Peak day 0.063 40,832 34,707	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Viotalle Solids Load (Ib-V5/d) SS0 Viotalle Solids Load (Ib-V5/d) SS0 Nitrogen Content (Ib-N/Ib-V5) SS0 Ammonium-N Load (Ib-N/day) HSOW No 2	Annual Average 0.063 86,139 73,218 0.053 3,501	Peak Month 0.063 68,771 58,456 0.053 2,795	e X-X: Nutrient Loading- Ammonia-N Estimat Peak 14 day 0.063 63.486 63.486 63.983 0.053 2.650	es Peak 7 day 0.063 55,935 47,544 0.053 2,273	Peak day 0.063 40,832 34,707 0.053 1,659	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SSO Total Solids and (lb-TS/d) SSO Valatil Solids and (lb-TS/d) SSO Nitrogen Content (lb-N/b-VS) SSO Ammonium- Lad (lb-N/ds/) HSOV No.2 ISSO Na.2 (lb-N/lb-TS)	Annual Average 0.063 86,139 73,218	Peak Month 0.063 68,771 58,456	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 63,486 53,963	es Peak 7 day 0.063 55,935 47,544	Peak day 0.063 40,832 34,707	Notes
SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSD Violatile Solids Load (Ib-YS/d) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Ammonium-M Load (Ib-N/day) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Slits Load (Ib-TS/d)	Annual Average 0.063 86.139 73.218 0.053 3,501 0.000 0	Peak Month 0.063 68,771 58,456 0.053 2,795 0.000 0	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 63.486 63.983 0.053 2.580 0.000 0	es Peak 7 day 0.063 55,935 47,544 0.053 2,273 0.000 0	Peak day 0.063 40,832 34,707 0.053 1,659 0.000 0	Notes
SSD Organic Nitrogen Content (b-N/b-TS) SSD Ordari Solid Scald (b-TS/d) SSD Viatilitie Solidi Scald (b-TS/d) SSD Nitrogen Content (b-N/b VS) SSD Nitrogen Content (b-N/b VS) SSD Nitrogen Content (b-N/b VS) SSD Nitrogen Content (b-N/b-TS) ISOW No.2 Corganic Nitrogen Content (b-N/b-TS) ISOW No.2 Total Solidis Load (b-TS/d) ISOW No.2 Total Solidis Load (b-TS/d) ISOW No.2 Total Solidis Load (b-TS/d)	Annual Average 0.063 86,139 73,218 0.053 3,501	Peak Month 0.063 68,771 58,456 0.053 2,795	e X-X: Nutrient Loading- Ammonia-N Estimat Peak 14 day 0.063 63.486 63.486 63.983 0.053 2.650	es Peak 7 day 0.063 55,935 47,544 0.053 2,273	Peak day 0.063 40,832 34,707 0.053 1,659	Notes
SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Oradi Solids (and (Ib-TS/d) SSD Violatile Solids Load (Ib-TS/d) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Amonium-NL Add (Ib-V/day) HSOW No.2 HSOW No.2 <td>Annual Average 0.063 86.139 73.218 0.053 3,501 0.000 0</td> <td>Peak Month 0.063 68,771 58,456 0.053 2,795 0.000 0</td> <td>e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 63.486 63.983 0.053 2.580 0.000 0</td> <td>es Peak 7 day 0.063 55,935 47,544 0.053 2,273 0.000 0</td> <td>Peak day 0.063 40,832 34,707 0.053 1,659 0.000 0</td> <td>Notes</td>	Annual Average 0.063 86.139 73.218 0.053 3,501 0.000 0	Peak Month 0.063 68,771 58,456 0.053 2,795 0.000 0	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 63.486 63.983 0.053 2.580 0.000 0	es Peak 7 day 0.063 55,935 47,544 0.053 2,273 0.000 0	Peak day 0.063 40,832 34,707 0.053 1,659 0.000 0	Notes
SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Oradi Solids (and (Ib-TS/d) SSD Violatile Solids Load (Ib-TS/d) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Amonium-NL Add (Ib-V/day) HSOW No.2 HSOW No.2 <td>Annual Average 0.063 86,139 73,218 0.053 3,501 0.000 0 0 0.000</td> <td>Peak Month 0.063 68,771 58,456 0.053 2,795 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0.3.486 0.3.983 0.053 2.580 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>es Peak 7 day 0.063 55,935 47,544 0.053 2,273 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak day 0.063 40,832 34,707 0.053 1,659 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Notes</td>	Annual Average 0.063 86,139 73,218 0.053 3,501 0.000 0 0 0.000	Peak Month 0.063 68,771 58,456 0.053 2,795 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 0.3.486 0.3.983 0.053 2.580 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 55,935 47,544 0.053 2,273 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 40,832 34,707 0.053 1,659 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Visitile Solids Load (b-TS/d) SS0 Visitile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Ammonium-NL Load (b-N/day) HSOW No.2 Organic Nitrogen Content (b-N/Ib-TS) HSOW No.2 Organic Altrogen Content (b-N/b-TS) HSOW No.2 Charlo Solids Load (b-TS/d) HSOW No.2 Animonium-N Load (b-N/day) Edding Phang Sludge Total Nitrogen Content (b-N/b-TS)	Annual Average 0.063 86,139 73,218 0.053 3,501 0.000 0 0 0.000	Peak Month 0.063 68,771 58,456 0.053 2,795 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 03.466 03.466 0.33.963 0.053 2.580 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 55,935 47,544 0.053 2,273 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 40,832 34,707 0.053 1,659 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/b-TS). SS0 Total Solids and (b-TS/d). SS0 Vitrogin Content (b-N/b-VS). SS0 Nitrogin Content (b-N/b-VS). MSOW No. 2 Organic Nitrogen Content (b-N/b-TS). MSOW No. 2 Notatin Solids Load (b-VS/d). Minary Sludge Total Solids Load (b-VS/d). Primary Sludge Total Solids Load (b-VS/d). Nitrogen Content (b-V/b-VS).	Annual Average 0.063 86,139 73,218 0.053 3,501 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 68,771 58,456 0.053 2,795 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 63.486 63.983 0.053 2.580 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e5 Peak 7 day 0.063 55.935 47,544 0.053 2.273 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 40,832 34,707 0.053 1,659 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solids and (b-TS/d) SS0 Vialitie Solids and (b-TS/d) SS0 Viangen Content ((b-N/b-TS) SS0 Ammonium-N Load (b-N/day) HSOW No 2 SS0 Ammonium-N Load (b-TS/d) HSOW No 2 HSOW No 2 SS0 Ammonium-N Load (b-S/d) HSOW No 2 HSOW NO 2 HSOM HSOM HSOM HSOM HSOM HSOM HSOM HSOM	Annual Average 0.063 0.063 73.218 0.053 3.501 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 68,771 58,456 0.053 2,795 - 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 59,049 51,373 0.057 1,900 27,574 0.0052 678 0.0010 3,991 3,193 0.005 24 36 7 7 0.32	2 X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 0.3466 0.053 0.253 0.050 0.000 0 0 0 0 0 0 0 0 0 0 0 0	65 Peak 7 day 0.063 56.335 47.544 0.053 2.2.73 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 40.832 40.632 40.633 1.659 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Viatal Solids and (b-TS/d) SS0 Viatal Solids and (b-TS/d) SS0 Viatal Solids and (b-TS/d) HSOW No.2 Nitrogen Content (b-N/Ib-TS) HSOW No.2 Nitrogen Content (b-S/d) HSOW No.2 Nitrogen Content (b-S/d) HSOW No.2 Nitrogen Content (b-N/Ib-TS) HSOW No.2 Nitrogen Content (b-N/Ib-TS) HSOW No.2 Nitrogen Content (b-N/Ib-TS) Nitrogen Content (b-N/Ib-TS) HSOW Total Solids Load (b-TS/d) Nitrogen Content (b-N/Ib-TS) HSOW Total Solids Load (b-N/S/d) Nitrogen Content (b-N/Ib-TS) HSOW Total Nitrogen Content (b-N/Ib-TS) HSOW Total Solids Load (b-N/S/d) HSOW Total Solids Load (b-N/S/d) HSOW Total Nitrogen Content (b-N/Ib-TS) HSOW Total Solids Load (b-N/S/d) HSOW Total Solids Load (b-N/S/d) HSOW Total Nitrogen Content (b-N/Ib-TS) HSOW Total Nitrogen Content (b-N/Ib-TS) HSOW Total Solids Load (b-N/S/d) HSOW Total Nitrogen Content (b-N/Ib-TS) HSOW Total Nitrogen Content (b-N/Ib-TS) HSOW Total Solids Load (b-N/S/d) HSOW Total Solids Load (b-N/S/d) HSOW Total Solids Load (b-N/S/d) HSOW Total Solids Load (b-N/S/d) HSOW Total Nitrogen Content (b-N/Ib-TS) HSOW Total Nitrogen Content (b	Annual Average 0,063 66,139 73,216 0,053 3,501 0,000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 88.456 0.053 2.795 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	y X-X. Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 63.466 9.33.963 0.053 2,580 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0.000 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.055 36.429 29.143 0.052 117 0.0191 3.193 0.028 24 36 7 9.47 5.228 0.321	es Peak 7 day 0.063 55.335 47.544 0.053 2.273 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 40,832 34,707 0.053 1.059 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Vortal Solids and (b-TS/d) SS0 Vortal Solids and (b-TS/d) SS0 Vortal Solids and (b-TS/d) SS0 Vortal Solids and (b-TS/d) ISOW No.2 SS0 Ammonium-N Load (b-N/day) ISOW No.2 ISOW NO.	Annual Average 0.063 0.063 73.218 0.053 3.501 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 68,771 58,456 0.053 2,795 - 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 59,049 51,373 0.057 1,900 27,574 0.0052 678 0.0010 3,991 3,193 0.005 24 36 7 7 0.32	2 X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 63.486 63.486 0.053 2.680 0.000 0 0 0 0 0 0 0 0 0 0 0 0	65 Peak 7 day 0.063 55.935 47.544 0.053 2.2.73 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 40.832 1.659 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes Notes Notes
SS0 Organic Nitrogen Content (b: N/1b-TS). SS0 Total Solids and (b: TS/0) SS0 Vitragen Content (b: N/1b-YS). Primary Sludge Total Nitrogen Content (b: N/1b-YS). Primary Sludge Total Solids Load (b: N/2 /d). Vitragen Content (b: N/1b-YS). Primary Sludge Total Solids Load (b: N/2 /d). Vitragen Content (b: N/1b-YS). Primary Sludge Total Solids Load (b: N/2 /d). Vitragen Content (b: N/1b-YS). PWAS Total Solids Load (b: N/2 /d). Vitragen Content (b: N/1b-YS). PWAS Total Solids Load (b: N/2 /d). Vitragen Content (b: N/1b-YS). PWAS Total Solids Load (b: N/2 /d). Vitragen Content (b: N/1b-YS). PWAS Total Nitragen Content (b: N/1b-YS).	Annual Average 0,063 66,139 73,216 0,053 3,501 0,000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 88.456 0.053 2.795 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	y X-X. Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 63.466 9.33.963 0.053 2,580 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0.000 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.055 36.429 29.143 0.052 117 0.0191 3.193 0.028 24 36 7 9.47 5.228 0.321	es Peak 7 day 0.063 55.335 47.544 0.053 2.273 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 40,832 34,707 0.053 1.059 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Viotal Solid ad (b-TS/d) SS0 Viotal Solid Solid Ad (b-TS/d) HS0V No. 2 Viotale Solid Solid (b-TS/d) HS0V No. 2 Nitrogen Content (b-T/b-TS) HS0V No. 2 Nitrogen Content (b-TS/d) Primary Sidge Total Nitrogen Content (b-TS/d) Primary Sidge Total Solid Solid (b-TS/d) Nitrogen Content (b-TS/d) Nitrogen	Annual Average 0.063 0.063 73.218 0.053 3.501 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 0.063 0.8771 0.063 58.456 0.053 2,795 0.000 0 0 0.000 0 0.001 0 0.005 59.049 51.373 0.055 0.005 59.049 51.373 0.057 1.900 0 0.005 59.049 51.373 0.057 1.900 0.055 9.005 678 0.005 3.913 3.913 3.913 3.913 3.913 3.913 0.022 36 7 9.47 5.397 0.32 1.994 0.32 1.914	2 X-X Nutrient Loading - Amonie -N Estimat Peak 14 day 0.061 63.486 63.486 0.053 2.680 0.000 0 0 0 0 0 0 0 0 0 0 0 0	65 Peak 7 day 0.063 55.935 47.544 0.053 2.2.73 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 440.832 1.659 0.000 0 0 0.005 0.005 0.057 0.055 0.055 0.057 0.055 0.057	Notes
SSO Organic Nitrogen Content (b-N/b-TS) SSO Varial Solida add (b-TS/d) SSO Varialit Solida add (b-TS/d) SSO Variange Content (b-N/b-YS) SSO Ammonium-N Load (b N/day) MEOW No. 2 Organic Nitrogen Content (b-N/b-TS) MEOW No. 2 National Solida Load (b-N/d) MEOW No. 2 National National (b-N/b-TS) MEOW No. 2 National National (b-N/b-TS) MEOW No. 2 National National (b-N/d) MEOW No. 2 National National National (b-N/d) MEOW No. 2 National Nationa	Annual Average 0,063 66,139 73,216 0,053 3,501 0,000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 88.456 0.053 2.795 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 63.486 63.486 0.053 2.680 0.000 0 0 0 0 0 0 0 0 0 0 0 0	65 Peak 7 day 0.063 55.935 47.544 0.053 2.2.73 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 40.832 1.659 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes

	Date Checked	Checked By	Job Number	By	Date	Calc No
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-003
Coldwoll		Project				Subject
Caldwell	Encina Biosolids, Energy, and Emissio	ins		Current Year - All Digest	ers in Service	

Mesophilic Digestion with Digesters 1-6

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.18	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	97	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Input Values	Reference	Parameter	Input Values	Reference
140,397	1	Use if facility already receives HSOW (blank if not applicable)		
4.1%	1	HSOW Name	FOG	1
87%	1	FOG Flow (gpd)	8,700	1
60,000	1	FOG Total Solids (%)	5.5%	1
6%	1	FOG Volatile Solids (%)	80%	2
80%	1	Are peaking factors applied to FOG?	No	
18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1
	140,397 4.1% 87% 60,000 6% 80%	140,397 1 4.1% 1 87% 1 60,000 1 6% 1 80% 1	140.397 Use if facility already receives HSOW (blank if not ap) 4.1% 1 HSOW Name 87% 1 FOG Flow (gpd) 60,000 1 FOG Flow (gpd) 6% 1 FOG Voiatile Solids (%) 8% 1 Are peaking factors applied to FOG?	140,397 1 Use if facility already receives HSOW (blank if not applicable) 4.1% 1 HSOW Name F0G 87% 1 F0G Flow (gd) 8,700 60,000 1 F0G Flow (gd) 8,700 60,000 1 F0G Total Solids (%) 5.5% 6% 1 F0G Volatile Solids (%) 80% 80% 1 Are peaking factors applied to F0G? No

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

			TWAS			Existing HSOW (if applicable)		
Parameter	Parameter Input Values Reference		Parameter	Input Values Reference		Parameter	Input Values	Reference
Nitrogen Speciation			Nitrogen Speciation			Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (lb-N/lb-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen Speciation		
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

L C	Table X-X: Existing Mesophilic Digestion with Digesters	1-6 Feed Assessment					
Answer Construction		Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Digent with With Solution 195/0 0.70 0.70 0.70 0.70 active plane data data (b) solution 195/0 Active plane data (b) solution 195/0	Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Wax Totas Shale Land (b. Ts/n) 28.027 34.468 36.029 32.311 44.587 Of Bas Shale Land (b. Ts/n) 3.091 3.091 3.091 3.091 3.091 Of Bas Shale Land (b. Ts/n) 80.000 97.407 102.459 10.042 125.638 Of Bas Shale Land (b. Ts/n) 1.100 1.101 1.102 5.01 3.091 3.091 One Note Shale Land (b. Ts/n) 1.100 1.101 3.109 3.101 3.10	Digester Volume (MG)	6.70	6.70	6.70	6.70	6.70	active volume of each digeser reduced to account for process
020 Data Solita Josef De Yo 3.911	Primary Sludge Total Solids Load (Ib-TS/d)	48,007	59,049	62,410	67,210	76,812	
Order Digenet Freed. Total Solis Land (P. Sr.) 88.020 97.97 10.2829 110.432 125.038 Wind Yeard Solis Land (P. Sr.) 4.1,766 51.373 54.296 58.473 68.056 Wind Yeard Solis Land (P. Sr.) 22.418 27.574 22.163 31.393 33.690 Order Solis Land (P. Sr.) 61.377 82.189 86.02 93.061 10.877 Order Solis Land (P. Sr.) 61.377 82.189 86.02 93.061 10.877 Operation Solis Land (P. Sr.) 61.377 82.189 86.02 93.061 10.877 Operation Solis Land (P. Sr.) 75.5 75.5 75.5 75.5 75.5 Operation Solis Land (P. Sr.) 75.5 75.5 75.5 75.5 75.5 Operation Solis Land (P. Sr.) 84.75 84.75 84.75 84.75 84.75 Operation Solis Land (P. Sr.) 84.75 84.75 84.75 84.75 84.75 Operation Solis Land (P. Sr.) 84.75 84.75 84.75 84.75 84.75 O	TWAS Total Solids Load (lb-TS/d)	28,022	34,468	36,429	39,231	44,836	
Name State Las Die Note (n. 1976) 41,766 61,373 64,266 59,473 66,826 OS Watte State Las Die Note (n. 1976) 22,418 27,574 29,143 31,353 31,89 OS Watte State Las Die Note (n. 1976) 21,133 31,33 31,33 31,33 31,33 OS Watte State Las Die Note (n. 1977) 82,139 86,522 83,051 105,837 Other Note State Las Die Note (n. 1977) 82,139 86,52 83,55 635 Other Note State Las Die Note (n. 1977) 45,75 55 635 635 Other Note State Las Die Note (n. 1977) 45,75 55 635 635 Other Peerst Note State Las Die Note (n. 1977) 45,75 45,75 45,75 45,75 Other Peerst Note State Las Die Note (n. 1977) 45,75 45,75 45,75 45,75 45,75 Other Peerst Note State Las Die Note (n. 1977) 45,75 45,75 45,75 45,75 45,75 Other Peerst Note State Las Die Note (n. 1977) 45,75 45,75 45,75 45,75 Other Note State Las Die Note (n. 1977)	FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991		
Nuk Yang Basinis Land (b-Ys, of) 22.418 27.574 29.143 31.385 33.586 35.869 Ord Digeted field Scient (b-Ys, of) 0.3193 3.153 <td>Total Digester Feed, Total Solids Load (lb-TS/d)</td> <td>80,020</td> <td>97,507</td> <td>102,829</td> <td>110,432</td> <td>125,638</td> <td></td>	Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
090 Volume Soules Lande (b VS / o) 1.131 3.133 3.133 3.133 3.133 090 Volume Soules Lande (b VS / o) 67.37 62.139 86.522 90.501 105.874 Vinany Judges Hore (V VS Load (N) 67.5 63.5 63.5 63.5 65.5 070 present of VS Load (N) 23.5 23.5 23.5 23.5 23.5 070 present of VS Load (N) 280.977 29.51.86 280.2 280.3 280.3 014 Present Solitic Load (N) 4.65. 4.65. 4.65. 4.65. 4.65. 014 Present Solitic Load (N) 84.27. 84.27. 84.37. 84.37. 45.3.7. 014 Present Solitic Load (N) (NG gol) 227.403 193.32. 177.264 157.2.44 117.1.64 014 Sequent More Load (NS / Solitic Load (NS / Solit Load (NS / Solitic Load (NS / Solitic Load (NS / Soli	Primary Sludge Volatile Solids Load (Ib-VS/d)						
Orab Digenet reek, Venifte Solds Load (b-S5, o) 97.77 82,139 88,632 99.051 105.887 WKS present VS Load (b) 62% 63% 63% 63% 63% 63% WKS present VS Load (b) 25% 63% 63% 34%	TWAS Volatile Solids Load (lb-VS/d)						
Nimey adapt protect of VS Load (b) 675 635 635 635 06 presert of VS Load (b) 335 345 345 345 345 05 presert of VS Load (b) 55 45 45 355 355 06 presert of VS Load (b) 465 465 355 355 06 and Presert Voilla Solis Load (b) 4675 4675 4675 4675 06 and Presert Voilla Solis Load (b) 84.25 84.25 84.35 6675 0700 0.00 0.106 0.106 0.106 1.016							
With present of VS Load (%) 33% 34% 34% 94% 34% 34% Objected if VS Load (%) 5% 4% 4% 3% 3% Otal Digeted if VS Load (%) 46.% 4.6%							
090 preserve (reg (reg (reg (reg (reg (reg (reg (re							
Oracl Digenser Feed Free (Forg) (poil) 2000,007 255,188 2020,216 299,326 329,336 Orall Precent Solits Lad (%) 4,6%							
Oran Percent Voluits Solids Load (%) 4.6% 84.3%							
Oran Present Vabilite Solids Load (¹ b, ²) 84.2% 84.2% 84.2% 84.2% 84.2% 84.2% 84.2% 84.2% 84.2% 84.2% 84.2% 84.2% 82.3%							
Jase HI (day) 32 28 23 23 20 Jase HI (b/S) (d-f) 0.08 0.09 0.10 0.10 0.10 0.10 0.10 0.10 0.10 0.10 0.10 0.10 0.10 0.10 0.11 0.00							
Jase Q.B. (phyS): d-d) 0.08 0.09 0.10 0.12 means almostable HRT 15 days Visalle Capacity (Vis) (day) 201,954 1102,745 1103,812 117,7284 137,764 191,115 Assems the minimum almostable HRT 15 days Visalle Capacity (Vis) (day) 201,954 1162,745 150,812 137,764 197,1155 Assems the minimum almostable HRT 15 days Protein Lination Organic Load Notes Visite Solids Load (Iv S/ (day) 93,793 170,031 74,538 68,119 55,282 Calcated malable cagnic Load, based on defined limit SOV No. 2 Visite Solids Load (Iv S/ (day) 93,793 170,031 74,538 68,119 55,282 Calcated malable cagnic Load, based on SO 30 SOV No. 2 Visite Solids Load (Iv S/ (day) 93,793 170,031 74,538 68,119 55,282 Calcated malable cagnic Load, based on SO 30 Calcated malable cagnic Load, based on SO 30 Calcated malable cagnic Load, based on SO 30 Calcated m							
jotalia 193.12 177.284 157.244 117.155 Assumes the minimum altowable HRT 15 days 0 Cas EquivaleNt Vision 03.793 190.01 77.538 65.119 55.222 Difference body MSW, including WSW, including WSWW, inc							
Lis & Equivalent V. Stad (b. V-S/day) 201.954 136.2745 136.812 133.764 99.870 Epuivalent do di HSCM, based on hydraulic capacity Transs. Lination Organic Load							
Dyganic Lad Capacity (b-V5(49) 93,733 79,031 74,538 68,119 55,522 Difference between max OLP (b. 13 fibs-V5/ c4) and current tool Chile 32: Massiphile (C-d) (fisstinn Eerd Assessment							
Impress Limitation Organic Load Notes SOV Motal Solids Load (b-							
Sale 3-2.6 Massphilic (0-digestion Feed Assessment) Annu Average Peak Month Peak 14 day Peak 7 day Peak day Notes Oral HSW Vabilite Solids Load (b-V5/day) 93,793 779.031 74.533 66.119 55.282 Calculated available again: load, based on defined limit Stor Vabilite Solids Load (b-V5/day) 93,793 79.031 74.538 66.119 55.282 Calculated available again: load, based on defined limit Stor Vabilite Solids Load (b-V5/day) 91,793 79.031 74.538 68.119 55.282 Calculated available again: load, based on defined limit Stor Vabilite Solids Load (b-V5/day) 91,793 79.031 74.538 68.119 55.282 Cancersion to Total Solids load based on SSO %15 Stor Vabilite Solids Load (b-V5/day) 10,245 92.977 87.691 80.140 65.1331 Conversion to Total Solids load based on SSO %15 Stor Vabilite Solids Load (b-St/day) 0 0 0 0 0 0 0 Conversion to Wet Solids load based on SSO %15 Stor Vabilite Solids Load (b-St/day) 0 0 0 0 0 0 Conversi							Difference between max OLR (0.18 lbs-VS/cf-d) and current load
Annual Average Peak Month Peak Iday Peak Tday Peak Tday Peak Tday Peak Tday Ness 041 HSW Velatice Solids Load (Ib-V5/day) 93.783 79.031 74.533 68.119 55.282 Alculeta antiliable agains load, based an definitie S00 Velatice Solids Load (Ib-V5/day) 93.783 79.031 74.533 68.119 55.282 Annual Average S00 Velatice Solids Load (Ib-V5/day) 93.783 79.031 74.538 68.119 55.282 Annual Average An		Organic Load	Organic Load	Organic Load	Organic Load	Organic Load	
Oral HSOV Wabilits Exolids Land (br Vs/day) 93,73 79,031 74,538 68,119 55,282 Calculated available organic load, based on defined limit SSO Valoids Solids Land (br-Vs/day) 0 <th>Table X-X: Mesophilic Co-digestion Feed Assessment</th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	Table X-X: Mesophilic Co-digestion Feed Assessment						
SQ Value Solids Load (b-VS (day) 93.783 79.031 74.533 68.119 55.282 SQ Value Solids Load (b-VS (day) 0 0 0 0 0 SQ Value Solids Load (b-VS (day) 93.793 79.031 74.533 68.119 55.282 SQ Value Solids Load (b-VS (day) 91.034 74.533 68.119 55.282 Conversion to Total Solids Load (b-TS (day) 0 0 0 0 SO Total Solids Load (b-TS (day) 0 0 0 0 0 0 SO Total Solids Load (b-TS (day) 110.345 92.917 87.691 60.140 65.038 Conversion to Total Solids Load hased on SSO %15 SO Total Solids Load (b-TS (day) 110.345 92.917 87.691 60.140 65.035 SO (bwet (day) 0 0 0 0 0 0 SO (bwet (day) 0 0 0 0 0 0 SO (bwet (day) 0 0 0 0 0 0 0 0 0 0 <t< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>							
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Orad Solids, Volatile Solids Laad (Ib-VS/d) 161.170 161.170 161.170 161.170 Otal Flow (ga) 319,353 348,091 356,837 369,332 394,321 Imany sludge pretent dVS Laad (%) 26% 32% 34% 36% 41% MXS pretent dVS Laad (%) 26% 32% 34% 36% 41% Op pretent dVS Laad (%) 24% 25% 22% 2% 2% S00 precent dVS Laad (%) 58% 49% 46% 42% 34% S00 precent dVS Laad (%) 0% 0% 0% 0% 0% S00 precent dVS Laad (%) 0% 0% 0% 0% 0% S00 precent dVS Laad (%) 0% 0% 0% 0% 0% 0%	Total Solids, Total Solids Load (Ib-TS/d)						
Oral Flow (pp) 319.353 348.091 366.337 369.332 348.21 many slogg percent VFS Load (%) 26% 32% 34% 36% 41% MAS percent VFS Load (%) 14% 17% 18% 19% 22% OG percent VFS Load (%) 2% 2% 2% 2% 2% Soperati VFS Load (%) 2% 2% 2% 2% 2% Soperati VFS Load (%) 2% 2% 2% 2% 2% Soperati VFS Load (%) 5% 40% 40% 42% 34% SOW No. 2 percent of VS Load (%) 0% 0% 0% 0% 0% Sobe web of VFS Load (%) 0% 0% 0% 0% 0% 0%	Total Solids, Volatile Solids Load (Ib-VS/d)						
Ymany sludge parcent of VS Load (%) 26% 32% 34% 36% 41% WKS present of VS Load (%) 14% 11% 18% 19% 22% Operator of VS Load (%) 2% 2% 2% 2% S00 present of VS Load (%) 58% 49% 46% 42% 34% S00 present of VS Load (%) 0% 0% 0% 0% 0% bit No. 2 present of VS Load (%) 0% 0% 0% 0% 0% bit No. 2 present of VS Load (%) 0% 0% 0% 0% 0%	Total Flow (gpd)						
WAS percent of VS Load (%) 14% 17% 18% 19% 22% OG percent of VS Load (%) 2% 2% 2% 2% 2% Soperant of VS Load (%) 2% 2% 2% 2% 2% Soperant of VS Load (%) 58% 49% 46% 42% 34% SOW No. 2 percent of VS Load (%) 0% 0% 0% 0% 0% Back ok ok ok ok ok ok							
Operated of VS Load (%) 2% 2% 2% 2% SS0 percent of VS Load (%) 56% 49% 46% 42% 34% SS0W No. 2 percent of VS Load (%) 0% 0% 0% 0% 0% heak ok ok ok ok ok ok ok	Primary sludge percent of VS Load (%)	26%	32%				
SSD percent of VS Load (%) 58% 49% 46% 42% 34% ISOW No. 2 percent of VS Load (%) 0% 0% 0% 0% Disck 0% 0% 0% 0% 0%	Primary sludge percent of VS Load (%) WAS percent of VS Load (%)				19%	22%	
ISOW No. 2 percentof VS Load (%) 0% 0% 0% 0% check ok ok ok ok ok	WAS percent of VS Load (%)	14%	17%	18%			
Check Ok Ok Ok Ok		14% 2%	17% 2%	18% 2%	2%	2%	
Codicestion HRT (days) 21 19 19 18 17	WAS percent of VS Load (%) FOG percent of VS Load (%)	14% 2% 58%	17% 2% 49%	18% 2% 46%	2% 42%	2% 34%	
	WAS percent of VS Load (%) FOG percent of VS Load (%) SSO percent of VS Load (%)	14% 2% 58% 0%	17% 2% 49% 0%	18% 2% 46% 0%	2% 42% 0%	2% 34% 0%	

Co Didection OLD (the VC /d of)	0.18	0.18	0.18	0.18	0.18	
Co-Digestion OLR (lbs-VS/d-cf) Process Check	0.18 OK	0.18 OK	0.18 OK	0.18 OK	0.18 OK	
Table X-X: Existing Mesophilic Solids and Biogas Produc	ction					
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007 14,751	43,437	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (lb-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	209,097	255,188	269,216	289,256	329,335	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	39,463	48,282	50,966	54,801	62,470	
Volatile Solids Effluent (Lbs-VS/d) Total Solids (% TS)	26,819 2.3%	32,914 2.3%	34,769 2.3%	37,419 2.3%	42,719 2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd) WAS Biogas Production (scfd)	483,237	594,382	628,208 243,813	676,532	773,179 300.077	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scid)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scl/lb-VSd
Biogas Production (scfd)	721,930	876,211	923,166	990,244	1,124,401	
Table X-X: Mesophilic Co-digestion Solids and Biogas P		1			-	
Delevant studies Vistabile Califab Destroyed (its VCs) (des)	Annual Average 27,148	Peak Month	Peak 14 day	Peak 7 day 38,007	Peak day 43,437	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	27,148	12,960	13.697	14,751	43,437	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	84,414	71,127	67,084	61,307	49,754	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	124,972	120,353	118,947	116,939	112,923	Assumes that valume in equale valume aut
Total Sludge Effluent (gpd) Total Solids (Lbs-TS/d)	65,394	70,132	71,574	369,332 73,634	394,321	Assumes that volume in equals volume out
Volatile Solids (Lbs-VS/d)	36,198	40,817	42,223	44,231	48,247	
Total Solids (% TS)	2.5%	2.4%	2.4%	2.4%	2.4%	
Volatile Solids (% VS)	55%	58%	59%	60%	62%	Demotrand astronome OFN asstronome
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	62,124 141	66,625 151	67,995	69,952 159	73,866 168	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (lb-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd)	1,519,445	1,280,295	1,207,510	1,103,531	895,574	Assumes a biogas yield of 18 scf/lb-VSd
Total Biogas Production (scfd)	2,241,375	2,156,505	2,130,675	2,093,775	2,019,975	
Table X-X: Nutrient Loading - Ammonia-N Estimates				-,	2,020,010	
HSOW No 1	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS)	0.063	0.063	0.063	0.063	0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	0.063 110,345	0.063 92,977	0.063 87,691	0.063 80,140	0.063 65,038	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-VS/d) SS0 Nitrogen Content (Ib-N/Ib-VS)	0.063	0.063	0.063	0.063	0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatlle Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 110,345 93,793	0.063 92,977 79,031	0.063 87,691 74,538	0.063 80,140 68,119	0.063 65,038 55,282	Notes
SSO Organic Nitrogen Content (lb-H/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Vistali Solids Load (lb-VS/d) SSO Nitrogen Content (lb-H/lb-VS) SSO Atmonium-N Load (lb-H/ldw) BSOV Hoa 2 BSOV Hoa 2	0.063 110,345 93,793 0.053 4,484	0.063 92,977 79,031 0.053 3,779	0.063 87,691 74,538 0.053 3,564	0.063 80,140 68,119 0.053 3,257	0.063 65,038 55,282 0.053 2,643	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solito: Laad (Ib-15/d) SS0 Valutile Solids Laad (Ib-15/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Annoulim-N-Laad (Ib-N/day) HSOW No.2 (Topanic Nitrogen Content (Ib-N/Ib-TS)	0.063 110,345 93,793 0.053	0.063 92,977 79,031 0.053	0.063 87,691 74,538 0.053	0.063 80,140 68,119 0.053	0.063 65,038 55,282 0.053	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Laad (Ib-TS/d) SSO Valatile Solids Laad (Ib-N/d) SSO Nitrogen Content (Ib-N/t-N/S) SSO Mitrogen Content (Ib-N/t-N/S) SSO Mitrogen Content (Ib-N/t-N/B) SSO Mitrogen Content (Ib-N/Ib-TS) SSO Mitrogen Content (Ib-N/Ib-TS) SSO Mitrogen Content (Ib-N/d) SSO Mitrogen Content (Ib-N/d) SSO Mitrogen Content (Ib-N/d) SSO Mitrogen Content (Ib-N/d)	0.063 110,345 93,793 0.053 4,484 0.000	0.063 92,977 79,031 0.053 3,779 0.000	0.063 87,691 74,538 0.053 3,564 0.000	0.063 80,140 68,119 0.053 3,257 0.000	0.063 65,038 55,282 0.053 2,643 0.000	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Total Solids Load (Ib-N5/d) SS0 Nitrogen Content (Ib-N/Ib-N5) SS0 Nitrogen Content (Ib-N/Ib-N5) SS0 Nitrogen Content (Ib-N/Ib-N5) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-	0.063 110,345 93,793 0.053 4,484 0.000 0	0.063 92,977 79,031 0.053 3,779 0.000 0 0 0.000	0.063 87.691 74.338 0.053 3.564 0.000 0 0 0 0 0.000	0.063 80,140 68,119 0.053 3.257 0.000 0 0 0.000	0.063 65,038 55,282 0.053 2,643 0.000 0 0 0 0 0.000	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Total Solids Load (Ib-N5/d) SS0 Nitrogen Content (Ib-N/Ib-N5) SS0 Nitrogen Content (Ib-N/Ib-N5) SS0 Nitrogen Content (Ib-N/Ib-N5) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-	0.063 110,345 93,793 0.053 4,484 0.000 0 0 0	0.063 92,977 79,031 0.053 3,779 0.000 0 0	0.063 87.691 74,538 0.053 3.564 0.000 0 0	0.063 80,140 68,119 0.053 3,257 0.000 0 0	0.063 65,038 55,282 0.053 2,643 	Notes
SSO 01ganic Nitrogen Content (Ib-N/Ib-TS) SSO 10tal Solids Load (Ib-TS/d) SSO 10tal Solids Load (Ib-N/d) SSO Namoniam-Nitrogen Content (Ib-N/Ib-NS) SSO Namoniam-Nitroad (Ib-N/dav) HSOW No. 2 HSOW No. 2 NSOW No. 2 SSO	0.063 110,345 93,793 0.053 4,484 0.000 0 0 0	0.063 92,977 79,031 0.053 3,779 0.000 0 0 0.000	0.063 87.691 74.338 0.053 3.564 0.000 0 0 0 0 0.000	0.063 80,140 68,119 0.053 3.257 0.000 0 0 0.000	0.063 65,038 55,282 0.053 2,643 0.000 0 0 0 0 0.000	Notes
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Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-003
	Pro	ject			Subject
Encina Biosolids, Energy, and Em	nissions		Current Year - All Diges	ters in Service	

15 day Thermophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter Input Values Reference		Parameter	Input Values	Reference	
Number of Primary Digesters	3	1	Minium HRT (days) 15 Assumed		Peaking Factors			
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d) 0.35 Assumed		Annual Average	1	2	
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production vield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SSO	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dof

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row			1		

Nutrients Speciation for Edsting Conditions

Primary Slud	ge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Specia	ation		Nitrogen Spec	ciation		Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	Input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

		Table X-X: E	kisting 15 day Thermophilic Digestion Feed A	lssessment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
						Service condition assumes largest digester is out of service with the
Digester Volume (MG)	5.84	5.84	5.84	5.84	5.84	active volume of each digeser reduced to account for process
						inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (Ib-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (Ib-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	28	23	22	20	18	
Base OLR (IbsVS/d-cf)	0.09	0.11	0.11	0.12	0.14	
Hydraulic Capacity (HC) (gpd)	180,403	134,312	120,284	100,244	60,165	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (lb-VS/day)	153,465	114,256	102,323	85,276	51,181	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (lb-VS/day)	206,002	191,240	186,747	180,328	167,492	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	
	-		X-X: Mesophilic Co-digestion Feed Assessm			-
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	153,465	114,256	102,323	85,276	51,181	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/day)	153,465	114,256	102,323	85,276	51,181	
HSOW No. 2 Volatile Solids Load (lb-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (lb-VS/day)	153,465	114,256	102,323	85,276	51,181	
SSO Total Solids Load (lb-TS/day)	180,547	134,419	120,380	100,324	60,213	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (lb-TS/day)	180,547	134,419	120,380	100,324	60,213	
SSO (lb-wet/day)	1,504,561	1,120,159	1,003,168	836,037	501,774	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (Ib-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	1,504,561	1,120,159	1,003,168	836,037	501,774	
SSO (wtpd)	752	560	502	418	251	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	752	560	502	418	251	
SSO (gpd)	180,403	134,312	120,284	100,244	60,165	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	180,403	134,312	120,284	100,244	60,165	
Total Solids, Total Solids Load (lb-TS/d)		231.926	223.209	210.757	185,851	
	260,568					
Total Solids, Volatile Solids Load (Ib-VS/d)	220,842	196,396	188,955	178,326	157,068	
				178,326 389,500	157,068 389,500	

WAS percent of VS Load (%)	10%	14%	15%	18%	23%	
FOG percent of VS Load (%)	1%	2%	2%	2%	2%	
SSO percent of VS Load (%)	69%	58%	54%	48%	33%	
HSOW No. 2 percent of VS Load (%)	0% 0k	0%	0%	0%	0%	
Check Co-digestion HRT (days)	0K 15	0K 15	ok 15	ок 15	ok 15	
Co-Digestion OLR (lbs-VS/d-cf)	0.28	0.25	0.24	0.23	0.20	
Process Check	OK	OK	OK	OK	OK	
		Table X-)	: Existing Mesophilic Solids and Biogas Proc	luction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day) Total Volatile Solids Destroyed (Ib-VSd/day)	2,873 40,558	2,873 49,225	2,873 51,863	2,873	2,873 63.169	
Total Sludge Effluent (gpd)	40,558	49,225	51,863	289 256	320 335	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	39,463	48.282	50,966	54.801	62,470	Assumes that tolume in equals volume but
Volatile Solids Effluent (Lbs-VS/d)	26,819	32,914	34,769	37,419	42,719	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd) Primary sludge Biogas Production (scfd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	483,237 187.548	230 684	243,813	262 568	300.077	Assumes a biogas yield of 17.8 sch/lb-VSd Assumes a biogas yield of 17.8 sch/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51.145	51.145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	721,930	876,211	923,166	990,244	1,124,401	
		Table X-X: I	Mesophilic Co-digestion Solids and Biogas P			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day) SSO Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	40,063	
Total Volatile Solids Destroyed (Ib-VSd/day)	178,677	152,056	143,954	132,380	109,232	
Total Sludge Effluent (gpd)	389,500	389,500	389,500	389,500	389,500	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	81,891	79,870	79,255	78,377	76,620	
Volatile Solids (Lbs-VS/d)	42,166	44,340	45,001	45,946	47,837	
Total Solids (% TS)	2.5%	2.5%	2.4%	2.4%	2.4%	
Volatile Solids (% VS) Dewatered Solids (Lbs-TS/d)	51%	75.877	57%	59% 74,458	62%	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtod)	177	172	171	169	165	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (lb-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	2,486,137	1,850,952	1,657,634	1,381,467	829,132	Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)	3.208.067	U	0	U	U	
				2 371 711		
	3,208,067	2,727,162 Tabl	2,580,800 e X-X: Nutrient Loading - Ammonia-N Estimat	2,371,711 es	1,953,534	
			e X-X: Nutrient Loading - Ammonia-N Estimat	es		Notes
HSOW No 1 SSO Organic Nitrogen Content (lb-N/lb-TS)	Annual Average	Tabl			1,953,534 Peak day 0.063	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	Annual Average	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day	es Peak 7 day	Peak day	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	Annual Average 0.063 180,547 153,465	Table Peak Month 0.063 134,419 114,256	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 102,323	es Peak 7 day 0.063 100,324 85,276	Peak day 0.063 60,213 51,181	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solidis Load (Ib-TS/d) SSO Violatile Solidis Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	Annual Average 0.063	Table Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
HSOW No. 1 SSO Organic Mitotogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotatile Solids Load (Ib-TS/d) SSO Mitogen Content (Ib-N/Ib-YS) SSO Ammonium-NL Load (Ib N/day)	Annual Average 0.063 180,547 153,465	Table Peak Month 0.063 134,419 114,256	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 102,323	es Peak 7 day 0.063 100,324 85,276	Peak day 0.063 60,213 51,181	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solidis Load (Ib-TS/d) SSO Violatile Solidis Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	Annual Average 0.063 180,547 153,465	Table Peak Month 0.063 134,419 114,256	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 102,323	es Peak 7 day 0.063 100,324 85,276	Peak day 0.063 60,213 51,181	Notes
HSOW No 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Viatalis Solids Load (Ib-V/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Ammonium-N Load (Ib-N/day) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063 180,547 153,465 0.053 7,338 0.000 0	Tabl Peak Month 0.063 134,419 114,256 0.053 5,463 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 102.323 0.053 4,892 0.000 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0	Notes
HSOW No 1 SSO Optains Nitrogen Content (Ib: N/Ib:TS) SSO Total Solids Load (Ib:TS/d) SSO Violatile Solids Load (Ib:TS/d) SSO Nitrogen Content (Ib:H/Ib:VS/d) SSO Noncolum-NL Load (Ib:K/day) HSOW No 2 HSOW NO 4 HSOW HSOW HSO HSOW HSOW HSOW HSOW HSOW H	Annual Average 0.063 180.547 153.465 0.053 7,338 0.000	Table Peak Month 0.063 134,419 114,256 0.053 5,463	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 102,323 0.053 4,892	es Peak 7 day 0.063 100,324 85,276 0.053 4,077	Peak day 0.063 60,213 51,181 0.053 2,447	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotalite Solids Load (Ib-TS/d) SSO Notalite Solids Load (Ib-TS/d) SSO Monoulina-With Load (Ib-N/Ib-TS) HSOW No. 2 HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Valiali Solids Load (Ib-TS/d)	Annual Average 0.063 180.547 153.465 0.053 7,338 0.000 0 0 0 0.000	Tabl Peak Month 0.063 134,419 114,256 0.053 5,463 0.000 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 102.323 0.053 4.892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Ital Solid Load (Ib-TS/d) SSO Violatilia Solid Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Mannoulm-N-Load (Ib-N/d/sol) HSOW No 2 HSOW NO	Annual Average 0.063 180,547 153,465 0.053 7,338 0.000 0	Tabl Peak Month 0.063 134,419 114,256 0.053 5,463 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 102.323 0.053 4,892 0.000 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0	Notes
HSOW No. 1 SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatils Solids Load (Ib-Yc/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Namoulan-W. Load (Ib-N/day) HSOW No. 2 HSOW No. 2 HSOW No. 2 TSOW No. 2 HSOW No. 2 </td <td>Annual Average 0.063 180.547 153.465 0.053 7,338 0.000 0 0 0 0.000</td> <td>Tabl Peak Month 0.063 134,419 114,256 0.053 5,463 0.000 0 0 0 0 0</td> <td>e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 102.323 0.053 4.892 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0</td> <td>Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0</td> <td>Notes</td>	Annual Average 0.063 180.547 153.465 0.053 7,338 0.000 0 0 0 0.000	Tabl Peak Month 0.063 134,419 114,256 0.053 5,463 0.000 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 102.323 0.053 4.892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0	Notes
HSOW No. 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solid Load (Ib-TS/d) SS0 Vibrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/do VS) SS0 No. 2 SS0	Annual Average 0.063 180.547 153.465 0.053 7,338 0.000 0 0 0 0.000	Tabl Peak Month 0.063 134,419 114,256 0.053 5,463 0.000 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 102.323 0.053 4.892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 100,324 85,276 0.053 4,077 0.000 0	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solid Load (Ib-TS/d) SSO Valatilis Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib VS) SSO Ammonium-NLoad (Ib-N/day) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Total Solids Load (Ib-N/day) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) Primary Sudge Total Solids Load (Ib-TS/d) Primary Sudge Total Solids Load (Ib-TS/d)	Annual Average 0.063 180,547 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 134,419 114,256 0.053 5,463 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 120.380 0.053 4,892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 100.324 85.276 0.053 4,077 	Peak day 0.063 60,213 51,181 0.053 2,447 0.000 0 0 0 0 0 0 0 0 0 0	Notes
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HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Namonium-N Load (Ib-N/Ib-TS) HSOW No. 2 Yosta Solids Load (Ib-TS/d) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Notable Solids Load (Ib-TS/d) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/day) Exting Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) TWAS Total Solids Load (Ib-TS/d) TWAS Stotal Solids Load (Ib-TS/d) TWAS Stotal Solids Load (Ib-TS/d)	Annual Average 0.063 180,547 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 134,419 114,256 0.053 5,463 0.000 0	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 120.380 0.053 4.892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85,276 0.053 4,077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60.213 51.181 0.053 2,447 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-YG) SSO Nitrogen Content (Ib-N/Ib-YG) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 (Organic Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) TWAS Total Solids Load (Ib-TS/d) TWAS Total Solids Load (Ib-TS/d) TWAS Stotal Solids Load (Ib-TS/d) TWAS Stotal Solids Load (Ib-TS/d)	Annual Average 0.063 180,547 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Cable Peak Month 0.063 134,419 114,256 0.0053 5,463 0.0000 0 0.0001 0.0002 0.0001 0.0001 0.0055 59,049 51,373 0.057 1,900 0.0665 34,465	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 120,380 0.053 4.892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85,276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60.213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 76.812 66.826 0.057 2.4711 0.0656	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Noncolim-N-Load (Ib-N/do-Y) HSOW No.2 Croganic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Primary Sludge Solids Load (Ib-TS/d) Prim	Annual Average 0.063 180,547 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Cabl Peak Month 0.063 134,419 114,256 0.0053 5,463 0.0000 0 0.0001 0.0002 0.0001 0.0001 0.0055 59,049 51,373 0.057 1,900 0.0665 34,465	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85,276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60.213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 76.812 66.826 0.057 2.4711 0.0656	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib. N/Ib-TS) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 HSOW NO. 2	Annual Average 0.063 180,547 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Cabl Peak Month 0.063 134,419 114,256 0.0053 5,463 0.0000 0 0.0001 0.0002 0.0001 0.0001 0.0055 59,049 51,373 0.057 1,900 0.0665 34,465	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 120,380 0.053 4.892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85,276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 60.213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 76.812 66.826 0.057 2.4711 0.0656	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Valatisio Load (Ib-TS/d) SSO Valatisio Load (Ib-TS/d) SSO Valatisio Load (Ib-TS/d) SSO Nanoniam-N-Load (Ib-N/dov) HSOW No.2 (HSOW	Annual Average 0.063 180,547 185,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Ch51 Peak Month 0.063 134,419 114,256 0.063 5,463 0.000 0 0 0.000 0 0 0 0 0 0.000 0 0.005 59,049 51,373 0.0057 1.900 0.0055 34,468 27,574 0.057 678	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 120.380 102.323 4.882 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0.213 51.181 0.003 2,447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0.006 0.0057 2,411 0.0058 44,836 35,869 0.052 882	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib. N/Ib-TS) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 HSOW NO. 2	Annual Average 0.063 180,547 185,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Ch51 Peak Month 0.063 134,419 114,256 0.063 5,463 0.000 0 0 0.000 0 0 0 0 0 0.000 0 0.005 59,049 51,373 0.0057 1.900 0.0055 34,468 27,574 0.057 678	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 120.380 102.323 4.882 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0.213 51.181 0.003 2,447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0.006 0.0057 2,411 0.0058 44,836 35,869 0.052 882	Notes
HSOW No 1 SSO Orbatis Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) HSOW No 2 SSO Amonium-N Load (Ib 4/day) HSOW No 2 Total Solids Load (Ib-TS/d) HSOW No 2 Not 2 HSOW No 2 HSOW	Annual Average 0.063 180,547 185,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Ch51 Peak Month 0.063 134,419 114,256 0.063 5,463 0.000 0 0 0.000 0 0 0 0 0 0.000 0 0.005 59,049 51,373 0.0057 1.900 0.0055 34,468 27,574 0.057 678	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 120.380 102.323 4.882 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0.213 51.181 0.003 2,447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0.006 0.0057 2,411 0.0058 44,836 35,869 0.052 882	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solid cal (dl (h-TS/d) SSO Visitili Solidis Load (bl-TS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) HSOW No.2 HSOW NO.H HSOM NO.H HSOW NO.H HSOM NO.H HSOM NO.H HSOM NO.H HSOW NO.H HSOM	Anual Average 0.063 180,547 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.063 134,419 0.063 0.003 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading- A Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,892 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.0213 0.053 2.447 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Namonium-NL Load (Ib-N/day) HSOW No. 2 Total Solids Load (Ib-TS/d) Primary Sulge Total Nitrogen Content (Ib-N/Ib-TS) Timary Sulge Total Solids Load (Ib-TS/d) Primary Sulge Total Solids Load (Ib-TS/d) Timary Sulge Total Solids Load (Ib-TS/d) WINS Total Nitrogen Content (Ib-N/Ib-TS) Timary Sulge Total Solids Load (Ib-TS/d) WINS Solids Solids Load (Ib-TS/d) Timary Sulge Total Solids Load (Ib-TS/d) MSS Total Nitrogen Content (Ib-N/Ib-TS) Timary Sulge Total Solids Load (Ib-TS/d) MSS Violal Solids Load (Ib-TS/d) Mitrogen Content(Ib-N/Ib-TS) MSW To	Annual Average 0.063 180,447 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 0.065 28,027 22,418 0.052 581 0.010 3,991 3,193 0.008	Tebl Peak Month 0.063 134,419 0.063 0.003 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading- A Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,892 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.0213 0.053 2.447 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Jorali Solida cald (Ib-TS/d) SSO Viatal Solida cald (Ib-TS/d) SSO Solida SSO Viatal Solida cald (Ib-TS/d) SSO SSO SSO VIATIS SOLIDA SOLIDA	Annual Average 0.063 180,447 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 0.065 28,027 22,418 0.052 581 0.010 3,991 3,193 0.008	Tebl Peak Month 0.063 134,419 0.063 0.003 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading- A Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,892 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.0213 0.053 2.447 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSD Violatile Solids Load (Ib-TS/d) ISOW No. 2 ISOW No.2 ISOW No.2 ISOW No.2 ISOW No.2 ISOW No.2 ISOW No.2 ISON ION INTOGEO CONTENT (Ib-N/Ib-NS)	Annual Average 0.063 180,447 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 0.065 28,027 22,418 0.052 581 0.010 3,991 3,193 0.008	Tebl Peak Month 0.063 134,419 0.063 0.003 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading- A Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,892 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.0213 0.053 2.447 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solids Load (Ib-TS/d) SSD Violatile Solids Load (Ib-TS/d) ISOW No. 2 ISOW No.2 ISOW No.2 ISOW No.2 ISOW No.2 ISOW No.2 ISOW No.2 ISON ION INTOGEO CONTENT (Ib-N/Ib-NS)	Annual Average 0.063 180,947 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 48,007 41,766 0.055 28,022 22,418 0.052 551 0.010 3,991 3,193 0.008 24	Tebl Peak Month 0.063 134,419 0.063 0.003 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,882 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 0.063 85.276 0.063 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.0213 0.053 2.447 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1. SSO Organic Nitrogien Content (Ib-N/Ib-TS). SSO Total Solito at (Ib-TS/d) SSO Total Solito at (Ib-TS/d) SSO Violatile Solida Load (Ib-TS/d) SSO Violatile Solida Load (Ib-TS/d) HSOW No 2. Tristo No. 2. Organic Nitrogen Content (Ib-N/Ib-TS). HSOW No. 2. Nitrogen Content (Ib-N/Ib-TS). HSOW No. 2. Nitrogen Content (Ib-N/Ib-TS). Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS). Primary Sludge Total Solida Load (Ib-TS/d) Primary Sludge Volatile Solida Load (Ib-TS/d) Primary Sludge Solida Load (Ib-TS/d) Primary Sludge Solida Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS). PriMaS Viatile Solida Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS). HXAS Viatile Solida Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS). HSOW Total Nitrogen Content (Ib-N/Ib-TS). HSOW Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS). HSOW No	Annual Average 0.063 180,547 185,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Teb! Peak Month 0.063 134,419 114,255 0.053 5,463 0.000 0 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.0057 1,900 0.005 678 0.010 3.911 3.193 0.005 24 66 7	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120.380 120.380 120.380 0.053 4.852 0.050 0 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0.213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1. SSD Organic Nitrogien Content (Ib-N/Ib-TS). SSD Totat Solids at add (Ib-TS/d) SSD Volatile Solids Load (Ib-TS/d) ISOW No.2 ISIGW IS	Annual Average 0.063 180,947 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 48,007 41,766 0.057 1,545 0.065 28,022 22,418 0.052 551 0.010 3,991 3,193 0.008 24 66 7 9,22 9,457 0.39	Tebl Peak Month 0.053 134,419 114,256 0.053 5,463 0.000 0 0.000 0 0.000 0 0.000 0 0.005 \$9,049 \$1,373 0.057 1,800 0.065 34,468 27,574 0.0052 678 0.0010 3,193 3,008 24 66 7 9,22 8,065 0.39	e X-X Nutrient Loading- A Estimat Ped 14 day Ped 14 day Ped 14 day Ped 14 day Ped 12, 320 Ped 22, 320 Ped 23, 320 Ped 24, 320	3 Peak 7 day 0.063 100,324 00,53 0.053 4,077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0.063 0.0213 51.181 0.053 2.447 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 2.447 0.006 66.20 0.057 2.411 0.065 2.441 3.5,869 0.052 0.010 3.991 3.991 3.991 3.991 3.991 3.991 3.991 3.991 3.24 Color 66 7 9.22 5.240 0.39	Notes
HSOW No. 1 SSO Optimic Nitrogen Content (Ib-N/Ib-TS) SSO Totali Solids Load (Ib-TS/d) SSO Totali Solids Load (Ib-TS/d) SSO Natogen Content (Ib-N/Ib-TS) SSO Natogen Content (Ib-N/Ib-TS) HSOW No.2 Conganic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Conganic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Conganic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Contails Solids Load (Ib-TS/d) HSOW No.2 National Solids Load (Ib-TS/d) HSOW No.2 National Solids Load (Ib-TS/d) HTMary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) HTMS Stali Solids Load (Ib-TS/d) HTMS Solida Ibids Load (Ib-TS/d) Httrogen Content (Ib-N/Ib-TS) HSOW No.2 National Solids Load (Ib-TS/d) Httrogen Content (Ib-N/Ib-TS) HSO Yolal Solids Load (Ib-TS/d) HSO Yolal Httrogen Content (Ib-N/Ib-TS) HSO Yolal Solids Load (Ib-TS/d) HSO Yolal Httrogen Content (Ib-N/Ib-TS) HS	Annual Average 0.063 180,547 185,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 48.007 41.766 0.057 1.545 0.055 28.022 22.418 0.051 551 0.010 3.991 3.193 0.008 24 66 7 9.22 9.457 0.39 2.941	Teb! Peak Month 0.063 134,419 114,256 0.053 5,453 0.000 0 0 0.000 0 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.052 678 0.010 3,931 0.008 24 26 7 9.224 2.66 0.7 9.248	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.065 0.213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SSO Orani Solitogen Content (Ib-N/Ib-TS) SSO Sol Total Solital Load (Ib-TS/d) SSO Violatile Solita Load (Ib-TS/d) SSO Notal Solital Load (Ib-TS/d) SSO Notal Solital Load (Ib-TS/d) HSOW No 2 HSOW NO HSON HSON NO HSOH NO HSOH NO	Annual Average 0.063 180,947 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 48,007 41,766 0.057 1,545 0.065 28,022 22,418 0.052 551 0.010 3,991 3,193 0.008 24 66 7 9,22 9,457 0.39	Tebl Peak Month 0.053 134,419 114,256 0.053 5,463 0.000 0 0.000 0 0.000 0 0.000 0 0.005 \$9,049 \$1,373 0.057 1,800 0.065 34,468 27,574 0.0052 678 0.0010 3,193 3,008 24 66 7 9,22 8,065 0.39	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 120,380 120,380 120,380 0.053 4,892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100,324 00,53 0.053 4,077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.063 0.011 0.053 2.447 0.000 0 0.005 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SSO Data Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Network No. Load (Ib-TA/d) SSO Network No. Load (Ib-TA/d) HSOW No.2 SSO Network No.2 SSO Network No.2 SSO Network No.2 SSO Network Solids Load (Ib-TS/d) HSOW No.2 SSO Network Solids Load (Ib-TS/d) HSOW No.2 SSO Network No.	Annual Average 0.063 180,547 185,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 48.007 41.766 0.057 1.545 0.055 28.022 22.418 0.051 551 0.010 3.991 3.193 0.008 24 66 7 9.22 9.457 0.39 2.941	Teb! Peak Month 0.063 134,419 114,256 0.053 5,453 0.000 0 0 0.000 0 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.052 678 0.010 3,931 0.008 24 26 7 9.224 2.66 0.7 9.248	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.065 0.213 51.181 0.053 2.447 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SSO Oran Soliton Content (Ib-N/Ib-TS) SSO Sol Total Solital Load (Ib-TS/d) SSO Violatile Solita Load (Ib-TS/d) SSO Notal Solital Load (Ib-TS/d) SSO Notal Solital Load (Ib-TS/d) HSOW No 2 HSOW NO H HSOW NO H HSOW NO H HSOW NO H	Annual Average 0.063 180,547 153,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 48,007 41,766 0.057 1,545 0.052 22,418 0.052 551 0.010 3,991 3,193 0.008 24 551 0 7 9,22 9,457 0,319 2,311 0,21 -2.86	Teb! Peak Month 0.063 134,419 114,256 0.053 5,453 0.000 0 0 0.000 0 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.052 678 0.010 3,931 0.008 24 26 7 9.224 2.66 0.7 9.248	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 120,380 120,380 0.053 4,892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.061 0.051 0.053 2.447 0.000 0 0.006 0.006 0.000 0 0.006 0.005 2.471 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Totali Solids Load (Ib-TS/d) SS0 Totali Solids Load (Ib-TS/d) SS0 Nationalin-XI Load (Ib-N/d) SS0 Nationalin-XI Load (Ib-N/d) HSOW No 2 (HSOW	Annual Average 0.063 180,547 185,465 0.053 7,338 0.000 0 0 0 0 0 0 0 0 0 0 0 0.005 48.007 41.766 0.057 1.545 0.055 28.022 22.418 0.051 551 0.010 3.991 3.193 0.008 24 66 7 9.22 9.457 0.39 2.941	Teb! Peak Month 0.063 134,419 114,256 0.053 5,453 0.000 0 0 0.000 0 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.052 678 0.010 3,931 0.008 24 26 7 9.224 2.66 0.7 9.248	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 120,380 120,380 120,380 0.053 4,892 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 100.324 85.276 0.053 4.077 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 0.063 0.011 0.053 2.447 0.000 0 0.005 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes

	Date Checked	Checked By	Job Number	Ву	Date	Calc No
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-003
Caldwall		Project				Subject
Caldwell	Encina Biosolids, Energy, and Emissio	ons		Current Year - All Digest	ers in Service	
and the second se						

15 day Thermophilic Digestion with All digesters in service

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicable)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

- [Parameter	Input Values	Reference	Parameter	Input Values	Reference
ſ	Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
[TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
[FOG VSR (%)	90%	3			
	SSO VSR (%)	90%	3			
[Do not use this row					

Nutrients Speciation for Existing Conditions

Primary	Sludge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen S	peciation		Nitrogen Spe	ciation		Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/I)	3.000	

- anno sponson o sugarano	Table	X-X: Existing 15 day The	rmophilic Digestion with All digesters in ser	vice Feed Assessment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	6.70	6.70	6.70	6.70	6.70	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (lb-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	32	26	25	23	20	
Base OLR (lbsVS/d-cf)	0.08	0.09	0.10	0.10	0.12	
Hydraulic Capacity (HC) (gpd)	237.403	191.312	177.284	157.244	117.165	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (Ib-VS/day)	201,954	162,745	150.812	133,764	99,670	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	246.009	231.246	226.754	220.335	207,498	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	
			: Mesophilic Co-digestion Feed Assessmen		.,	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (lb-VS/day)	201,954	162,745	150,812	133,764	99,670	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (Ib-VS/day)	201,954	162,745	150,812	133,764	99,670	
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	Ó	0	Ó	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	201,954	162,745	150,812	133,764	99,670	
SSO Total Solids Load (Ib-TS/day)	237,593	191,465	177,426	157,370	117,259	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	237,593	191,465	177,426	157,370	117,259	
SSO (lb-wet/day)	1,979,941	1,595,539	1,478,548	1,311,417	977,154	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	1,979,941	1,595,539	1,478,548	1,311,417	977,154	
SSO (wtpd)	990	798	739	656	489	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	990	798	739	656	489	
SSO (gpd)	237,403	191,312	177,284	157,244	117,165	
HSOW No. 2 (gpd)	0	Ó	0	Ó	0	
SSO (gpd)	237,403	191,312	177,284	157,244	117,165	
Total Solids, Total Solids Load (Ib-TS/d)	317,613	288,972	280,255	267,802	242,897	
Total Solids, Volatile Solids Load (Ib-VS/d)	269,331	244,884	237,444	226,815	205,557	
Total Flow (gpd)	446,500	446,500	446,500	446,500	446,500	
Primary sludge percent of VS Load (%)	16%	21%	23%	26%	33%	
WAS percent of VS Load (%)	8%	11%	12%	14%	17%	
FOG percent of VS Load (%)	1%	1%	1%	1%	2%	
SSO percent of VS Load (%)	75%	66%	64%	59%	48%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	15	15	15	15	15	

Origination 1000100100100100100100100100IND 1000IND 1000IND 1000IND 1000IND 1000IND 1000IND 1000IND 1000Non 10000IND 1000IND 1000IND 1000IND 1000IND 1000IND 1000Non 100000IND 10000IND 10000IND 10000IND 10000IND 10000Non 10000000IND 100000IND 100000IND 100000IND 100000Non 1000000000000000000000000000000000000							
The base of the second	Co-Digestion OLR (Ibs-VS/d-cf) Process Check	0.30	0.27 OK	0.27 OK	0.25 0K	0.23 0K	
International problemMake and any part of the set of					n	<u>on</u>	
011 Work Schward Prifty Work Schward Prifty 			Peak Month	Peak 14 day			Notes
Bit Market Mar		27,148		35,293		43,437	
Sink Name Problem94.039		2,873		2.873		2.873	
Sind March 28: 5.0SolidS	Total Volatile Solids Destroyed (lb-VSd/day)		49,225	51,863	55,632		
Same Same Same Same Same Same Same Same							Assumes that volume in equals volume out
Instance3.2%3.2%3.2%3.2%3.2%3.2%3.2%Names and large Anderson3.0%3.2%3.2%3.2%3.2%3.2%3.2%Names and large Anderson3.0%3.1%1.0%1.0%3.0%	Total Solids Effluent (Lbs-TS/d)					62,470	
Same bank Same bank Bank bank bank Bank bank Bank bank bank bank Bank bank <br< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th></br<>							
Based and MaxBasedBasedBasedBasedBased Add Part of A		68%	68%	68%	68%	68%	
non-space Non-space <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>							
NEX Mage Andorm 10411/1 / 4112/1 / 4412/1	Biosolids Cake (wtpd) Primary sludge Biogas Production (scfrl)		104				Assumes biosolids cake has a solids content of 22% 15 Assumes a biogas yield of 17.8 scf/lb.VSd
001 model mod	WAS Biogas Production (sofd)		230,684		262,568		
International production state in the X & Maxee Marked Ex & General Direct Production Field 7 mod Production State Internation State Internate Internate Internation State Internation State Internation State	FOG Biogas Production (scfd)						Assumes a biogas yield of 17.8 scf/lb-VSd
International matrix three part of the sector of th	Biogas Production (scfd)	721,930				1,124,401	
Inten and products bials Description27.1033.2033.2033.2041.0010.00Winds bials Description100.0010.0010.0010.0010.0010.0010.00S30 Wates bials Description101.0111.0111.0111.0111.0111.0111.01S30 Wates bials Description100.001000000000100 Wates 100.00100.00100.00100.00100.00100.00100.0000100 Wates 100.00100.00100.00100.00100.00100.00100.0000100 Wates 100.00100.00100.00100.00100.00100.00100.0000100 Wates 100.00100.00100.00100.00100.00100.00100.00100.00100.00100 Wates 100.00100.00100.00100.00100.00100.00100.00100.00100.00100 Wates 100.00100.00100.00100.00100.00100.00100.00100.00100.00100.00100 Wates 100.00100.00100.00100.00100.00100.00100.00100.00100.00100.00100 Wates 100.00100.00100.00100.00100.00100.00100.00100.00100.00100.00100 Wates 100.00100.00100.00100.00100.00100.00100.00100.00100.00100.00100 Wates 100.00100.00100.00 <th></th> <th>Annual Average</th> <th></th> <th></th> <th></th> <th>Peak day</th> <th>Notes</th>		Annual Average				Peak day	Notes
00000000000000000000000000000000000	Primary sludgeVolatile Solids Destroyed (lb-VSd/day)		33,392				
SSN Works Status Description 36 (9)18,17318,07118,17118,28369,173SSN Works Status Description 36 (9)444.00444.0019000Total Status Description 36 (9)444.00444.00444.00444.00444.00444.00Total Status Description 36 (9)444.00444.00444.00444.00444.00444.00Total Status Description 36 (9)40.0219,7890.0290.0290.02Status Description 36 (9)40.0240.0240.0290.0290.02Status Description 36 (9)40.0240.0240.0240.0290.02Status Description 36 (9)40.0240.0240.0240.0240.02Status Description 36 (9)40.0280.0240.0240.0240.02Status Description 36 (9)40.0220.0220.0240.0210.0240.02Status Description 36 (9)40.0220.0220.0220.0220.0210.0240.02Status Description 36 (9)40.0220.0220.0220.0220.0220.0240.0240.02Status Description 36 (9)40.0220.02	WAS Volatile Solids Destroyed (lb-VSd/day)	10,536	12,960	13,697	14,751	16,858	
distry b. 2. South Subi Boning B. Soly (a)0000000100 thore b. Soly (a)0.000010000110000011000000110000001100000	FUG volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Tark Values Sub besing the Yang722.316195.000195.000197.000197.000197.000Stables the Values Sub Description4.0.0004.0.0004.0.0004.0.000Alest for the other legal values of the part of t							
Total Subje Thematogin445.500445.500445.500445.500Access of Marceline and Archive in equal rolem of aTotal Subje Turing10.71710.71810.71810.71810.71810.718Total Subje Turing10.71810.71810.71810.71810.71810.718Total Subje Turing10.71810.71810.71810.71810.71810.718Total Subje Turing10.71710.71810.71810.71810.71810.71810.718Total Subje Turing10.71710.71710.718	Total Volatile Solids Destroyed (lb-VSd/day)						
Name:0.10140.10340.1080.1080.1070.2.08Baseline (Samo)0.5100.5100.5100.5100.5100.5100.510Baseline (Samo)0.5120.5120.5120.5130.5130.5130.5130.513Baseline (Samo)0.5120.513 <td>Total Sludge Effluent (gpd)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Assumes that volume in equals volume out</td>	Total Sludge Effluent (gpd)						Assumes that volume in equals volume out
fact Seine, 1%)2.0%2.5%2.5%2.4%Web Seine, 1%)63%63%63%67%67%Basile, 1%, 1%6.0%67%7%%7%%Basile, 1%, 1%7%%7%%7%%7%%Basile, 1%, 1%7%%7%%7%%7%%Basile, 1%, 1%7%%7%%7%%7%%Basile, 1%, 1%1%%1%%7%%7%%Basile, 1%, 1%1%%1%%7%%7%%Basile, 1%%1%%1%%1%%7%%8%%Basile, 1%%1%%1%%1%%7%%8%%Basile, 1%%1%%1%%1%%1%%8%%8%%Basile, 1%%1%%1%%1%%1%%8%%8%%Basile, 1%%1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%%1%%1%%1%%Basile, 1%%1%%1%% </th <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>							
Wather Solid4%5%5%5%5%5%SolidS		2.6%	2.5%	2.5%	2.5%	2.4%	
Biositic Cale login 200 201 200 198 Meanue beoling cale sa gabb canted d2215 Mice Value Static Retroy (B /VK (A)) 101.52 704.52 77.13 Access 2000000 (P / KK (A)) Mice Value Static Retroy (B /VK (A)) 101.52 202.64 202.05 300.077 Access 200000 (P / KK (A)) Mice Value Static Retroy (B / VK (A)) 202.64 202.05 300.077 Access 200000 (P / KK (A)) Static Retro (B / KK (A)) 202.64 202.05 300.077 Access 200000 (P / KK (A)) Static Retro (B / KK (A)) 303.555 303.552 303.552 303.552 300.077 Access 200000 (P / KK (A)) Static Retro (B / KK (A)) 303.555 305.252 303.552 300.077 Access 200000 (P / KK (A)) Static Retro (B / KK (A)) 0.00 300.071 Access 20000 (P / KK (A)) Note Static Retro (B / KK (A)) 0.053 0.053 0.053 0.053 0.053 Static Retro (B / KK (A)) 0.000 0.000 0.000 0.000 0.000 Static Retro (B / KK (A)) 0.053 0.055 <t< th=""><td>Volatile Solids (% VS)</td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Volatile Solids (% VS)						
Sinay adaptication Solido Bedrograf (b VSM) (a) 440.327 69.328 67.328 67.528 67.528 77.178 Ansame a biogy oided 175 ad (b VSM) C00 Biogy Control (b VSM) (a) 10.138 10.149 10.149 10.149 10.149 0.118 Ansame a biogy oided 175 ad (b VSM) C00 Biogy Control (b VSM) (a) 10.149 10.149 10.149 0.0 0	Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtod)						
NUX Voids Solds Debryed (PSC) (an) 107.54 226.864 20.23.81 20.23.81 300.077 Anomale a bage yield 178 act (PSC) Sold Debryed (PSC) (and (PSC) 1.1160 1.1160 1.1160 Anomale a bage yield 178 act (PSC) Sold Debryed (PSC) 1.1160 1.1160 Anomale a bage yield 178 act (PSC) Sold Debryed (PSC) 1.1160 Anomale A bage yield 178 act (PSC) Anomale A bage yield 178 act (PSC) Sold Debryed (PSC) 1.1160 1.1160 Anomale A bage yield 178 act (PSC) Anomale A bage yield 178 act (PSC) Sold Debryed (PSC) 1.1160 1.1160 1.1160 Anomale A bage yield 178 act (PSC) Sold Debryed (PSC) 1.1160 1.1161 1.1161 Anomale bage yield 178 act (PSC) Sold Debryed (PSC) 0.000 0.0							
S3D Biogn Puddeting Ledd3.271.633.283.0402.443.1522.10.501.51.50Assense biogn pidel of 3.4(2) VoldUna Biogn Puddeting Ledd3.963.053.364.31800<	WAS Volatile Solids Destroyed (Ib-VSd/day)					300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
StOW A.2. Bagas Abduction (sch)00000104 Bagas Abduction (sch)3.952.853.355.2633.355.2633.157.2202.785.051205 Open Ling Lange Abduction (sch)Annota Ab LangePeak X dayPeak X day0.0510.051205 Open Ling Lange Abduction (sch)0.0510.0510.0510.0510.051205 Open Ling Lange Abduction (sch)0.0510.0510.0510.0510.051205 Open Ling Lange Abduction (sch)0.0510.0510.0510.0510.051205 Open Ling Lange Abduction (sch)0.0510.0510.0500.0500.050205 Open Ling Lange Abduction (sch)0.0500.0500.0500.0500.050205 Open Ling Lange Abduction (sch)0.0500.0500.0500.0500.050205 Open Ling Ling Lange Abduction (sch)0.0500.0500.0500.050205 Open Ling Ling Lange Abduction (sch)0.0500.0500.0500.050205 Open Ling Ling Ling Ling Ling Ling Ling Lin		51,145	51,145	51,145	51,145		Assumes a biogas yield of 17.8 scf/lb-VSd
Nate Base phonome (sch)3.312.883.312.883.312.883.312.883.112.287.123.85Born LaAnamone (Sama)Anamone (Sama)Real MonReal		3,271,000	2,030,409	2,443,102	2,100,985	1,014,050	Assumes a mugas yield of 18 SCI/10-V30
Story is in the second seco		3,993,585			3,157,229	2,739,051	
S30 Organ Wingin Conturt (D+ V)/PS)0.0630.0630.0630.0630.063S30 Value Wingin Conturt (D+ V)/PS)227,503112,425115,012113,74699,670S30 Value Solis Lad (D+ V),910.0530.0530.0530.0530.053S30 Manne Minder (D+ V) PS)0.0600.070.070.07S30 Value Solis Lad (D+ V),910.0000.0000.0000.000S50 Value Solis Lad (D+ V),910.0550.0550.0550.055S50 Value Solis Lad (D+ V),910.0520.0520.0520.052S50 Value Soli			Table X-X	Nutrient Loading - Ammonia-N Estimates			
SSD Teak Solvis Land (b × 1/0)201,591191,465177,783157,710177,289SSD Visite Solvis Land (b × 1/0)201,59410,27,151150,812133,76499,670SSD Namoulan K Land (b × 1/0)0,8557,7311,2116,3654,755SSD Namoulan K Land (b × 1/0)0,8557,7311,2116,3654,755SSD Namoulan K Land (b × 1/0)0,0000,0000,0000,0000,000SSD Namoulan K Land (b × 1/0)0,0000,0000,0000,000SSD Namoulan K Land (b × 1/0)0,0550,0550,0550,055Pinary Stolg Fold Solids Land (b × 1/0)0,0570,0570,0570,057Pinary Stolg Fold Solids Land (b × 1/0)0,0550,0550,055Pinary Stolg Fold Solids Land (b × 1/0)0,0550,0570,057Pinary Stolg Fold Solids Land (b × 1/0)0,0150,0570,057Pinary Stolg Fold Solids Land (b × 1/0)0,0160,0160,016Pinary Stolg Fold Solids Land (b × 1/0)0,0160,0160,016 <td< th=""><th>HSOW No 1</th><th></th><th></th><th></th><th></th><th></th><th></th></td<>	HSOW No 1						
S30 Via Solving Control (F-V)(-S)20,15410,74510,0310,0330,0330,033S50 Amount In Lad (B-V,(n))0,0557,7317,2116,3964,755S50 Amount In Lad (B-V,(n))0,0000,0000,0000,0000,000S50 Amount In Lad (B-V,(n))0,0000,0000,0000,000S50 Amount In Lad (B-V,(n))0,0050,0050,0550,055S50 Amount In Lad (B-V,(n))0,0550,0550,0550,057S50 Amount In Lad (B-V,(n))0,0550,0550,0570,057S50 Amount In Lad (B-V,(n))0,0570,0570,0570,057S50 Amount In Lad (B-V,(n))0,0520,0520,0520,052S50 Amount In Lad (B-V,(n))0,0500,0520,0520,052S50 Amount In Lad (B-V,(n))0,0100,0100,0100,010S50 Amount In Lad (B-V,(n))0,010	SSO Organic Nitrogen Content (Ib-N/Ib-TS)						10183
S30 Amount M Load (b A(shy)0.8687.7817.7210.9.090.4.09HSOW No20 granic Mitragen Content (b A/Vh TS)0.0000.0000.0000.0000.000HSOW No20 Stabilit Scald (b N5/n)0.0000.0000.0000.0000.000HSOW No20 Stabilit Scald (b N5/n)0.0000.0000.0000.0000.000HSOW No20 Stabilit Scald (b N5/n)0.0000.0000.0000.0000.000HSOW No20 Stabilit Scald (b N5/n)0.0050.0050.0050.005HSOW No20 Stabilit Scald (b N5/n)0.0050.0050.0050.005HSOW Scald (b N5/n)0.0050.0050.0050.0050.005HSOW Scald (b N5/n)0.0050.0050.0050.005 <th>SSO Organic Nitrogen Content (Ib-N/Ib-TS)</th> <th>0.063</th> <th>0.063</th> <th>0.063</th> <th>0.063</th> <th>0.063</th> <th>10105</th>	SSO Organic Nitrogen Content (Ib-N/Ib-TS)	0.063	0.063	0.063	0.063	0.063	10105
HSOW No.2 Image Image Image Image Image HSOW No.2 Total Solis Load (b V5/0) 0.0 0.000 0.000 0.000 0.000 HSOW No.2 Total Solis Load (b V5/0) 0.000 0.000 0.000 0.000 0.000 HSOW No.2 Nucleis Solis Load (b V5/0) 0.000 0.000 0.000 0.000 0.000 HSOW No.2 Nucleis Solis Load (b V5/0) 0.000 0.000 0.000 0.000 Harry Shage Total Solis Load (b V5/0) 0.005 0.005 0.005 0.005 Prinary Shage Total Solis Load (b V5/0) 44.007 Sp.049 0.2.10 0.615 0.005 Prinary Shage Total Solis Load (b V5/0) 45.007 Sp.049 0.2.005 0.065 0.065 Prinary Shage Total Solis Load (b V5/0) 0.057 0.067 0.067 0.067 0.067 MS Total Solis Load (b V5/0) 0.056 0.065 0.065 0.065 0.065 MS Total Solis Load (b V5/0) 2.2.168 2.7.18 3.2.168 3.6.01 MS Total Solis Load (b V5/0)	SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	0.063 237,593 201,954	0.063 191,465 162,745	0.063 177,426 150,812	0.063 157,370 133,764	0.063 117,259 99,670	
HSOW No. 2 data Sinki Sady (H-Y) 0.000 0.000 0.000 0.000 HSOW No. 2 data Sinki Sady (H-Y) 0 0 0 0 0 HSOW No. 2 data Sinki Sady (H-Y) 0.000 0.000 0.000 0.000 0.000 HSOW No. 2 data Sinki Sady (H-Y) 0.000 0.000 0.000 0.000 0.000 HSOW No. 2 data Sinki Sady (H-Y) 0.005 0.005 0.005 0.005 Hang Sady Eal Ntrogen Content (H-N/H-YS) 0.065 0.065 0.065 0.065 Hang Sady Eal Ntrogen Content (H-N/H-YS) 0.065 0.065 0.065 0.065 Hang Sady Eal Ntrogen Content (H-N/H-YS) 0.065 0.065 0.065 0.065 Hang Sady Eal Ntrogen Content (H-N/H-YS) 0.055 0.055 0.055 0.055 Hang Sady Eal Ntrogen Content (H-N/H-YS) 0.055 0.052 0.052 0.052 Hang Sady Eal Ntrogen Content (H-N/H-YS) 0.055 0.052 0.052 0.052 Hang Sady Eal Ntrogen Content (H-N/H-YS) 0.055 0.052 0.052 0.052 <tr< th=""><td>SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Soliids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)</td><td>0.063 237,593 201,954 0.053</td><td>0.063 191,465 162,745 0.053</td><td>0.063 177,426 150,812 0.053</td><td>0.063 157,370 133,764 0.053</td><td>0.063 117,259 99,670 0.053</td><td>10003</td></tr<>	SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Soliids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	0.063 237,593 201,954 0.053	0.063 191,465 162,745 0.053	0.063 177,426 150,812 0.053	0.063 157,370 133,764 0.053	0.063 117,259 99,670 0.053	10003
HSOW No. 2 Volutile Solids Land (ID-K/dy) 0 0 0 0 HSOW No. 2 Manon Lotand (ID-K/dy) 0 0 0 0 0 HSOW No. 2 Manon Lotand (ID-K/dy) 0 0 0 0 0 Hang Stage Total Solids Load (ID-K/dy) 0.005 0.005 0.005 0.005 Phang Stage Total Solids Load (ID-K/dy) 48.007 59.048 62.210 67.210 76.812 Phang Stage Total Solids Load (ID-K/dy) 48.007 59.048 62.210 67.210 76.812 Phang Stage Total Solids Load (ID-K/dy) 40.057 0.057 0.057 0.057 0.057 Ningsen Content (ID-K/dy) 1.1545 1.800 2.008 2.163 2.471 WAS Total Ningen Content (ID-K/dy) 0.055 0.065 0.065 0.057 WAS Total Ningen Content (ID-K/dy) 2.8022 3.4488 3.6429 39.231 44.836 WAS Total Ningen Content (ID-K/dy) 2.8012 0.052 0.052 0.052 WAS Total Ningen Content (ID-K/dy) 0.010 0.010	SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 237,593 201,954 0.053	0.063 191,465 162,745 0.053	0.063 177,426 150,812 0.053	0.063 157,370 133,764 0.053	0.063 117,259 99,670 0.053	INTER
HSOW No.2 Almonge Content (De-Wich vs) 0.000 0.000 0.000 0.000 Extend 0 0 0 0 0 Extend 0 0 0 0 0 Extend 0 0 0 0 0 Extend 0 0 0.055 0.056 0.065 0.065 Primary Studge Total Nutingen Content (De-Wich TS) 0.057 0.057 0.057 0.057 0.057 Primary Studge Total Statis Aud (D-K)(A) 0.057 0.057 0.057 0.057 0.057 Mongen Content (De-Wich TS) 0.058 0.056 0.056 0.057 0.057 Mongen Content (De-Wich TS) 0.052 0.052 0.052 0.052 0.052 0.052 MSS Total Statis Load (D-K)(A) 2.2418 2.7574 2.2163 2.3556 Mongen Content (De-Wich TS) 0.010 0.010 0.010 0.010 0.010 Mongen Content (De-Wich TS) 0.010 0.010 0.010 0.010 0.010	SSO Organic Nitrogen Content (D-N/(b-TS) SSO Total Solids (and (b-TS/d) SSO Violatile Solids Load (b-YS/d) SSO Nitrogen Content (D-N/b-YS) SSO Amonium -N Load (b-H/(ay) HSOW No.2 (Caparic Nitrogen Content (b-N/(b-TS))	0.063 237,593 201,954 0.053 9,656 0.000	0.063 191,465 162,745 0.053 7,781 0.000	0.063 177.426 150.812 0.053 7.211 0.000	0.063 157,370 133,764 0.053 6,396 0.000	0.063 117,259 99,670 0.053 4,765 0.000	NVGC
HSOW No. 2 Ammonium-NLoad (b-N/dsy) 0 0 0 0 0 Phrang Sidge Total Ninogen Content (b-N/b-Ts) 0.065 0.065 0.065 0.065 Phrang Sidge Total Ninogen Content (b-N/b-Ts) 0.065 0.065 0.065 0.065 Phrang Sidge Total Ninogen Content (b-N/b-Ts) 0.065 0.065 0.065 0.065 Phrang Sidge Total Ninogen Content (b-N/b-N) 0.057 0.057 0.057 0.057 Ninogen Content (b-N/b-N) 0.055 0.065 0.065 0.065 0.065 Ninogen Content (b-N/b-N) 0.055 0.065 0.065 0.065 0.065 Ninogen Content (b-N/b-N) 0.052 0.052 0.052 0.052 0.052 0.052 0.052 Ninogen Content (b-N/b-N) 0.052	SSO 01ganic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatilie Solids Load (Ib-N/S/d) SSO Nitrogen Content (Ib-N/Ib-NS) SSO Amonium-N-Load (Ib-N/day) HSOW No. 2 HSOW No. 2 SGO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2	0.063 237,593 201,954 0.053 9,656 0.000 0	0.063 191,465 162,745 0.053 7,781 0.000 0	0.063 177,426 150,812 0.053 7,211 0.000 0	0.063 157,370 133,764 0.053 6,396 0.000 0	0.063 117,259 99,670 0.053 4,765 0.000 0	
Primary Sudge Total Nitrogen Content (b-N/b-TS) 0.065 0.065 0.065 0.065 Primary Sudge Total Nitrogen Content (b-N/b-TS) 44.067 59.049 66.2410 67.210 77.6812 Primary Sudge Total Solis Load (b-N/G) 41.766 51.373 54.296 59.473 66.826 Ninogen Content (b-N/b-N) 0.057 0.057 0.057 0.057 0.057 Annonium-Ni Load (b-N/dyn) 1.545 1.900 2.008 2.163 2.471 WAS Total Solis Load (b-N/dyn) 0.057 0.057 0.057 0.057 WAS Content (b-N/dyn) 0.052 0.065 0.065 0.065 WAS Total Solis Load (b-N/dyn) 2.2418 2.7574 2.9413 31.385 2.5849 WMS Total Solis Load (b-N/dyn) 0.0102 0.052 0.052 0.052 0.052 Annonium-N Load (b-N/dyn) 0.010 0.010 0.010 0.010 0.010 SOW Total Solis Load (b-N/dyn) 3.193 3.193 3.193 3.193 3.193 SOW Total Solis Loa	SSO 01ganic Nitrogen Content (Ib-N/Ib-TS) SSO 1143 Losit Load (Ib-15/0) SSD 1143 Losit Load (Ib-15/0) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO No. 2 Total Solidis Load (Ib-VS/0) SSON No.2 Total Solidis Load (Ib-VS/0)	0.063 237,593 201,954 0.053 9,656 0.000 0 0	0.063 191,465 162,745 0.053 7,781 0.000 0 0	0.063 177.426 150.812 0.053 7.211 0.000 0 0	0.063 157,370 133,764 0.053 6,396 0.000 0 0	0.063 117,259 99,670 0.053 4,765 	
Primary Sudge Total Nitrogen Content (b-N/b-TS) 0.065 0.065 0.065 0.065 Primary Sudge Total Nitrogen Content (b-N/b-TS) 44.067 59.049 66.2410 67.210 77.6812 Primary Sudge Total Solis Load (b-N/G) 41.766 51.373 54.296 59.473 66.826 Ninogen Content (b-N/b-N) 0.057 0.057 0.057 0.057 0.057 Annonium-Ni Load (b-N/dyn) 1.545 1.900 2.008 2.163 2.471 WAS Total Solis Load (b-N/dyn) 0.057 0.057 0.057 0.057 WAS Content (b-N/dyn) 0.052 0.065 0.065 0.065 WAS Total Solis Load (b-N/dyn) 2.2418 2.7574 2.9413 31.385 2.5849 WMS Total Solis Load (b-N/dyn) 0.0102 0.052 0.052 0.052 0.052 Annonium-N Load (b-N/dyn) 0.010 0.010 0.010 0.010 0.010 SOW Total Solis Load (b-N/dyn) 3.193 3.193 3.193 3.193 3.193 SOW Total Solis Loa	SS0 Organic Nitrogen Content (D-M/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatils Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-M/Ib-VS) SS0 Ammonium-N Load (Ib-M/day) HSOW No.2 HSOW No.2 HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2	0.063 237.593 201,954 0.053 9.656 0.000 0 0 0 0.000	0.063 191,465 162,745 0.053 7,781 0.000 0 0 0 0.000	0.063 177,426 150,812 0.053 7,211 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 157,370 133,764 0.053 6,396 0.000 0 0 0 0 0	0.063 117,259 99,670 0.053 4,765 	
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Annmalan-Ni Ladg (b-N/dsp) 1,845 1,900 2,008 2,183 2,471 WMS	SS0 Organic Nitrogen Content (D-N/(b-TS)) SS0 Valatile cad (b-TS/d) SS0 Total Solids Load (b-TS/d) SS0 Nitrogen Content (D-N/b-YS) SS0 Nitrogen Content (D-N/b-YS) SS0 Nitrogen Content (D-N/b-YS)	0.063 237,593 201,954 0.053 9,656 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 191,465 162,745 0.053 7,781 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 177.426 150.812 0.053 7.211 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 157,370 133,764 0.053 6,396 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 117,259 99,670 0.053 4,765 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
TWAS Image	SS0 Organic Nitrogen Content (D-N/(b-TS)) SS0 Total Solids (and (b) TS/d) SS0 Viatilité Solids Load (b) TS/d) SS0 Nitrogien Content (D-N/b /S) Statistical Solids Load (D-N/dy)	0.063 237,593 201,954 0.053 9,656 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 191.465 162,745 0.053 7,781 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 177.426 150.812 0.053 7.211 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 157,370 133,764 0.053 6,396 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 117,259 99,670 0.053 4,765 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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Annonlum-Wonc, (mg/1) 3,162 2,788 2,674 2,512 2,187 Annonlum-Wonc, (mg/1) 0.23 0.20 0.19 0.18 0.16 ing Annonlum-Wonc, (mg/1) 2.22 -2.87 -2.89 2.92 -2.98 Annonlum-Goncentration (mg/HH_H/L) 2.125 18.73 17.97 16.88 14.69 Annonlum-Minicon (mg/HH_L) 2.584 22.79 2.186 20.53 17.87	SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Orladi Solido Load (Ib-TS/d) SS0 Violatile Solido Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Amonium-N Load (Ib-N/day) BSW No. 2. Organic Nitrogen Content (Ib-N/Ib-TS) HSW No. 2. Organic Nitrogen Content (Ib-N/Ib-TS) HSW No. 2. Volatile Solido Load (Ib-TS/d) HSW No. 2. Annonium-N Load (Ib-N/day) Extense Phanay Stadge Content (Ib-N/Ib-TS) HSW No. 2. Annonium-N Load (Ib-N/day) Extense Phanay Stadge Total Nitrogen Content (Ib-N/Ib-TS) HSW No. 2. Annonium-N Load (Ib-N/day) Extense Phanay Stadge Total Nitrogen Content (Ib-N/Ib-TS) Phanay Stadge Total Nitrogen Content (Ib-N/Ib-TS) Phanay Stadge Total Nitrogen Content (Ib-N/Ib-TS) Phanay Stadge Total Nitrogen Content (Ib-N/Ib-TS) Nitros Total Solido Load (Ib-TS/d) WSS Total Solido Load (Ib-TS/d) SOW Total Solido Load (Ib-TS/d) HSOW	0.063 237,593 201,954 0.053 9,656 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 191.465 162.745 0.053 7,781 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.083 177.426 150.812 0.053 7,211 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 157.370 133.764 0.053 6.396 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0.063 117.259 9.070 0.053 4.765 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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Ammonia Concentration (mg.NHj-N/L) 21.25 18.73 17.97 16.88 14.69 Ammonia Concentration (mg.NHj-L/L) 25.84 22.79 21.86 20.53 17.87	SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Orala Solids Load (Ib-TS/d) SSO Viabilit Solids Load (Ib-TS/d) SSO Nitrogin Content (Ib-N/Ib-TS) SSO Annonium-N Laad (Ib-N/day) SSO Annonium-N Laad (Ib-TS/d) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) Primary Sildge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sildge Viabilis Solids Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) TWAS Total Solids Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) TWAS Total Solids Load (Ib-YS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-YS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-YS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-YS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-YS/d) HSOW Total Soli	0.063 237,593 201,954 0.053 9,856 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 191.465 102.745 0.053 7,781 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 177.426 150.812 0.053 7.211 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 157.370 133.764 0.053 6.396 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.005 0.005 99.670 0.053 4.765 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
Ammonia Concentration (mg-NHz/L) 25.84 22.79 21.86 20.53 17.87	SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Orlad Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Amonium-N Load (Ib-N/day) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Notal Solids Load (Ib-TS/d) HSOW No. 2 Notal Solids Load (Ib-TS/d) HSOW No. 2 Amonium-N Load (Ib-N/Ib-TS) HSOW No. 2 Amonium-N Load (Ib-N/Ib-TS) HIMBY Solidge Total Nitrogen Content (Ib-N/Ib-TS) HIMBY Solidie Solids Load (Ib-TS/d) HIMBY HIMBY HIMBY HIMBY Solidie Solids Load (Ib-TS/d) HIMBY Solidie Solids Load (Ib-TS/d) HIMBY Solidie Solids Load (Ib-TS/d) HIMBY HIMBY HIMBY HIMBY HIMBY HIM	0.063 237,593 201,954 0.053 9,656 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 191.465 162.745 0.053 7.781 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.083 177.426 150.812 0.053 7,211 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 157.370 133.764 0.053 6.396 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0.063 99.670 0.053 4.765 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
Ammonia Toxic ok ok ok ok	SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Orala Solids Load (Ib-TS/d) SSO Viabilit Solids Load (Ib-TS/d) SSO Nitrogin Content (Ib-N/Ib-TS) SSO Annonium-N Laad (Ib-N/day) SSO Annonium-N Laad (Ib-TS/d) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Viabilits Load (Ib-TS/d) SSO Annonium-N Laad (Ib-N/day) SSO Kore Solids Load (Ib-TS/d) Primary Sildge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sildge Viabilis Solids Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) TWAS Total Solids Load (Ib-YS/d) Nitrogen Content (Ib-N/Ib-TS) TWAS Total Solids Load (Ib-YS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) PriMAS Total Solids Load (Ib-YS/d) HSOW Total Solids Load (Ib-YS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-YS/d) HSOW Total Solids Load (Ib-YS/	0.063 237,593 201,954 0.053 9,856 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 191.465 102.745 0.053 7,781 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 177.426 150.812 0.053 7.211 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 157.370 133.764 0.053 6.396 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.005 0.005 117.259 90.670 0.053 4.765 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Image Image </td
	SSO 01 and Nulls cand (Ib-Yk/b-TS) SSO 1041 Solids Load (Ib-Ys/d) SSO Vialati Solids Load (Ib-Ys/d) SSO Notes Control (Ib-Yk/b-Ys) Statis Control (Ib-Yk/b-Ys) Primary Studge Total Nitrogen Content (Ib-Yk/b-Ys) Notes Control (Ib-Yk/b-Ys) Ammonium-K Load (Ib-Yk/dy) WMS Total Solids Load (Ib-Ys/d) Nitrogen Content (Ib-N/b-TS) WMS Total Solids Load (Ib-Ys/d) Nitrogen Content (Ib-N/b-TS) Statis Solids Load (Ib-Ys/d) Statis S	0.063 237,593 201,954 0.053 9,856 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 191.465 102.745 0.053 7,781 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 177.426 150.812 0.053 7,211 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 157.370 133.764 0.053 6.396 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0.063 117.259 9.670 0.053 4.765 0.000 0 0 0 0 0 0 0 0 0 0 0 0	INDEC Image:

Brown AND Caldwell	
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Date Checked	Checked By	Job Number	By	Date	Calc No		
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-003		
Project					Subject		
Encina Biosolids, Energy, and Emiss	ons		Current Year - All Digesters in Service				

10 day Thermophilic Digestion

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days) 10 Assumed Peaking Factors					
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference	
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSOW (blank if not applicable)			
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1	
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1	
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1	
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2	
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No		
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1	

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dofe

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Slud	Primary Sludge		TWAS Existing HSOW (if applic			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speci	ation		Nitrogen Spec	ciation		Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (lb-N/lb-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

			#REF!			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	5.84	5.84	5.84	5.84	5.84	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (Ib-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (Ib-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	28	23	22	20	18	
Base OLR (lbsVS/d-cf)	0.09	0.11	0.11	0.12	0.14	
Hydraulic Capacity (HC) (gpd)	375,153	329,062	315,034	294,994	254,915	Assumes the minimum allowable HRT 10 days
HC as Equivalent VS Load (lb-VS/day)	319,135	279,926	267,993	250,946	216,851	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (lb-VS/day)	206,002	191,240	186,747	180,328	167,492	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Organic Load		Organic Load	Organic Load	
		Table	X-X: Mesophilic Co-digestion Feed Assessm	ent		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	206,002	191,240	186,747	180,328	167,492	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/day)	206,002	191,240	186,747	180,328	167,492	
HSOW No. 2 Volatile Solids Load (lb-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (lb-VS/day)	206,002	191,240	186,747	180,328	167,492	
SSO Total Solids Load (lb-TS/day)	242,355	224,988	219,702	212,151	197,049	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (lb-TS/day)	242,355	224,988	219,702	212,151	197,049	
SSO (lb-wet/day)	2,019,629	1,874,900	1,830,851	1,767,926	1,642,074	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	2,019,629	1,874,900	1,830,851	1,767,926	1,642,074	
SSO (wtpd)	1,010	937	915	884	821	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	1,010	937	915	884	821	
SSO (gpd)	242,162	224,808	219,527	211,981	196,891	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	242,162	224,808	219,527	211,981	196,891	
Total Solids, Total Solids Load (lb-TS/d)	322,376	322,495	322,532	322,583	322,687	
Total Solids, Volatile Solids Load (Ib-VS/d)	273,379	273,379	273,379	273,379	273,379	
Total Flow (gpd)	451.259	479,996	488,743	501.237	526.227	

WAS percent of VS Load (%)	8%	10%	11%	11%	13%	
FOG percent of VS Load (%)	1%	1%	1%	1%	1%	
SSO percent of VS Load (%)	75%	70%	68%	66%	61%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0% 0k	
Check	0K 13	0K 12	<u>ok</u> 12	ок 12	0K 11	
Co-digestion HRT (days) Co-Digestion OLR (lbs-VS/d-cf)	0.35	0.35	0.35	0.35	0.35	
Process Check	OK	OK	0K	OK	OK	
	•	Table X-)	: Existing Mesophilic Solids and Biogas Proc	luction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960	13,697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day) Total Volatile Solids Destroyed (Ib-VSd/day)	2,873 40,558	2,873 49,225	2,873 51,863	2,873	2,873 63.169	
Total Sludge Effluent (gpd)	40,558	49,225	51,863	289 256	320 335	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	39,463	48.282	50,966	54.801	62,470	Assumes that fortune in equals fortune but
Volatile Solids Effluent (Lbs-VS/d)	26,819	32,914	34,769	37,419	42,719	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd) Primary sludge Biogas Production (scfd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	483,237 187,548	230 684	243,813	262 568	300.077	Assumes a biogas yield of 17.8 sci/lb-VSd Assumes a biogas yield of 17.8 sci/lb-VSd
FOG Biogas Production (scfd)	51.145	51,145	51.145	51.145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	721,930	876,211	923,166	990,244	1,124,401	
			Mesophilic Co-digestion Solids and Biogas P			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (lb-VSd/day) FOG Volatile Solids Destroyed (lb-VSd/day)	10,536	12,960	13,697	14,751	16,858	
SSO Volatile Solids Destroyed (Ib-VSd/ day)	2,013	2,873	2,013 168.072	2,013	2,873	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	225,960	221,341	219,935	217,927	213,911	
Total Sludge Effluent (gpd)	451,259	479,996	488,743	501,237	526,227	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	96,416	101,154	102,596	104,656	108,776	
Volatile Solids (Lbs-VS/d) Total Solida (V. TS)	47,419	52,038	53,444	55,452	59,468	
Total Solids (% TS) Volatile Solids (% VS)	2.6%	2.5%	2.5%	2.5%	2.5%	
Dewatered Solids (Lbs-TS/d)	91.595	96.096	97.466	99.423	103.337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	208	218	222	226	235	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145 3.337,235	51,145 3.098.084	51,145 3.025.299	51,145 2.921.320	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd) HSOW No. 2 Biogas Production (scfd)	3,337,235	3,098,084	3,025,299	2,921,320	2,713,363	Assumes a biogas yield of 18 scf/lb-VSd
1150W No. 2 Diogast Toduction (sciu)						
Total Biogas Production (scfd)	4.059.165	3.974.295	3.948.465	3.911.565	3.837.765	
Total Biogas Production (scfd)	4,059,165				3,837,765	
HSOW No 1	4,059,165 Annual Average		3,948,465 e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day		3,837,765 Peak day	Notes
HSOW No 1 SSO Organic Nitrogen Content (lb-N/lb-TS)		Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	Annual Average	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day	es Peak 7 day	Peak day	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	Annual Average 0.063 242,355 206,002	Table Peak Month 0.063 224,988 191,240	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 186,747	es Peak 7 day 0.063 212,151 180,328	Peak day 0.063 197,049 167,492	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solidis Load (Ib-TS/d) SSO Violatile Solidis Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	Annual Average	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day 0.063	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	Annual Average 0.063 242,355 206,002	Table Peak Month 0.063 224,988 191,240	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 186,747	es Peak 7 day 0.063 212,151 180,328	Peak day 0.063 197,049 167,492	Notes
HSOW No 1 SSO Organs Nitogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-YS/d) SSO Nitogen Content (Ib-N/Ib-YS) SSO Ammonium-Load (Ib-N/day) HSOW No 2 IISOW No 2 SSO Nano Salma Salma Salma Salma Salma Salma Salma Salma HSOW No 2 HSOW No 2	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000	Table Peak Month 0.063 224,988 191,240	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 186,747	es Peak 7 day 0.063 212,151 180,328	Peak day 0.063 197,049 167,492	Notes
HSOW No 1 SS0 Organic Nitrogen Content (Ib-A/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-N/d) SS0 Monter Solids Load (Ib-N/d-N) SS0 Monter Solids Load (Ib-N/d-N) SS0 Ammonium-N Load (Ib-N/d-N) HSOW No. 2 Organic Nitrogen Content (Ib-N/lb-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/d)	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0	Tabl Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 186,747 0.053 8,929 0.000 0	es Peak 7 day 0.063 212,151 180,328 0.053 8,622 0.000 0 0	Peak day 0.063 197,049 167,492 0.053 8,008 0.000 0	Notes
HSOW No 1. SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solida Load (Ib-TS/d) SSO Violatile Solida Load (Ib-YS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Namonium-NL Load (Ib-N/Vday) HSOW No 2 HSOW NO 4 HSOW HSO 4 HSOW NO 4 HSOW HSO 4 HSOW NO 4 HSOW HSO 4 HSOW HSOW HSOW HSOW HSOW HSOW HSOW HSOW	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000	Table Peak Month 0.063 224,988 191,240 0.053 9,144	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 196,747 0.053 8.529	es Peak 7 day 0.063 212,151 180,328 0.053 8,622	Peak day 0.063 197,049 167,492 0.053 8,008	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-4//b-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotatile Solids Load (Ib-Y,d) SSO Viotatile Solids Load (Ib-Y,d) SSO Monosilant - NLad (Ib-N/Jb-TS) HSOW No. 2 HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Valial Solids Load (Ib-TS/d)	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0	Tabl Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 186,747 0.053 8,929 0.000 0	es Peak 7 day 0.063 212,151 180,328 0.053 8,622 0.000 0 0	Peak day 0.063 197,049 167,492 0.053 8,008 0.000 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) SSO Moneolime-NL Load (Ib-N/Ib-TS) HSOW No. 2	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0.000	Tabl Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 186,747 0.053 8,929 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 212,151 180,328 0.053 8,622 0.000 0 0	Peak day 0.063 197,049 167,492 0.053 8,008 0.000 0	Notes
HSOW No. 1 SS0 Organic Nitrogen Content (Ib-H/Ib-TS) SS0 Total Solid Load (Ib-TS/d) SS0 Visiti Solidis Load (Ib-TS/d) SS0 Nitrogen Content (Ib-H/Ib-VS) SS0 Nitrogen Content (Ib-H/Ib-VS) SS0 Nitrogen Content (Ib-H/Ib-VS) HSOW No.2	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 224,988 191,240 0.053 9,144 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 196,747 0.053 8,929 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 212,151 180,328 0.053 8,622 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197,049 167,492 0.053 8,008 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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HSOW No. 1 SSO Organic Nitrogen Content (Ib-H/Ib-TS) SSO Total Solid Load (Ib-TS/d) SSO Valatilis Solid Load (Ib-TS/d) SSO Nitrogen Content (Ib-H/Ib VS) SSO Ammonium-NLaod (Ib-H/day) HSOW No.2 HSOW NO.2	Annual Average 0.063 242,355 206,002 0.053 9,849 0 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219,702 186,747 0.053 8,929 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 212.151 180.328 0.053 8.622 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197,049 167,492 0.053 8,008 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No.1 SSO Orbanic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Natoliane X-10 Add (Ib-Y/d) SSO Natoliane X-10 Add (Ib-Y/d) SSO Manoniane-NL Load (Ib-Y/d) HSOW No.2 HSOW No.2 HSOW No.2 HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 HSOW No.2 HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 HSOW No.2 HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 HSOW No.2 HSOW No.2 Add (Ib-YS/d) HSOW No.2 HSOW No.2 HSOW No.2 HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 HSOW No.2 <td< td=""><td>Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Tabl Peak Month 0.063 224,988 191,240 0.053 9,144 0 0 0 0 0 0 0</td><td>e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219.702 186.747 0.053 8.829 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>e3 Peak 7 day 0.063 212,151 180,328 0.053 8,622 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Peak day 0.063 197,049 167,492 0.053 8,008 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>Notes</td></td<>	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 224,988 191,240 0.053 9,144 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219.702 186.747 0.053 8.829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 212,151 180,328 0.053 8,622 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197,049 167,492 0.053 8,008 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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HSOW No. 1 SSO Organic Nitrogen Content (Ib-H/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Visitile Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-H/Ib-TS) SSO Nitrogen Content (Ib-H/Ib-TS) HSOW No.2 HSOW NO.4 HSOM NO.4 HSOW NO.4 HSOM NO.4 HSOW NO.4 HSOM NO.4 HSOM NO.4 HSOM NO.4 HSOW NO.4 HSOM NO	Anual Average 0.063 242,335 266,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.063 224.988 191.240 0.053 9.144 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading- A monoia-N Estimat Peak 14 day 0.063 215,702 188,747 0.053 8,929 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 212,151 212,151 180,328 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 197.049 0.053 8.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Namoniam-N Load (Ib-N/do) HSOW No.2 Total Content (Ib-N/Ib-TS) HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 Notatile Solids Load (Ib-TS/d) HSOW No.2 Notatile Solids Load (Ib-TS/d) HTMS Model Solids Load (Ib-TS/d) HTMS Total Solids Load (Ib-TS/d) HTMS Solids Load (Ib-TS/d) HSW Notal Solids Load (Ib-TS/d) HSM Solids Load (Ib-YS/d) HSM Solids Load (Ib-TS/d) HSM Total HSM Load Load (Ib	Anual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Crist Peak Month 0.063 224,988 191,240 0.053 9,144 0.063 9,144 0.000 0 0 0 0 0 0 0 0 0.005 59,049 51,373 0.0057 1.900 0.0055 34,468 27,574 0.057 678	e X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 219.702 186.747 0.053 8.929 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 212,151 180,328 0.053 8,622 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197,049 167,492 0.053 8.008 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-H/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Visitile Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-H/Ib-TS) SSO Nitrogen Content (Ib-H/Ib-TS) HSOW No.2 HSOW NO.4 HSOM NO.4 HSOW NO.4 HSOM NO.4 HSOW NO.4 HSOM NO.4 HSOM NO.4 HSOM NO.4 HSOW NO.4 HSOM NO	Antual Average 0.063 242,355 206,002 0.053 9,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.053 224,988 191,240 0.053 9,144 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.065 678 0.052 678 0.010 3,991 3,193	e X-X Nutrient Loading- A monoia-N Estimat Peak 14 day 0.063 215,702 188,747 0.053 8,929 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 212,151 212,151 180,328 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 197.049 0.053 8.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Jotal Solide Cold (Ib-TS/d) SSO Variati Solide Load (Ib-TS/d) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Not Solide Load (Ib-TS/d) Not Solide Load (Ib-TS/d) Not Solide Load (Ib-TS/d) Not Solide Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-	Antual Average 0.063 242,355 206,002 0.053 9,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.053 224,988 191,240 0.053 9,144 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.065 678 0.052 678 0.010 3,991 3,193	e X-X Nutrient Loading- A monoia-N Estimat Peak 14 day 0.063 215,702 188,747 0.053 8,929 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 212,151 212,151 180,328 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 197.049 0.053 8.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Violatile Solids Load (Ib-TS/d) HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 North Solids Load (Ib-TS/d) HSOW No.2 North Solids Load (Ib-TS/d) HSOW No.2 North Solids Load (Ib-TS/d) HTMAY Solids Total Solids Load (Ib-TS/d) HTMAY Solids Total Solids Load (Ib-TS/d) HTMAS Solids Load (Ib-TS/d) HTMAS Total Solids Load (Ib-TS/d) HTMAS Solids Load (Ib-TS/d) HOMONICH LOAD (Ib-H/Ib-TS) HSOW Total Solids Load (Ib-TS/d) HSOW Holatile Solids Load (Ib-TS/d) HSOW Total Solids Load (Ib-TS/d	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.053 224,988 191,240 0.053 9,144 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.065 678 0.052 678 0.010 3,991 3,193	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 2119,702 106,747 0.063 8,829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.053 212,151 150,328 0.053 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 197.049 0.053 8.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organice Nitrogen Content (Ib-N/Ib-TS) SSO Organice Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Solids Load (Ib-TS/d) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) HTMary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) HTMAS Solid Ib-N/Ib-NS) Ammonium-N Load (Ib-N/Ib-NS) TMAS Total Solids Load (Ib-TS/d) TWAS Total Nitrogen Content (Ib-N/Ib-TS) TWAS Total Nitrogen Content (Ib-N/Ib-TS) HXAS Total Solids Load (Ib-TS/d) HXAS Total Nitrogen Content (Ib-N/Ib-TS) HXAS Total Tengenzhure (deg C) Digester pH	Annual Average 0.063 242,355 206,002 0.053 9,849 0 0 0 0 0 0 0 0 0 0 0 0 0	Tel: Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.0057 1,900 0.005 678 0.010 3.911 3.193 0.005 24 66 7	e X-X. Nutrient Loading - A monoia-N Estimat Peak 14 day 0.063 219,702 186,747 0.053 8,829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 212,151 180,328 0.053 8,622 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 197.049 0.053 8,008 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SSO Organic Nitrogien Content (Ib-H/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-TS/d) HSOW No 2 HSOW	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0.005 48.007 41.766 0.057 1.545 0.052 22.418 0.052 551 0.010 3.991 3.193 0.008 24 66 7 9.22	Tebl Peak Month 0.053 224,988 191,240 0.053 9,144 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading- A monoia-N Estimat Peak 14 day 0.063 2119,702 105,702 0.053 8,829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 212,151 150,328 0.053 0.053 8,662 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.053 197.049 167.492 0.053 8.006 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-YG) SS0 Nitrogen Content (Ib-N/Ib-YG) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Namonium-N Load (Ib-N/C40y) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No 2 Organic Nitrogen Content (Ib-N/Ib-YG) HSOW No 2 Nitrogen Content (Ib-N/Ib-YG) HSOW No 2 Nitrogen Content (Ib-N/Ib-YG) HSOW No 2 Nitrogen Content (Ib-N/Ib-YG) HTMAS Studie Studie Suids Load (Ib-TS/d) WItrogen Content (Ib-N/Ib-YG) Nitrogen Content (Ib-N/Ib-YG) Nitrogen Content (Ib-N/Ib-YG) Nitrogen Content (Ib-N/Ib-YG) Ammonium-N Load (Ib-N/day) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Notalie Solids Load (Ib-TS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Notalie Solids Load (Ib-TS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Notalie Solids Load (Ib-TS/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Notalie Solids Load (Ib-YG/d) HSOW Total Nitrogen Content (Ib-N/Ib-TS) HSOW Notalie Solids Load (Ib-YG/d) HSOW Notalie Solids Load	Annual Average 0.063 242,355 206,002 0.053 9,849 0 0 0 0 0 0 0 0 0 0 0 0 0	Tel: Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.0057 1,900 0.005 678 0.010 3.911 3.193 0.005 24 66 7	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 2195,747 0.053 8,829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 212,151 180,328 0.053 8,622 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 197.049 0.053 8,008 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Oracla Solica Load (Ib-H/(Ib-TS) SSO Violatile Solids Load (Ib-TS/d) HSOW No.2 SSO AmoniumN Load (Ib-H/dos) HSOW No.2 SSO Violatile Solids Load (Ib-TS/d) HSOW No.2 Nove Content (Ib-H/Ib-TS) HSOW No.2 Nove Content (Ib-H/Ib-TS) Homay Solidge Total Solids Load (Ib-TS/d) Primay Solidge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-H/Ib-TS) HYMS Total Solids Load (Ib-TS/d) HNS Total Solids Load (Ib-TS/d) HNS Total Solids Load (Ib-TS/d) HSOW Total S	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0.065 48,007 41,766 0.057 1,545 0.052 551 0.010 3,991 3,193 0.008 24 66 7 9.22 11,969 0.45	Tebl Peak Month 0.053 224,988 191,240 0.053 9,144 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59,049 0.0057 1,800 0.0052 678 0.0010 3,991 3,193 0.008 2.4 66 7 9,22 11,745 0.48	e X-X Nutrient Loading- Ammonia-N Estimat Ped 643 219,702 219,702 105,702 105,702 0,053 8,829 0,000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 212,151 150,328 0.053 8,622 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.053 197.049 167.492 0.053 8.006 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Violatile Solid Load (Ib-TS/d) HSOW No.2 (SSO Amonium-N-Load (Ib-TK/ds)) HSOW No.2 (SSO Amonium-N-Load (Ib-TK/ds)) HSOW No.2 (SSO Amonium-N-Load (Ib-TK/d) HSOW No.2 (SSO Amonium-N-Load (Ib-TK/d)) HTMay Sidde Total Solids Load (Ib-TS/d) Primay Sidde Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-H/Ib-TS) HSOW Total Solids Load (Ib-TS/d) HXAS Storal Solids Load (Ib-TS/d) HXAS Solid Solids Load (Ib-TS/d) HXAS HSOW NO IS Almonium-N Load (Ib-H/H)-TS) HXAS HSOW NO IS Almonium-N Load (Ib-H/H)-TS) HXAS Total Solids Load (Ib-TS/d) HXAS HSOM HXAS HSOLID ALMONIUM-HXAG) Ammonium-N Load (Ib-H/d) HXAS HXAIL SOLID ALMONIUM-HXAG) HXAS HXAIL SOLID HXAIL HXAGHXAGA HXAGHXAGHXAGHXAGHXAGHXAG	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.053 224,988 191,240 0.053 9,144 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 2195,747 0.053 8,829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 212,151 150,328 0.053 0.053 8,662 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.053 197.049 167.492 0.053 8.006 0.000 0 0.000 0 0.000 0 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SSO Data Solids Load (Ib TS/d) SSO Total Solids Load (Ib TS/d) SSO Total Solids Load (Ib TS/d) SSO Total Solids Load (Ib TS/d) SSO Network TL Load (Ib A/dv) HSOW No 2 SSO Network TL Load (Ib A/dv) HSOW No 2 HSOW NO 1	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 48,007 41,766 0.057 1.545 0.065 28,022 22,418 0.051 3,193 0.008 24 66 7 9.22 11,969 0.45 3,180	Teb! Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.052 678 0.001 3,931 0.002 66 7 9.224 0.048 2,934	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 219,702 186,747 0.053 8,829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.053 212,151 180,328 0.053 8,622 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 167.492 0.053 8.008 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Oracle Solic Academic (Ib-H/Ib-TS) SSO Violatile Solid Load (Ib-TS/d) HSOW No.2 (SSO Amonium-N-Load (Ib-TK/ds) HSOW No.2 (SSO Naccount-(Ib-H/Ib-TS) HIMANS (Salad Hinogen Content (Ib-H/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-H/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-H/Ib-TS) WIAS Total Nitrogen Content (Ib-H/Ib-TS) HIMAS Sludge Iodal Load (Ib-Yd o) WAS Total Solids Load (Ib-Yd o) HMAS Sludge Iodal Solids (Load (Ib-Yd)) HMAS HSOW No.2 (Ib-H/Ib-VS) Ammonium-N Load (Ib-H/Ib-TS) HSOW Total Solids Load (Ib-H/Ib-TS) HSOW Total HSOW HS HS HY (I) HSOW	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 48,007 41,766 0.057 1.545 0.065 28,022 22,418 0.051 3,193 0.008 24 66 7 9.22 11,969 0.45 3,180	Teb! Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.052 678 0.001 3,931 0.002 66 7 9.224 0.048 2,934	e X-X Nutrient Loading - Amonia - N Estimat Peak 14 day 0.063 2115,702 108,747 0.053 8,829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.063 21/2,151 21/2,151 180,328 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 197.049 197.049 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No 1 SSO Data Solids Load (Ib TS/d) SSO Total Solids Load (Ib TS/d) SSO Total Solids Load (Ib TS/d) SSO Total Solids Load (Ib TS/d) SSO Network TL Load (Ib A/dv) HSOW No 2 SSO Network TL Load (Ib A/dv) HSOW No 2 HSOW NO 1	Annual Average 0.063 242,355 206,002 0.053 9,849 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 48,007 41,766 0.057 1.545 0.065 28,022 22,418 0.051 3,193 0.008 24 66 7 9.22 11,969 0.45 3,180	Teb! Peak Month 0.063 224,988 191,240 0.053 9,144 0.000 0 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.057 1,900 0.052 678 0.001 3,931 0.002 66 7 9.224 0.048 2,934	e X-X Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 2119,702 108,747 0.053 8,829 0.000 0 0 0 0 0 0 0 0 0 0 0 0	3 Peak 7 day 0.053 212,151 180,328 0.053 8,622 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 197.049 167.492 0.053 8.006 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes

	Date Checked	Checked By	Job Number	Ву	Date	Calc No
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-003
Caldwall		Project				Subject
Caldwell	Encina Biosolids, Energy, and Emissio	ons		Current Year - All Digest	ers in Service	
and the second se						

10 day Thermophilic Digestion with All digesters in service

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	10	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicable)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

- [Parameter	Input Values	Reference	Parameter	Input Values	Reference
ſ	Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
[TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
[FOG VSR (%)	90%	3			
	SSO VSR (%)	90%	3			
[Do not use this row					

Nutrients Speciation for Existing Conditions

Primar	y Sludge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen	Speciation		Nitrogen Spe	ciation		Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		
	_							

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/I)	3,000	

		Table X-X: Existi	ng 10 day Thermophilic Digestion Feed Asse	essment		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	6.70	6.70	6.70	6.70	6.70	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812	
TWAS Total Solids Load (lb-TS/d)	28,022	34,468	36,429	39,231	44,836	
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638	
Primary Sludge Volatile Solids Load (Ib-VS/d)	41,766	51,373	54,296	58,473	66,826	
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887	
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%	
WAS percent of VS Load (%)	33%	34%	34%	34%	34%	
FOG percent of VS Load (%)	5%	4%	4%	3%	3%	
Total Digester Feed Flow (gpd)	209,097	255,188	269,216	289,256	329,335	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%	
Base HRT (days)	32	26	25	23	20	
Base OLR (lbsVS/d-cf)	0.08	0.09	0.10	0.10	0.12	
Hydraulic Capacity (HC) (gpd)	460,653	414.562	400.534	380,494	340.415	Assumes the minimum allowable HRT 10 days
HC as Equivalent VS Load (Ib-VS/day)	391,868	352,659	340.726	323,679	289.584	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	246.009	231.246	226,754	220,335	207,498	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load	
		Table X-)	: Mesophilic Co-digestion Feed Assessmen	t		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (lb-VS/day)	246,009	231,246	226,754	220,335	207,498	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (Ib-VS/day)	246,009	231,246	226,754	220,335	207,498	-
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	Ó	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	246,009	231,246	226,754	220,335	207,498	
SSO Total Solids Load (Ib-TS/day)	289,422	272,055	266,769	259,218	244,116	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	289,422	272,055	266,769	259,218	244,116	
SSO (lb-wet/day)	2,411,851	2,267,122	2,223,074	2,160,148	2,034,296	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	2.411.851	2.267.122	2,223,074	2.160.148	2.034.296	
SSO (wtpd)	1.206	1.134	1.112	1.080	1.017	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	1.206	1.134	1.112	1.080	1.017	
SSO (gpd)	289.191	271.837	266.556	259.011	243.920	
HSOW No. 2 (gpd)	0	0	0	Ó	0	
SSO (gpd)	289.191	271.837	266,556	259.011	243.920	
Total Solids, Total Solids Load (Ib-TS/d)	369,443	369,562	369,598	369,650	369,754	
Total Solids, Volatile Solids Load (Ib-VS/d)	313,386	313,386	313,386	313,386	313,386	
Total Flow (gpd)	498,288	527,025	535,772	548,266	573,256	
Primary sludge percent of VS Load (%)	13%	16%	17%	19%	21%	
WAS percent of VS Load (%)	7%	9%	9%	10%	11%	
FOG percent of VS Load (%)	1%	1%	1%	1%	1%	
SSO percent of VS Load (%)	79%	74%	72%	70%	66%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	13	13	13	12	12	

Co-Digestion OLR (lbs-VS/d-cf)	0.35	0.35	0.35	0.35	0.35	
Process Check	0.35 OK	0.35 OK	0.35 OK	0.35 OK	0.35 OK	
		Table X-X: Exi	sting Mesophilic Solids and Biogas Productio	n		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	27,148	33,392	35,293	38,007	43,437	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (lb-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd) Total Solids Effluent (Lbs-TS/d)	209,097	255,188 48,282	269,216	289,256 54,801	329,335 62,470	Assumes that volume in equals volume out
Volatile Solids Effluent (Lbs-VS/d)	26.819	48,282	34,769	37,419	42,719	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	37,489 85	45,868 104	48,418 110	52,061 118	59,346 135	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) Biogas Production (scfd)	51,145 721,930	51,145 876,211	51,145 923,166	51,145 990,244	51,145 1,124,401	Assumes a biogas yield of 17.8 scf/lb-VSd
Slogas Production (scru)	721,930	Table X-X: Meso			1,124,401	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392	35,293	38,007	43,437	
WAS Volatile Solids Destroyed (Ib-VSd/day)	10,536	12,960 2,873	13,697 2,873	14,751 2,873	16,858 2,873	
FOG Volatile Solids Destroyed (lb-VSd/day) SSO Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	198,302	186,748	
HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day)	Ö	Ó	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	261,966	257,347	255,941	253,933	249,917	
Total Sludge Effluent (gpd) Total Solids (Lbs-TS/d)	498,288 107.477	527,025 112,215	535,772 113,657	548,266 115,717	573,256 119.837	Assumes that volume in equals volume out
Volatile Solids (Lbs-VS/d)	51,420	56,039	57,444	59,452	63,469	
Total Solids (% TS)	2.6%	2.6%	2.5%	2.5%	2.5%	
Volatile Solids (% VS)	48%	50%	51%	51%	53%	Downstand cake accumes ()5% conturn rate
Dewatered Solids (Lbs-TS/d) Biosolids Cake (wtpd)	102,103 232	106,604 242	107,974 245	109,931 250	113,845 259	Dewatered cake assumes 95% capture rate Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) SSO Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	Assumes a biogas yield of 10 sci/ 10-v Su
Total Biogas Production (scfd)	4,707,273	4,622,403	4,596,573	4,559,673	4,485,873	
	Annual Annuals		Nutrient Loading - Ammonia-N Estimates	Deals 7 days	Deals day	Neter
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063	Peak Month 0.063	Peak 14 day 0.063	Peak 7 day 0.063	Peak day 0.063	Notes
SS0 Total Solids Load (lb-TS/d)	289,422	272,055	266,769	259,218	244,116	
SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	246,009	231,246	226,754	220,335	207,498	
SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	246,009 0.053	231,246 0.053	226,754 0.053	220,335 0.053	207,498 0.053	
SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	246,009	231,246	226,754	220,335	207,498	
SS0 Total Solids Load (Ib-15/d) SS0 Violatile Solids Load (Ib-15/d) SS0 Nitrogen Content (Ib-14/Ib-15) SS0 Ammonium-N Load (Ib-14/day) SS0 No.2 Grapaic Nitrogen Content (Ib-14/Ib-T5)	246,009 0.053 11,762 0.000	231,246 0.053 11,056 0.000	226,754 0.053 10,842 0.000	220,335 0.053 10,535 0.000	207,498 0.053 9,921 0.000	
SS0 Total Solids Load (b-15;d) SS0 Notatile Solids Load (b-16;d) SS0 Nitrogen Content (b-1/(b-15)) SS0 Amonium-N Load (b-1/(do)) BKOW No 2. SGW No 2. SGW No 2. Official Nitrogen Content (b-1/(b-15)) SGW No 2. SGW No 2.	246,009 0.053 11,762 0.000 0	231,246 0.053 11,056 0.000 0	226,754 0.053 10,842 0.000 0	220,335 0.053 10,535 0.000 0	207,498 0.053 9,921 0.000 0	
SS0 Total Solids Load (Ib-15/d) SS0 Violatile Solids Load (Ib-15/d) SS0 Nitrogen Content (Ib-14/Ib-15) SS0 Ammonium-N Load (Ib-14/day) SS0 No.2 Grapaic Nitrogen Content (Ib-14/Ib-T5)	246,009 0.053 11,762 0.000	231,246 0.053 11,056 0.000	226,754 0.053 10,842 0.000	220,335 0.053 10,535 0.000	207,498 0.053 9,921 0.000	
SS0 Total Solids Load (Ib-15/d) SS0 Volatille Solids Load (Ib-V5/d) SS0 Nitrogen Content (Ib-14/lb-V5) SS0 Amonium-N Load (Ib-N/day) MSW Mo. 2 MSW Mo. 2 Organic Nitrogen Content (Ib-16/lb-15) MSW No. 2 fordis Solids Load (Ib-15/d)	246,009 0.053 11,762 0.000 0 0	231,246 0.053 11,056 0.000 0 0	228,754 0.063 10,842 0.000 0 0	220,335 0.053 10,535 0.000 0 0	207,498 0.053 9,921 0.000 0 0	
SSD Total Solids Load (b-15;d) SSD Natiles Solids Load (b-16;d) SSD Nitrogen Content (b-14/ho-Ys) SSD Nitrogen Content (b-14/ho-Ys) SSD Nitrogen Content (b-14/ho-Ys) SSD Nitrogen Content (b-16/ho-Ys) SSO Nitrogen Content (b-16/ho-Ys)	246,009 0.053 11,762 0.000 0 0 0.000	231,246 0.053 11,056 0.000 0 0 0.000	226,754 0.053 10,842 0.000 0 0 0.000	220,335 0.053 10,535 0.000 0 0 0 0.000	207,498 0.053 9,921 0.000 0 0	
SS0 Total Solids Load (b-15;(d) SS0 Viaitile Solids Load (b-14;(d) SS0 Nitrogen Content (b-14/(b-15) SS0 Ammonium-N Load (b-14/(day) SS0 Ammonium-N Load (b-15/(d) HSOW No. 2 VISOW To 2 VISOW To 2 SS0 Ammonium-N Load (b-15/(d) HSOW No. 2 Vointile Solids Load (b-15/(d) HSOW No. 2 Nitrogen Content (b-14/(b-15) HSOW No. 2 Ammonium-N Load (b-14/(dsy) Excluting Phimap Studgig	246,009 0.053 11,762 0.000 0 0 0 0 0 0 0 0 0 0	231,246 0.053 11,056 0.000 0 0.000 0 0.000 0	228,754 0.053 10,842 0.000 0 0 0.000 0 0 0 0	220,335 0.053 10,535 0.000 0 0 0.000 0 0	207,498 0.053 9,921 0.000 0 0 0.000 0	
SS0 Total Solids Load (b-15;d) SS0 Natile Solids Load (b-15;d) SS0 Natiogen Content (b-14/br/s) SS0 Natiogen Content (b-16/br) HSOW No.2 HSOW	246,009 0.053 11,762 0.000 0 0 0.000 0 0 0.005 48,007	231,246 0.053 11,056 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	226,754 0.053 10,842 0.000 0 0 0.000	220,335 0.053 10,535 0.000 0 0 0 0.000	207,498 0.053 9,921 0.000 0 0	
SS0 Total Solids Load (b-15;d) SS0 Natile Solids Load (b-15;d) SS0 Nitrogen Content (b-14/hb-15) SS0 Nitrogen Content (b-16/hb) HSOW No. 2 HSOW No. 2 </th <td>246,009 0.053 11,762 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>231,246 0.053 11,056 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>226,754 0.053 10,842 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>220,335 0.053 10,535 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>207,498 0.053 9,921 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td></td>	246,009 0.053 11,762 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	231,246 0.053 11,056 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	226,754 0.053 10,842 0.000 0 0 0 0 0 0 0 0 0 0 0 0	220,335 0.053 10,535 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	207,498 0.053 9,921 0 0 0 0 0 0 0 0 0 0 0 0 0	
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SSO Totals Solids Load (b-Ts(d) SSO Natile Solids Load (b-Vs(d) SSO Nitrogina Content (b-V)(b-VS) SSO Nitrogina Content (b-V)(b-VS) SSO Nitrogina Content (b-V)(b-TS) SSOW No. 2 Total Solids Load (b-Ts(d) SSOW No. 2 Total Solids Load (b-Ts(d) SSOW No. 2 Notestina Content (b-V)(b-VS) SSOW No. 2 Notestina Content (b-V)(b-VS) SSOW No. 2 Atmonbium-N Load (b-N/ day) Soliding Status (b-V) Solidits Solids Load (b-Ts(d) SSOW No. 2 Notestina Content (b-V)(b-TS) SSOW No. 2 Notestina Solids Load (b-Ts(d)) SSOW No. 2 Notestina Solids Load (b-Ts(d)) SSOW No. 2 Atmosfue Content (b-V)(b-TS) SSOW No. 2 Notestina Solids Load (b-Ts(d)) What Status Nitrogen Content (b-V)(b-TS) SSOW SSO Solidits Solids Load (b-Ts(d)) Witrogen Content (b-V,(b-VS)) Minonchum-N Load (b-V/day) SSOW SSOW SSOW SSOW SSOW SSOW SSOW SSOW	246,009 0.053 11.762 0.000 0 0 0 0 0 0 0 0 0 0 0 0	231,246 0.053 11,056 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	226,754 0.053 10,842 0.000 0 0 0 0 0 0 0 0 0 0 0 0	220,335 0,053 10,535 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	207498 207498 0.053 9.921 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
SSO Totals Solids Load (b-Ts(d) SSO Natile Solids Load (b-Vs(d) SSO Nitrogina Content (b-V)(b-VS) SSO Nitrogina Content (b-V)(b-VS) SSO Nitrogina Content (b-V)(b-TS) SSOW No. 2 Total Solids Load (b-Ts(d) SSOW No. 2 Total Solids Load (b-Ts(d) SSOW No. 2 Notestina Content (b-V)(b-VS) SSOW No. 2 Notestina Content (b-V)(b-VS) SSOW No. 2 Atmonbium-N Load (b-N/ day) Soliding Status (b-V) Solidits Solids Load (b-Ts(d) SSOW No. 2 Notestina Content (b-V)(b-TS) SSOW No. 2 Notestina Solids Load (b-Ts(d)) SSOW No. 2 Notestina Solids Load (b-Ts(d)) SSOW No. 2 Atmosfue Content (b-V)(b-TS) SSOW No. 2 Notestina Solids Load (b-Ts(d)) What Status Nitrogen Content (b-V)(b-TS) SSOW SSO Solidits Solids Load (b-Ts(d)) Witrogen Content (b-V,(b-VS)) Minonchum-N Load (b-V/day) SSOW SSOW SSOW SSOW SSOW SSOW SSOW SSOW	246,009 0.053 11,762 0.000 0 0 0 0 0 0 0 0 0 0 0 0	231,246 0.053 11,056 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	226,754 0.053 0.053 0.054 0.050 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	220,335 0,053 10,535 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	207,498 0,053 9,921 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
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SSO Total Solids Load (b-Ts/d) SSO National Solids Load (b-Ks/d) SSO Nitrogen Content (b-N/b-Ks) Nitrogen Content (b-N/b-Ks) Nitrogen Content (b-N/b-Ks) Nitrogen Content (b-N/b-Ks) SSO Nitrogen Content (b-N/b-Ts) SSO Nitro	246,009 0.053 11.762 0.000 0 0 0 0 0 0 0 0 0 0 0 0	231,246 0.053 11,056 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	228,754 0.053 10.842 0.000 0 0 0 0 0 0 0 0 0 0 0 0	220,335 0,053 10,535 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	207,493 0,053 9,921 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
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SSD Total Solids Load (b-Ts/d) SSD Voistle Solids Load (b-Ys/d) SSD Nitrogen Content (b-N/h-Ys) Nitrogen Content (b-N/h-Ys) Nitrogen Content (b-N/h-Ys) SSD Nitrogen Content (b-N/h-Ys) SSD Nitrogen Content (b-N/h-Ts) Nitrogen Content (b-N/h-Ts) SSD Nitrog	246,009 0.053 11.762 0.000 0 0 0 0 0 0 0 0 0 0 0 0	231,246 0.053 11,056 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	228,754 0.053 10.842 0.000 0 0 0 0 0 0 0 0 0 0 0 0	220,335 0,053 10,535 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	207,493 0,053 9,921 0,000 0 0 0 0 0 0 0 0 0 0 0 0	

	Date Checked	Checked By	Job Number	By		Date	Calc No	
Brown	9/22/2017	Chris Muller	150871	Tracy Chouina	ard	9/15/2017	C-003	
Oaldwall		ect	Subject					
Caldwell	Encina Biosolids, Energy, and Emissions				Current Year - All Digesters in Service			

Thermal Hydrolysis with Mesophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	12	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.4	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1	Percent Solids Content of Digester Feed	9%	Assumed	Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	102	Assumed	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	140,397	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	60,000	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0		Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dof

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Sludge			TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speciation			Nitrogen Speciation			Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

Table X-X: Existing Thermal Hydrolysis with Mesophilic Digestion Feed Assessment									
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes			
Peaking Factors	1.00	1.23	1.30	1.40	1.60				
Digester Volume (MG)	5.84	5.84	5.84	5.84	5.84	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.			
Primary Sludge Total Solids Load (lb-TS/d)	48,007	59,049	62,410	67,210	76,812				
TWAS Total Solids Load (Ib-TS/d)	28,022	34,468	36,429	39,231	44,836				
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991				
Total Digester Feed, Total Solids Load (lb-TS/d)	80,020	97,507	102,829	110,432	125,638				
Primary Sludge Volatile Solids Load (lb-VS/d)	41,766	51,373	54,296	58,473	66,826				
TWAS Volatile Solids Load (lb-VS/d)	22,418	27,574	29,143	31,385	35,869				
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193				
Total Digester Feed, Volatile Solids Load (lb-VS/d)	67,377	82,139	86,632	93,051	105,887				
Primary sludge percent of VS Load (%)	62%	63%	63%	63%	63%				
WAS percent of VS Load (%)	33%	34%	34%	34%	34%				
FOG percent of VS Load (%)	5%	4%	4%	3%	3%				
Total Digester Feed Flow (gpd)	106,609	129,906	136,996	147,125	167,384				
Total Percent Solids Load (%)	9.0%	9.0%	9.0%	9.0%	9.0%				
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.3%	84.3%				
Base HRT (days)	55	45	43	40	35				
Base OLR (lbsVS/d-cf)	0.09	0.11	0.11	0.12	0.14				
Hydraulic Capacity (HC) (gpd)	380,266	356,969	349,879	339,750	319,491	Assumes the minimum allowable HRT 12 days			
HC as Equivalent VS Load (lb-VS/day)	323,485	303,667	297,635	289,018	271,785	Equivalent load of HSOW, based on hydraulic capacity			
Organic Load Capacity (Ib-VS/day)	245,056	230,294	225,801	219,383	206,546	Difference between max OLR (0.4 lbs-VS/cf-d) and current load			
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load				
		Table	X-X: Mesophilic Co-digestion Feed Assessm	ient					
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes			
Total HSOW Volatile Solids Load (lb-VS/day)	245,056	230,294	225,801	219,383	206,546	Calculated available organic load, based on defined limit			
SSO Volatile Solids Load (lb-VS/day)	245,056	230,294	225,801	219,383	206,546				
HSOW No. 2 Volatile Solids Load (lb-VS/day)	0	0	0	0	0				
Total HSOW Volatile Solids Load (Ib-VS/day)	245,056	230,294	225,801	219,383	206,546				
SSO Total Solids Load (Ib-TS/day)	288,302	270,934	265,648	258,097	242,995	Conversion to Total Solids load based on SSO %VS			
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0				
SSO Total Solids Load (lb-TS/day)	288,302	270,934	265,648	258,097	242,995				
SSO (lb-wet/day)	2.402.513	2.257.783	2,213,735	2,150,809	2,024,958	Conversion to Wet Solids load based on SSO %TS			
HSOW No. 2 Total Load (lb-wet/day)									
noom no. 2 rotai Loau (io-wet/ udy)	0	0	0	0	0				
SSO (lb-wet/day)		0 2,257,783	2,213,735	0 2,150,809	0 2,024,958				
SSO (lb-wet/day) SSO (wtpd)	0 2,402,513 1,201	0 2,257,783 1,129	2,213,735 1,107	2,150,809 1,075	2,024,958 1,012				
SSO (lb-wet/day)	0 2,402,513	0 2,257,783 1,129 0	2,213,735 1,107 0	2,150,809 1,075 0	2,024,958 1,012 0				
SSO (lb-wet/day) SSO (wtpd)	0 2,402,513 1,201 0 1,201	0 2,257,783 1,129 0 1,129	2,213,735 1,107 0 1,107	2,150,809 1,075 0 1,075	2,024,958 1,012 0 1,012				
SSO (lb·wet/day) SSO (wtpd) HSOW No. 2 (wtpd)	0 2,402,513 1,201 0	0 2,257,783 1,129 0	2,213,735 1,107 0	2,150,809 1,075 0	2,024,958 1,012 0	Assume 9% TS			
SS0 (Ib-wet/day) SS0 (wtpd) HSOW No. 2 (wtpd) SS0 (wtpd) SS0 (wtpd) SS0 Digester Feed (gpd) HSOW No. 2 (gpd)	0 2,402,513 1,201 0 1,201 384,095 0	0 2,257,783 1,129 0 1,129 360,957 0	2,213,735 1,107 0 1,107 353,915 0	2,150,809 1,075 0 1,075 343,854 0	2,024,958 1,012 0 1,012 323,734 0	Assume 9% TS			
SS0 (0:+wet/day) SS0 (wtpd) HSOW No. 2 (wtpd) SS0 (wtpd) SS0 (wtpd) SS0 (wtpd) HSOW No. 2 ((ppd) HSOW No. 2 ((ppd) HSOW No. 2 ((ppd) HSOW No. 2 ((ppd) SS0 ((pstster Feed((pdd)) HSOW No. 2 ((ppd)) SS0 ((pstster Feed((pdd)) HSOW No. 2 ((ppd)) SS0 ((pstster Feed((pdd)) HSOW No. 2 ((ppd)) SS0 ((pstster Feed((pdd))) HSOW No. 2 ((pstster Feed((pdd))) SS0 ((pstster Feed((pstster Feed((pstste	0 2,402,513 1,201 0 1,201 384,095	0 2,257,783 1,129 0 1,129 360,957 0 360,957	2,213,735 1,107 0 1,107 353,915	2,150,809 1,075 0 1,075 343,854	2,024,958 1,012 0 1,012 323,734 0 323,734	Assume 9% TS Assume 9% TS			
SS0 (Ib-wet/day) SS0 (wtpd) HSOW No. 2 (wtpd) SS0 (wtpd) SS0 (wtpd) SS0 Digester Feed (gpd) HSOW No. 2 (gpd)	0 2,402,513 1,201 0 1,201 384,095 0	0 2,257,783 1,129 0 1,129 360,957 0	2,213,735 1,107 0 1,107 353,915 0	2,150,809 1,075 0 1,075 343,854 0	2,024,958 1,012 0 1,012 323,734 0	Assume 9% TS			
SS0 (0: wet/day) SS0 (wtpd) HSOW (bx. 2 (wtpd)) SS0 (wtpd) SS0 (wtpd) SS0 (wtpd) HSOW (bx. 2 (wpd)) HSOW (bx. 2 (wpd)) SS0 (bgstorf Feed(gpd))	0 2,402,513 1,201 0 1,201 384,095 0 384,095 288,071 0 0	0 2,257,783 1,129 0 1,129 360,957 0 360,957 270,717 0	2,213,735 1,107 0 1,107 33,3915 0 353,915 265,336 0 0	2,150,809 1,075 0 1,075 343,854 0 343,854 257,891 0	2,024,958 1,012 0 1,012 323,734 0 323,734 242,801 0	Assume 9% TS Assume 9% TS Assume 12% TS Assume 12% TS			
SS0 (Dr.wet/day) SS0 (wtpd) SS0 (wtpd) SS0 (wtpd) SS0 (wtpd) SS0 (wtpd) SS0 Digester Feed (gpd) HS0W No. 2 (gpd) SS0 Digester Feed(gpd) SS0 A Received(gpd) SS0 A Received(gpd)	0 2,402,513 1,201 0 1,201 384,095 0 384,095 288,071	0 2,257,783 1,129 0 1,129 360,957 0 360,957 270,717	2,213,735 1,107 0 1,107 333,915 0 353,915 265,436	2,150,809 1,075 0 1,075 343,854 0 343,854 257,891	2,024,958 1,012 0 1,012 323,734 0 323,734 242,801	Assume 9% TS Assume 9% TS Assume 12% TS			

Total Solids, Volatile Solids Load (Ib-VS/d)	312,433	312,433	312,433	312,433	312,433	
Total Flow (gpd)	490,703	490,862	490,911	490,980	491,118	
Primary sludge percent of VS Load (%)	13%	16%	17%	19%	21%	
WAS percent of VS Load (%)	7%	9%	9%	10%	11%	
FOG percent of VS Load (%)	1%	1%	1%	1%	1%	
SSO percent of VS Load (%)	78%	74%	72%	70%	66%	
HSOW No. 2 percent of VS Load (%) Check	0%	0% ok	0% 0k	0%	0% 0k	
Check Co-digestion HRT (days)	12	0K 12	0K 12	0K 12	0K 12	
Co-digestion HRT (days) Co-Digestion OLR (lbs-VS/d-cf)	0.40	0.40	0.40	0.40	0.40	
	0.40 OK	0.40 OK	0.40 OK	0.40 OK	0.40 OK	
Process Check	UK UK		: Existing Mesophilic Solids and Biogas Prod	uction	UK	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	27,148	33 392	35 293	38.007	43,437	1005
WAS Volatile Solids Destroyed (Ib-VSd/day)	10.536	12,960	13.697	14,751	16,858	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2.873	
Total Volatile Solids Destroyed (Ib-VSd/day)	40,558	49,225	51,863	55,632	63,169	
Total Sludge Effluent (gpd)	106,609	129,906	136,996	147,125	167,384	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	39,463	48,282	50,966	54,801	62,470	
Volatile Solids Effluent (Lbs-VS/d)	26,819	32,914	34,769	37,419	42,719	
Total Solids (% TS)	4.4%	4.5%	4.5%	4.5%	4.5%	
Volatile Solids (% VS)	68%	68%	68%	68%	68%	
Dewatered Solids (Lbs-TS/d)	37,489	45,868	48,418	52,061	59,346	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	85	104	110	118	135	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	721,930	876,211 Table X X:	923,166 Moconhilia Co digostion Solids and Riogas Pr	990,244	1,124,401	
	Annual Average		Mesophilic Co-digestion Solids and Biogas Pr		Dook doo:	Notes
Primany sludgeVolatile Solide Destroyed (Ib VCd /day)	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	27,148	33,392 12,960	35,293 13.697	38,007	43,437 16,858	
WAS Volatile Solids Destroyed (Ib-VSd/day) FOG Volatile Solids Destroyed (Ib-VSd/day)	2.873	2,873	2.873	14,751 2,873	2.873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	2,013	2,873	203 221	2,873	185 891	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	261,109	256,490	255,084	253,076	249,060	
Total Sludge Effluent (gpd)	490,703	490,862	490,911	490,980	491,118	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	107,213	111,951	113,393	115,453	119,573	
Volatile Solids (Lbs-VS/d)	51,325	55,943	57,349	59,357	63,373	
Total Solids (% TS)	2.6%	2.7%	2.8%	2.8%	2.9%	
Volatile Solids (% VS)	48%	50%	51%	51%	53%	
Dewatered Solids (Lbs-TS/d)	101,853	106,354	107,724	109,681	113,595	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	231	242	245	249	258	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	483,237	594,382	628,208	676,532	773,179	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	187,548	230,684	243,813	262,568	300,077	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145 3 346 040	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	3,969,912	3,730,761	3,657,976	3,553,998	3,346,040	Assumes a biogas yield of 18 scf/lb-VSd
	0	•	0	0	0	
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
	0 4,691,842	0 4,606,972 Table	0 4,581,142 2 X.Y: Nutrient Loading - Ammonia-N Ectimat	0 4,544,242	0 4,470,442	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)		Table	e X-X: Nutrient Loading - Ammonia-N Estimate	es		
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1	Annual Average				0 4,470,442 Peak day 0,063	Notes
HSOW No. 2 Blogas Production (scfd) Total Blogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)		Table Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimate	es Peak 7 day		
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1	Annual Average	Table Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimate	es Peak 7 day	Peak day 0.063	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	Annual Average 0.063 288,302	Table Peak Month 0.063 270,934	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 265,648	es Peak 7 day 0.063 258,097	Peak day 0.063 242,995	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violattile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	Annual Average 0.063 288,302 245,056	Table Peak Month 0.063 270,934 230,294	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 205,648 225,841	es Peak 7 day 0.063 258,097 219,383	Peak day 0.063 242,995 206,546	
HSOW No.2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Totalic Solids Load (Ib-T5/d) SSO Viotalic Solids Load (Ib-T5/d)	Annual Average 0.063 288,302 245,056 0.053	Table Peak Month 0.063 270,934 230,294 0.053	2 X-X: Nutrient Loading - Anmonia-N Estimate Peak 14 day 0.063 265.648 225.801 0.053	es Peak 7 day 0.063 258,097 219,383 0.053	Peak day 0.063 242,995 206,546 0.053	
HSOW No. 2. Biogas Production (scht) Total Biogas Production (scht) BSON No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Violatic Schtls Scht (Ib-TS/c) SSO Violatic Scht Scht Scht (Ib-TS/c) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Annonium-N-Load (Ib N/day)	Annual Average 0.063 288,302 245,056 0.053	Table Peak Month 0.063 270,934 230,294 0.053	2 X-X: Nutrient Loading - Anmonia-N Estimate Peak 14 day 0.063 265.648 225.801 0.053	es Peak 7 day 0.063 258,097 219,383 0.053	Peak day 0.063 242,995 206,546 0.053	
HSOW No.2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-YG) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Annonium-N Load (Ib-N/day) HSOW No 2	Annual Average 0.063 288,302 245,056 0.053 11,717 0.000 0	Table Peak Month 0.063 270,934 230,294 0.053 11,011 0.000 0	2 XX: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 265,648 225,801 0.053 10,796 0.00 0 0 0 0 0 0 0	es Peak 7 day 0.063 258,097 219,383 0.053 10,489 0.000 0	Peak day 0.063 242,995 206,546 0.053 9,875 0.000 0	
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HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 HSOW No.1 HSOW No.1 HSOW No.2 SSO Total Solids Load (Ib-Y5/d) SSO total Solids Load (Ib-Y5/d) HSOW No.2 HSOW NO.	Annual Average 0.083 288.302 245.056 0.063 11,717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 270,934 230,294 0.063 11,011 0.000 0 0.000 0 0.000 0 0.000 0 0.005 59,049 51,373 0.065 0.065 0.065 34,469 27,574	2 X-S: Nutrilent Loading - Ammonia-N Estimat Peak 14 day 2 656 448 2 255 648 2 255 801 0 0 653 1 0 0 753 1 0 796 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 258.0077 219.383 0.053 0.053 10.449 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242.945 206.546 0.053 9.875 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) SSO Total Biogas Production (scfd) SSO Total Solitos Load (b. N/lb. TS) SSO Totalis Solitos Load (b. N/lb. TS) SSO Noncolima N-N Load (b. N/lb. YS) SSO Namoniam-N Load (b. N/lb. YS) HSOW No. 2 HSOW HSO HSOW HSOW HSOW HSOW HSOW HSOW H	Annual Average 0.083 248,050 0.063 0.053 11,717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Cabb 1 Peak Month 0.003 270.934 270.234 20.053 11.011 0.000 0 0 0 0.000 0 0 0 0.000 0 0 0 0.005 59.049 51.373 0.057 1.900 1.900 0.005 34.468 27.574 0.057 6.78	2 X-X Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 265.648 225.801 0.053 10,796 0.000 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 256,007 2119,383 0.053 10,489 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242,995 206,546 0.053 9.053 9.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 HSOW No.1 HSOW No.2 HSO Total Sillois cand (b-Y5/d) SSO Valatile Solids Load (b-Y5/d) SSO Valatile Solids Load (b-Y5/d) HSOW No.2 HSOW	Annual Average 0.063 268,302 245,056 0.053 11,717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table 1 Peak Month 0.063 270.934 2.00,294 0.053 11.011 0.000 0 0 0.005 678 0.010 0.010	2 X-S: Nutrient Loading - Ammonia N Estimat Peak 14 day Peak 14 day 265 648 225 801 0.053 0.053 0.050 0 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 258.097 219.383 0.053 0.053 0.054 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242,995 206,546 0.053 9,875 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Intrails Solids Load (Ib-Ts/d) SSO Mitogan Content (Ib-N/Ib-TS) SSO Mitogan Content (Ib-N/Ib-TS) HSOW No.2 HSOW	Annual Average 0.083 248,055 0.053 0.11,717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabb 1 Peak Month 0.063 270.934 270.934 230.294 0.053 11.011 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.055 34,468 27.574 0.052 678 0.010 3.991 3.193 0.008	2 X-S: Nutrilent Loading - Ammonia-N Estimat Peak 14 day 0.063 265.648 0.053 0.053 0.053 0.050 0 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 256,0077 219,383 0.053 0.053 0.053 0.053 0.057 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242,996 206,546 0.053 0.055 0.055 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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HSOW No. 2. Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Total Solids Land (Ib-15/d) SSO Total Solids Land (Ib-15/d) SSO Integen Content (Ib-N/Ib-15) SSO Nitrogen Content (Ib-N/Ib-15) HSOW No.2 HSOW	Annual Average 0.083 248,055 0.053 0.11,717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabb 1 Peak Month 0.063 270.934 270.934 230.294 0.053 11.011 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.055 34,468 27.574 0.052 678 0.010 3.991 3.193 0.008	2 X-S: Nutrilent Loading - Ammonia-N Estimat Peak 14 day 0.063 265.648 0.053 0.053 0.053 0.050 0 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 256,0077 219,383 0.053 0.053 0.053 0.053 0.057 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242,996 206,546 0.053 0.055 0.055 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
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HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Optimality and the state of the state of the state of the state SSO Optimality and the state of the st	Annual Average 0.083 288.002 245.056 0.063 11,1717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabb 1 Tabb 0.063 270.934 2.30.294 2.05.31 0.053 11.011 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 34.468 27.574 0.0052 678 0.005 3.991 3.991 3.991 7 9.45 3.99 7 9.45 13.613	2.X: Nutrient Loading - Ammonia N Estimat Peak 14 day Peak 14 day Peak 14 day 265 84 265 84 265 84 265 84 0 063 265 84 0 063 0 00 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 258.097 219.383 0.053 0.053 0.053 0.065 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242.945 206.546 0.053 9.876 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Minogan Content (Ib-N/Ib-TS) HSOW No. 2 HSOW NO. 2 HS	Annual Average 0.083 248,050 0.053 0.053 1,1,717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabb Tabb 1 0.063 270.934 20.024 20.053 11.011 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 59.049 51.373 0.065 34.454 27.574 0.052 67 0.0052 670 0.010 3.991 3.991 3.991 3.991 3.91 3.92 7 9.45 13.613 0.429 3.42	2 X-X Nutrient Loading - Ammonia N Estimat Peak 14 day 0.063 265,681 0.053 10,796 0.000 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 266,007 219,383 0.053 0.053 10,489 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242,996 200,546 0.053 0.055 0.055 0.050 0 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) HSOW No.1 SSO Optimality and the state of the state of the state of the state SSO Optimality and the state of the st	Annual Average 0.083 288.002 245.056 0.063 11,1717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabb 1 760 9 9 1 0.063 270.934 230.294 0.053 11.011 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.001 3,991 3,193 0.008 204 2 7 9.45 13.613 0.49 3.22 3.24 3.24	2.X: Nutrient Loading - Ammonia N Estimat Peak 14 day Peak 14 day Peak 14 day 265 84 265 84 265 84 265 84 0 063 265 84 0 063 0 00 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 258.0077 219.383 0.053 0.053 0.053 0.065 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242.945 206.546 0.053 9.876 0.000 0 0 0 0 0 0 0 0 0 0 0 0	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-TS/d) HSOW No.2 HSOW N	Annual Average 0.063 268,302 245,056 0.033 11,717 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabb Tabb 1 0.063 270.934 20.024 0.063 230.244 0.063 11.011 0 0 0 0 0 0 0 0 0 0 0 0 0.065 59.049 51.373 0.057 1.900 0.065 34.454 27.574 0.0052 673 0.010 3.991 3.991 3.991 3.991 3.991 3.91 3.92 7 9.45 13.613 0.429 3.42	2.X: Nutrient Loading - Annonia N Estimat Peak 14 day Peak 14 day 20.653 2025.831 0.053 2025.831 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 258.097 219.383 0.053 0.053 0.065 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 242.985 206,546 0.053 9.875 0.000 0 0 0 0 0 0 0 0 0 0 0 0	

Brown AND Caldwell

Date Checked	Checked By	Job Number	Ву	Date	Calc No	
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-004	
	Project				Subject	
Encina Biosolids, Energy, and Emiss	ons		2030 Year - All Digesters in Service			

Mesophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days) 15 Assumed Peaking Factors					
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.18	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	97	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSO	W (blank if not applicabl	e)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SSO	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

Primary Slud	ge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Specia	ation		Nitrogen Spec	iation		Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Nutrients Speciation for HSOW		
Parameter	Input Values	Reference
Nitrogen Specia	ation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (lb-N/lb-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

		Table X	-X: Existing Mesophilic Digestion Feed Asses	sment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
eaking Factors	1.00	1.23	1.30	1.40	1.60	
igester Volume (MG)	5.84	5.84	5.84	5.84	5.84	Service condition assumes largest digester is out of service with the ac
rimary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299	
VAS Total Solids Load (Ib-TS/d)	37,020	45,534	48,125	51,827	59,231	
OG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
tal Digester Feed, Total Solids Load (Ib-TS/d)	101,822	124,324	131,172	140,955	160,521	
mary Sludge Volatile Solids Load (lb-VS/d)	52,906	65,075	68,778	74,069	84,650	
AS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
IG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193	
tal Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228	
imary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
AS percent of VS Load (%)	35%	35%	35%	35%	35%	
DG percent of VS Load (%)	4%	3%	3%	3%	2%	
tal Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
tal Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
tal Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
ase HRT (days)	22	18	17	16	14	
ase OLR (lbsVS/d-cf)	0.11	0.13	0.14	0.15	0.17	
(draulic Capacity (HC) (gpd)	123.692	64.557	46.559	20.848	-30.573	Assumes the minimum allowable HRT 15 days
as Equivalent VS Load (lb-VS/dav)	105.222	54,917	39.607	17,735	-26.008	Equivalent load of HSOW, based on hydraulic capacity
ganic Load Capacity (Ib-VS/day)	54.880	35,900	30,124	21.871	5.367	Difference between max OLR (0.18 lbs-VS/cf-d) and current load
press Limitation	Organic Load	Organic Load	Organic Load	Hydraulic	No Capacity	
		Table	X-X: Mesophilic Co-digestion Feed Assessm	ient		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
al HSOW Volatile Solids Load (lb-VS/dav)	54.880	35,900	30.124	17.735	0	Calculated available organic load, based on defined limit
O Volatile Solids Load (lb-VS/dav)	54.880	35,900	30,124	17,735	0	
OW No. 2 Volatile Solids Load (lb-VS/day)	0	0	0	0	0	
tal HSOW Volatile Solids Load (Ib-VS/day)	54.880	35,900	30.124	17.735	0	
50 Total Solids Load (Ib-TS/day)	64,565	42.235	35,440	20.865	0	Conversion to Total Solids load based on SSO %VS
SOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
50 Total Solids Load (Ib-TS/day)	64,565	42,235	35,440	20,865	0	
SO (lb-wet/day)	538.042	351.962	295.330	173.875	0	Conversion to Wet Solids load based on SSO %TS
SOW No. 2 Total Load (Ib-wet/day)	0	0	0	0	0	
50 (lb-wet/day)	538,042	351,962	295,330	173,875	0	
50 (wtpd)	269	176	148	87	0	
SOW No. 2 (wtpd)	0	0	0	0	0	
60 (wtpd)	269	176	148	87	0	
60 (gpd)	64.513	42,202	35.411	20.848	0	
SOW No. 2 (gpd)	0	0	0	0	0	
0 (gpd)	64.513	42.202	35.411	20.848	0	
tal Solids, Total Solids Load (lb-TS/d)	166.387	166.559	166.611	161.820	160.521	
otal Solids, Volatile Solids Load (Ib-13/d)	140,595	140,595	140,595	136.459	135.228	
otal Flow (gpd)	330.322	367,145	378.352	389,500	420.073	
rimary sludge percent of VS Load (%)	330,322	46%	49%	54%	63%	
AS percent of VS Load (%)	21%	26%	27%	30%	35%	
DG percent of VS Load (%)	21%	20%	2%	2%	2%	
a percent of 45 Load (16)	2.8	2.0	2./0	270	2.0	

SSO percent of VS Load (%)	39%	26%	21%	13%	0%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	18	16	15	15	14	
Co-Digestion OLR (lbs-VS/d-cf)	0.18	0.18	0.18	0.17	0.17	
Process Check	OK	OK	OK K: Existing Mesophilic Solids and Biogas Proc	OK	No Capacity	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2.873	2,873	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)						
Total Volatile Solids Destroyed (Ib-VSd/day)	51,182	62,293	65,674	70,505	80,167	Annual that a forma in annuals and and and
Total Sludge Effluent (gpd)	265,808	324,943 62.031	342,941 65.497	368,652	420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	34,533		44,797	70,450 48.218		
Volatile Solids Effluent (Lbs-VS/d)	34,533	42,402	44,191	48,218	55,061	
Total Solids (% TS) Volatile Solids (% VS)	68%	68%	68%	68%	2.3%	
Dewatered Solids (Lbs-TS/d)	48.108	58.929	62,222	66.927	76.337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	40,100	134	141	150	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128	752,917	795.766	856.979	979.404	Assumes biosonus cake has a sonus content of 22 % 13 Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247 765	304 751	322.004	346 871	396 424	Assumes a blogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scid)	51 145	51,145	51.145	51 145	51 145	Assumes a biogas yield of 17.8 scl/lb-VSd Assumes a biogas yield of 17.8 scl/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	Assumes a biogas yield of 11.0 307 10-430
510500 1 1000000 (3010)	311,037	Table X-X-	Mesophilic Co-digestion Solids and Biogas Pi	oduction	1,420,312	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42.299	44,706	48.145	55.023	INUES
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/ day)	2.873	2.873	2.873	2.873	22,271	
SSO Volatile Solids Destroyed (Ib-VSd/day)	49.392	32.310	2,513	15.962	2,813	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	02,010	0	0	Ő	
Total Volatile Solids Destroyed (Ib-VSd/day)	100,574	94,603	92,786	86,467	80,167	
Total Sludge Effluent (gpd)	330.322	367,145	378,352	389.500	420,073	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	65,813	71,956	73,826	75,353	80,354	
Volatile Solids (Lbs-VS/d)	40,021	45,992	47,809	49,992	55,061	
Total Solids (% TS)	2.4%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	61%	64%	65%	66%	69%	
Dewatered Solids (Lbs-TS/d)	62,523	68,358	70,134	71,585	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	142	155	159	163	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	889,060	581,583	488,003	287,311	0	Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
Total Biogas Production (scfd)	1,800,097	1,690,395	1,657,007	1,542,304	1,426,972	
					1,120,012	
		Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat	es		
HSOW No 1	Annual Average	Tabl Peak Month			Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS)	0.063	Tabl Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day <mark>0.063</mark>	Peak day 0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	0.063 64,565	Tabl Peak Month 0.063 42,235	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35,440	es Peak 7 day 0.063 20,865	Peak day 0.063 0	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d)	0.063	Tabl Peak Month 0.063	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day <mark>0.063</mark>	Peak day 0.063 0 0	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	0.063 64,565	Tabl Peak Month 0.063 42,235 35,900 0.053	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35,440	es Peak 7 day 0.063 20,865	Peak day 0.063 0 0 0.000	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 64,565	Tabl Peak Month 0.063 42,235	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35,440	es Peak 7 day 0.063 20,865	Peak day 0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Viotatie Solids Load (Ib-VS/d) SS0 Nitrogen Content (Ib-N/Ib-VS) SS0 Ammonium-N Load (Ib-N/day) HSOW No 2	0.063 64,565 54,880 0.053 2,624	Tabl Peak Month 0.063 42,235 35,900 0.053 1,716	e X-X: Nutrient Loading - Amnonia-N Estimat Peak 14 day 0.063 35,440 30,124 0.053 1,440	es Peak 7 day 0.063 20,865 17,735 0.053 848	Peak day 0.063 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Traff Solids Load (b-TS/d) SS0 Violatile Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/b V-S) SS0 Amonum-N Load (b-V/dsy) HSOV No.2 HSOV No.2 SV Amonum-N Load (b-V/lb-TS)	0.063 64,565 54,880 0.053 2,624 0.000	Tabl Peak Month 0.063 42,235 35,900 0.053 1,716 0.000	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35,440	es Peak 7 day 0.063 20,865	Peak day 0.063 0 0 0.000 0	Notes
SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-YS/d) SSD Nitrogen Content (Ib-N/Ib-TS) SSD Ammonium-M Load (Ib-N/day) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Slots Load (Ib-TS/d)	0.063 64,565 54,880 0.053 2,624 0.000 0	Tabl Peak Month 0.063 42,235 35,900 0.053 1,716 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35.440 30.124 0.053 1,440 	es Peak 7 day 0.063 20,865 17,735 0.053 848 0.000 0	Peak day 0.063 0 0.000 0 0 0.000 0	Notes
SSD Organic Nitrogen Content (b-N/b-TS) SSD Ordat Solids and (b-TS/d) SSD Viatilite Solids Load (b-VS/d) SSD Nitrogen Content (b-V/b VS) SSD Nitrogen Content (b-V/day) HBOW No 2 HSOW No 2	0.063 64.565 54.880 0.053 2,624 0.000 0 0 0	Tabl Peak Month 0.063 42,235 35,900 0.053 1,716 0.000 0 0 0	X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35.440 30.124 0.053 1.440 0.053 0.050 0.000 0 0	es Peak 7 day 0.063 20,865 17,735 0.053 848	Peak day 0.063 0 0 0.000 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Ammonium-NL Load (Ib-N/day) HSOW No.2 HSOW No.2 </th <td>0.063 64.555 54.880 0.053 2,624 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Tabl Peak Month 0.063 42,235 35,900 0.053 1,716 0.000 0</td> <td>e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35.440 30.124 0.053 1,440 </td> <td>es Peak 7 day 0.063 20,865 17,735 0.053 848 0.000 0</td> <td>Peak day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Notes</td>	0.063 64.555 54.880 0.053 2,624 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 42,235 35,900 0.053 1,716 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35.440 30.124 0.053 1,440 	es Peak 7 day 0.063 20,865 17,735 0.053 848 0.000 0	Peak day 0.063 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/1b-TS) SS0 Vorlail Solids and (b-TS/d) SS0 Vorlail Solids and (b-TS/d) SS0 Vorlain Content (b-N/1b-YS) SS0 Ammonium-N Load (b-N/day) HSW No 2 SS0 Ammonium-N Load (b-N/day) HSW No 2 HSW	0.063 64,565 54,880 0.053 2,624 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 42.235 35.900 0.053 1.716 0 0 0 0 0 0 0 0 0 0 0 0.005 74.799 65.075 0.055 2.407 2.407 0.065 36.427 0.052 896 0.010 3.991 3.63 3.64 7 9.47 9.47	X-X: Nutrient Loading - Ammonia-N Estimat Pok 14 day 0.063 30,124 0.063 1.1,440 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 20,865 17,735 0.063 848 	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Varial Solids and (b-TS/d) SS0 Varial Solids and (b-TS/d) SS0 Varial Solids and (b-TS/d) HBOW No 2 HSOW	0.063 64.565 54.880 0.053 2,624 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 42.235 35.900 0.063 1,116 0.000 0 0.000 0 0.000 0 0.000 0 0.005 2,407 0.065 2,407 0.065 36,427 0.062 86 0.001 3,991 0.002 36 7 9,47 5,043 0.67 3,67 1,647 0,62	X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 35,440 0.053 1,440 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 20.865 17,735 0.053 848 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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ed to account for process inefficiencies.

	Date Checked	Checked By	Job Number	By	Date	Calc No
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-004
Caldwall		Project				Subject
Caldwell	Encina Biosolids, Energy, and Emissio	ins		2030 Year - All Digeste	rs in Service	

Mesophilic Digestion with Digesters 1-6

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.18	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	97	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSO	W (blank if not applicable)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

Primary	Sludge		TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen	peciation		Nitrogen Speciation			Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3.000	

Table X-X: Existing Mesophilic Direction with Directors 1-6 Feed Assessment							
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes	
Peaking Factors	1.00	1.23	1.30	1.40	1.60		
Digester Volume (MG)	6.70	6.70	6.70	6.70	6.70	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.	
Primary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299		
TWAS Total Solids Load (lb-TS/d)	37,020	45,534	48,125	51,827	59,231		
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991		
Total Digester Feed, Total Solids Load (lb-TS/d)	101,822	124,324	131,172	140,955	160,521		
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650		
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385		
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193		
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228		
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%		
WAS percent of VS Load (%)	35%	35%	35%	35%	35%		
FOG percent of VS Load (%)	4%	3%	3%	3%	2%		
Total Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073		
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%		
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%		
Base HRT (days)	25	21	20	18	16		
Base OLR (lbsVS/d-cf)	0.10	0.12	0.12	0.13	0.15		
Hydraulic Capacity (HC) (gpd)	180.692	121.557	103.559	77.848	26.427	Assumes the minimum allowable HRT 15 days	
HC as Equivalent VS Load (Ib-VS/day)	153,711	103,406	88.096	66.224	22,481	Equivalent load of HSOW, based on hydraulic capacity	
Organic Load Capacity (Ib-VS/day)	75,455	56,475	50.698	42,446	25,942	Difference between max OLR (0.18 lbs-VS/cf-d) and current load	
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	Hydraulic		
		Table X-)	: Mesophilic Co-digestion Feed Assessment				
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes	
Total HSOW Volatile Solids Load (lb-VS/day)	75,455	56,475	50,698	42,446	22,481	Calculated available organic load, based on defined limit	
SSO Volatile Solids Load (Ib-VS/day)	75,455	56,475	50,698	42,446	22,481		
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	0	0		
Total HSOW Volatile Solids Load (Ib-VS/day)	75,455	56,475	50,698	42,446	22,481		
SSO Total Solids Load (Ib-TS/day)	88,771	66,441	59,645	49,937	26,448	Conversion to Total Solids load based on SSO %VS	
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0		
SSO Total Solids Load (Ib-TS/day)	88,771	66,441	59,645	49,937	26,448		
SSO (lb-wet/day)	739,756	553,677	497,044	416,140	220,398	Conversion to Wet Solids load based on SSO %TS	
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0		
SSO (lb-wet/day)	739,756	553,677	497,044	416,140	220,398		
SSO (wtpd)	370	277	249	208	110		
HSOW No. 2 (wtpd)	0	0	0	0	0		
SSO (wtpd)	370	277	249	208	110		
SSO (gpd)	88,700	66,388	59,598	49,897	26,427		
HSOW No. 2 (gpd)	0	0	0	0	0		
SSO (gpd)	88,700	66,388	59,598	49,897	26,427		
Total Solids, Total Solids Load (Ib-TS/d)	190,593	190,765	190,817	190,892	186,969		
Total Solids, Volatile Solids Load (Ib-VS/d)	161,170	161,170	161,170	161,170	157,709		
Total Flow (gpd)	354,508	391,331	402,538	418,549	446,500		
Primary sludge percent of VS Load (%)	33%	40%	43%	46%	54%		
WAS percent of VS Load (%)	18%	23%	24%	26%	30%		
FOG percent of VS Load (%)	2%	2%	2%	2%	2%		
SSO percent of VS Load (%)	47%	35%	31%	26%	14%		
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%		
Check	ok	ok	ok	ok	ok		
Co-digestion HRT (days)	19	17	17	16	15		

Co-Digestion OLR (lbs-VS/d-cf)	0.18	0.18	0.18	0.18	0.18	
Process Check	0.18 OK	0.18 OK	0.18 OK	0.18 OK	0.18 OK	
		Table X-X: Exi	sting Mesophilic Solids and Biogas Productio	n		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	34,389	42,299 17.121	44,706	48,145	55,023 22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2.873	2.873	2.873	2.873	2,873	
Total Volatile Solids Destroyed (lb-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50,640 34,533	62,031	65,497 44,797	70,450	80,354	
Volatile Solids Effluent (Lbs-VS/d) Total Solids (% TS)	2.3%	42,402 2.3%	2.3%	48,218 2.3%	55,061 2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd) WAS Biogas Production (scfd)	612,128 247,765	752,917 304,751	795,766	856,979	979,404 396.424	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51.145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scl/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
			philic Co-digestion Solids and Biogas Produc			
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	Annual Average	Peak Month	Peak 14 day 44,706	Peak 7 day 48,145	Peak day 55.023	Notes
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	42,299	18.095	19,487	22.271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	67,910	50,828	45,629	38,202	20,233	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (lb-VSd/day) Total Sludge Effluent (gpd)	119,091	113,120	111,303 402,538	108,707	100,400	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	71,502	77,644	79,514	82,185	86,569	
Volatile Solids (Lbs-VS/d)	42,078	48,049	49,867	52,463	57,309	
Total Solids (% TS)	2.4%	2.4%	2.4%	2.4%	2.3%	
Volatile Solids (% VS) Dewatered Solids (Lbs-TS/d)	59% 67,926	62% 73,762	63% 75,538	64% 78,076	66% 82,241	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	154	168	172	177	187	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) SSO Biogas Production (scfd)	51,145	51,145 914,895	51,145 821.315	51,145 687,630	51,145 364,186	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	Assumes a biogas yield of 10 sci/ 10-v Su
Total Biogas Production (scfd)	2,133,410	2,023,708	1,990,320	1,942,623	1,791,158	
			: Nutrient Loading - Ammonia-N Estimates			
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063	Peak Month 0.063	Peak 14 day	Peak 7 day 0.063	Peak day 0.063	Notes
SSO Total Solids Load (Ib-TS/d)	88,771	66,441	59,645	49,937	26,448	
SSO Volatile Solids Load (lb-VS/d)	75,455	56,475	50,698	42,446	22,481	
SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	75,455 0.053	56,475 0.053	50,698 0.053	0.053	22,481 0.053	
SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	75,455	56,475	50,698		22,481 0.053 1,075	
SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day) HSOW No. 2 SOYANO.2 Organic Nitrogen Content (Ib-N/Ib-TS)	75,455 0.053 3,608 0.000	56,475 0.053 2,700 0.000	50,698 0.053 2,424 0.000	0.053	1,075 0.000	
SSO Volatile Solid Load (Ib-VS; d) SSO Nitrogen Content (Ib-V/Ib-VS) SSO Amnonium- KLoad (Ib-N/Ib-VS) HSOW No.2 HSOW No.2 Corganic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Total SolidS Load (Ib-TS/d)	75,455 0.053 3,608 0.000 0	56,475 0.053 2,700 0.000 0	50,698 0.053 2,424 0.000 0	0.053 2,029 0.000 0	1,075 0.000 0	
SS0 Violatile Solidis Load (lb-V5/c) SS0 Nitrogen Content (lb-V1/b-V5) SS0 Ammenolium-N Load (lb-V/day) BSOV No 2 BSOW No 2 SSO No 2, Strain Silviogen Content (lb-V/lb-T5) HSOW No 2, Violatile Solidis Load (lb-T5/c) HSOW No 2, Violatile Solidis Load (lb-V5/c)	75,455 0.053 3,608 0.000 0 0	56,475 0.053 2,700 0.000 0 0	50,698 0.053 2,424 0.000 0 0	0.053 2,029 0.000 0 0	1,075 0.000 0 0	
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SSO Violatile Solidis Load (Ib-VS/c) SSO Nitrogen Content (Ib-V/Ib-VS) SSO Ammonium-N Load (Ib-V/ds) ISOW No. 2 (Iboy No. 2 Solidis Load (Ib-TS/c) ISOW No. 2 Total Solidis Load (Ib-TS/c) ISOW No. 2 Notice Solidis Cland (Ib-VS/c) ISOW No. 2 Nitrogen Content (Ib-V/Ib-VS) ISOW No. 2 Ammonium-N Load (Ib-IV/ds) ISOW No. 2 Ammonium-N Load (Ib-IV/ds)	75,455 0.053 3,608 0.000 0 0 0.000	56,475 0.053 2,700 0.000 0 0 0.000	50,698 0.063 2,424 0.000 0 0 0.000	0.053 2,029 0.000 0 0 0.000	1,075 0.000 0 0	
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SSQ Violatile Solids Load (Ib-VS/d) SSQ Viologia Content (Ib-V(Ib-VS) SSQ Armonium-N Load (Ib-N/day). SSQ Marcon SSW Wa 2 SSW Wa	75,455 0,053 3,608 0,000 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 74,799 65,075 0.057 2,407 0.055 36,427 0.052 896 0.010 3,991 3,193	50.698 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2,029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
S80 Violattie Solidis Load (b-Ys/d) S80 Altrogen Content (b-Yl-Vs) S80 Ammonium-N Load (b-N/dsy) S80 Amnonium-N Load (b-N/dsy) S80 Miregen Content (b-Yl-Vs) S80 Miregen Content (b-Yl-Vs) Miregen Content (b-Yl-Vs) S90 Miregen Co	75,455 0,053 3,608 0,000 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 74,799 65,075 2,407 0.057 2,407 0.057 36,427 0.052 896 0.010	50.698 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2,029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
S20 Violatile Solids Load (Ib-VS/d) S20 Viologia Content (Ib-V/b-VS) S20 Ammonium-N Load (Ib-N/day) S20 Ammonium-N Load (Ib-N/day) S20 Ammonium-N Load (Ib-N/day) S20 Mro. 2 Total Solids Load (Ib-TS/d) S20 Mro. 2 Violatile Solids Load (Ib-TS/d) S20 Mro. 2 Ammonium-N Load (Ib-N/day) Service 2 Ammonium-N Load (Ib-N/day) Service 2 Ammonium-N Load (Ib-TS/d) S70 Mro. 2 Solids Load (I	75,455 0,053 3,608 0 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	50.688 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2,029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
SSQ Violatile Solids Load (Ib-VS/d) SSQ Annonium-N Load (Ib-N/b-VS) SSQ Annonium-N Load (Ib-N/b-VS) SSQ Annonium-N Load (Ib-V/b-VS) HSQW No. 2 Disolits Load (Ib-VS/d) HSQW No. 2 Violatile Solids Load (Ib-VS/d) HSQW No. 2 Alvisolits Load (Ib-VS/d) HSQM Coll Liber (Ib-V/Ib-VS) HSQM Coll Liber (I	75,455 0,053 3,608 0,000 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.000 0 0.005 74,799 65,075 0.057 2,407 0.056 0.057 2,407 0.052 896 0.010 3,991 3,193 0.008 24	50.698 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2.029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
SSQ Violatile Solids Load (Ib-VS/d) SSQ Annonium-N Load (Ib-N/day) SSQ Annonium-N Load (Ib-N/day) SSQ Annonium-N Load (Ib-N/day) SSQ March 2 Constantion of the Solids Load (Ib-TS/d) SSW No. 2 Total Solids Load (Ib-TS/d) SSW No. 2 Total Solids Load (Ib-TS/d) SSW No. 2 Annonium-N Load (Ib-N/day) Solidge Total Nitrogen Content (Ib-N/Ib-TS) Solidge Total Solids Load (Ib-TS/d) Solidge Total Nitrogen Content (Ib-N/Ib-TS) Solidge Total Solids Load (Ib-TS/d) Solids Load (Ib-TS/d) Solids Solids Load (Ib-Y/d) Solids Solids Solids Load (Ib-Y/d) Solids Solids Solids Load (Ib-Y/d) Solids Solids Solids Load (Ib-Y/d) Solids Solids Load (Ib-Y/d) Solids Solids Sol	75,455 0.053 3,608 0 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0.000 0 0.000 0 0.005 74,799 0.057 2,407 0.052 896 0.010 3,193 3,193 3,193 3,642 36	50.688 0.053 2.424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2,029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 Violatile Solids Load (Ib-VS/d) SS0 Artispen Content (Ib-V/lb-VS) SS0 Armonium-N Load (Ib-V/day). SS0 Armonium-N Load (Ib-V/day). SS0 Mro. 2 Organic Nitrogen Content (Ib-V/lb-TS) SS0 Wro. 2 Violatile Solids Load (Ib-VS/d) SS0 Wro. 2 Alvengen Content (Ib-V/lb-TS) SS0 Wro.	75,455 0,053 3,608 0,000 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 74,799 65,075 0.067 2,407 0.065 36,427 0.052 896 0.010 3,991 3,193 0.008 24 36 7	50.698 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2.029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
SSO Violatile Solids Load (Ib-Xy, d) SSO Niorgen, Content (Ib-Xy), VA(sy), SSO Ammonium-N Load (Ib-N/dsy), SSO Ammonium-N Load (Ib-N/dsy), SSO March 2, Organic Nitrogen Content (Ib-H/Ib-TS), SSO No. 2 103 Solids Load (Ib-TS/d) SSO No. 2 Violatile Solids Load (Ib-TS/d) SSO No. 2 Ammonium-N Load (Ib-N/dsy) Solidge Total Nitrogen Content (Ib-H/Ib-TS) Solidge Total Nitrogen Content (Ib-H/Ib-TS) Solidge Violatile Solids Load (Ib-TS/d) Yimary Sludge Total Nitrogen Content (Ib-H/Ib-TS) Solidge Violatile Solids Load (Ib-TS/d) Yimary Sludge Total Nitrogen Content (Ib-H/Ib-TS) Was Total Solids Load (Ib-TS/d) WMS Total Solids Load (Ib-TS/d) SOW Total Solids Load (Ib-TS/d) SOW Total Solids Load (Ib-Y/d) SOW Total Solids Solid	75,455 0.053 3,608 0 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0.000 0 0.000 0 0.005 74,799 0.057 2,407 0.052 896 0.010 3,193 3,193 3,193 3,642 36	50.688 0.053 2.424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2,029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
SSO Violatile Solids Load (Ib-Xy, d) SSO Niorgen, Content (Ib-Xy), VA(sy), SSO Ammonium-N Load (Ib-N/dsy), SSO Ammonium-N Load (Ib-N/dsy), SSO Marco, 2 Organic Nitrogen Content (Ib-Xy), Ib- SSO No. 2 Total Solids Load (Ib-TS/d) SSO No. 2 Violatile Solids Load (Ib-TS/d) SSO No. 2 Ammonium-N Load (Ib-N/dsy) Solidge Total Nitrogen Content (Ib-Ay), Ib- SSO No. 2 Ammonium-N Load (Ib-S/d) Yimary Sludge Total Nitrogen Content (Ib-Ay), Ib- SSO No. 2 Ammonium-N Load (Ib-S/d) Yimary Sludge Total Nitrogen Content (Ib-Ay), Ib- SSO No. 2 Ammonium-N Load (Ib-TS/d) Yimary Sludge Total Nitrogen Content (Ib-Ay), Ib- Yimary Sludge Total Nitrogen Content (Ib-Ay), Ib- Yimary Sludge Violatile Solids Load (Ib-TS/d) WMS Not Solids Load (Ib-TS/d) WMS Total Solids Load (Ib-TS/d) WMS Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-Y/d) SSO Total Solids Solids Load (Ib-Y/d) SSO Total Solids Load (Ib-Y/d) SS	75,455 0,053 3,608 0 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0,053 2,700 0 0 0 0 0 0 0 0 0 0 0 0	50.688 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2,029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
SSQ Visalitie Solids Load (b-Ys/a) SSQ Antoneon (b-Wh-Ys) SSQ Annonium-N Load (b-N/day) BSQW No. 2. Organic Nitrogen Content (b-Yh/b-TS) HSQW No. 2. Organic Nitrogen Content (b-Yh/b-TS) HSQW No. 2. Visalitie Solids Load (b-Ys/d) HSQW No. 2. Nitrogen Content (b-Yh/b-TS) HSQW No. 2. Nitrogen Content (b-Yh/b-TS) HSQW No. 2. Nitrogen Content (b-Yh/b-TS) Primary Studge Total Solids Load (b-TS/d) Primary Studge Total Solids Load (b-TS/d) Primary Studge Total Solids Load (b-TS/d) Primary Studge Load (b-TS/d) Primary Studge Load (b-TS/d) Primary Studge Load (b-TS/d) Primary Studge Load (b-Yh/dy) TMSS Total Solids Load (b-Ys/d) Nitrogen Content (b-Yh/b-TS) TMSS Total Solids Load (b-Ys/d) HSQW Total Solids Load (b-Ys/d)	75,455 0,053 3,608 0,000 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 74,799 65.075 2,407 0.052 896 0.010 3,193 3,193 0.008 24 36 7 9,47 9,47 6,026 0.39 1,846	50.698 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2.029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
SSO Visabile Solids Load (b-Ys/d) SSO Nitrogen Content (b-Y,lh-Ys) SSO Ammonium-N Load (b-N/day) MSOW No. 2 Organic Nitrogen Content (b-Y,lh-Ys) HSOW No. 2 Organic Nitrogen Content (b-Y,lh-Ys) HSOW No. 2 Not Solids Load (b-Ys/d) HSOW No. 2 Ammonium-N Load (b-N/day) Primary Siudge Tolal Nitrogen Content (b-Y,lh-Ys) HSOW No. 2 Ammonium-N Load (b-Ys/d) HSOW Solids Load (b-Ts/d) HSOW Solids Solids Load (b-Ts/d) HSOM Solids Load (b-Ts/d) HSOM Solids Load (b-Ts/d) HSO Solids Load (b-Ys/d) HSOS Tolal Nitrogen Content (b-H/lb-TS) HSO Stolal HSOW No. 2 HSO Solids Load (b-Ts/d) HSOS Volatile Solids Load (b-Ts/d) HSOS HSON Tolal Solids Load (b-Ts/d) HSOS HSON Tolal Solids Load (b-Ts/d) HSOS Tolal Nitrogen Content (b-H/lb-TS) HSOS Tolal Nitrogen Content (b-H/lb-TS) HSOS Volatile Solids Load (b-Ts/d) HSOS Volatile Solids Load (b-Ts/d) HSOS HSON Tolal HSOS HSON HSON HSON HSON HSON HSON HSON	75,455 0.053 3,608 0.000 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0,053 2,700 0 0 0 0 0 0 0 0 0 0 0 0	50.688 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0 0.005 79.055 68.778 0.057 2,544 0.065 48,125 38,500 0.652 947 0.010 3,991 3,193 0.008 24 36 7 9.47 5.538 0.40 1,763	0.053 2.029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 Violatti Solidis Load (b-V5/d) SS0 Antongo. Content (b-V1/b-V5) SS0 Annonium-N Load (b-V/dsy). MSVM No. 2. Organic Nitrogen Content (b-V1/b-T5) HSVM No. 2. Organic Nitrogen Content (b-V1/b-T5) HSVM No. 2. Volattis Solidis Load (b-V5/d) HSVM No. 2. Volattis Solidis Load (b-V5/d) HSVM No. 2. Volattis Solidis Load (b-V5/d) MSVM No. 2. Natura (b-V1/b-T5) Prinary Sludge Total Nitrogen Content (b-V1/b-T5) Prinary Sludge Volatili Solidis Load (b-V5/d) Nitrogen Content (b-V1/b-T5) TWAS Total Solidis Load (b-V5/d) Nitrogen Content (b-V1/b-T5) TWAS Total Solidis Load (b-V5/d) HSVM Yolatili Solidis Load (b-V6/d) Ammonium-Y Load (b-V/dsy) Ammonium-Y Load (b-V/dsy) A	75,455 0,053 3,608 0,000 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0.053 2,700 0 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 74,799 65.075 2,407 0.057 2,407 0.052 896 0.010 3,193 0.008 24 36 7 9.47 9.47 9.47 9.47 0.13 3.30	50.688 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2.029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day) HSOW No. 2 SOYANO.2 Organic Nitrogen Content (Ib-N/Ib-TS)	75,455 0.053 3,608 0.000 0 0 0 0 0 0 0 0 0 0 0 0	56,475 0,053 2,700 0 0 0 0 0 0 0 0 0 0 0 0	50.688 0.053 2,424 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.053 2.029 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1,075 0,000 0 0 0 0 0 0 0 0 0 0 0 0	

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Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-004
	Pro	ject			Subject
Encina Biosolids, Energy, and Em	issions		2030 Year - All Digeste	rs in Service	

15 day Thermophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference	
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable)			
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1	
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1	
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1	
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2	
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No		
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production vield (scf/lb-VSd)	17.8	1	

High Strength Organic Waste (HSOW)

Par	meter	Input Values	Reference	Parameter	Input Values	Reference
HSOWN	o. 1 Name	SSO	0	Percent of SSO (%)	100%	Assumed
HSOW M	o. 2 Name			Percent of (%)	0%	
SSO Tota	I Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volat	le Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2	fotal Solids (%)					
HSOW No. 2 V	olatile Solids (%)					

Dof

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row			1		

Nutrients Speciation for Edsting Conditions

Primary Slud	lge		TWAS		Existing HSOW (if applicable)			
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speci	ation		Nitrogen Spec	ciation		Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (lb-N/lb-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

	i i i i i i i i i i i i i i i i i i i	Table X-X: E	xisting 15 day Thermophilic Digestion Feed A	issessment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	5.84	5.84	5.84	5.84	5.84	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299	
TWAS Total Solids Load (Ib-TS/d)	37,020	45,534	48,125	51,827	59,231	
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	101,822	124,324	131,172	140,955	160,521	
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650	
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
Total Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
Base HRT (days)	22	18	17	16	14	
Base OLR (lbsVS/d-cf)	0.11	0.13	0.14	0.15	0.17	
Hydraulic Capacity (HC) (gpd)	123,692	64,557	46,559	20,848	-30,573	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (lb-VS/day)	105,222	54,917	39,607	17,735	-26,008	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	187,664	168,684	162,908	154,655	138,151	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Hydraulic	Hydraulic	Hydraulic	Hydraulic	No Capacity	
	·		X-X: Mesophilic Co-digestion Feed Assessm		l	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	105,222	54,917	39,607	17,735	0	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/day)	105,222	54,917	39,607	17,735	0	
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	105,222	54,917	39,607	17,735	0	
SSO Total Solids Load (lb-TS/day)	123,791	64,608	46,596	20,865	0	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (lb-TS/day)	123,791	64,608	46,596	20,865	0	
SSO (lb-wet/day)	1,031,588	538,403	388,303	173,875	0	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	1,031,588	538,403	388,303	173,875	0	
SSO (wtpd)	516	269	194	87	0	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SS0 (wtpd)	516	269	194	87	0	
SSO (gpd)	123,692	64,557	46,559	20,848	0	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	123,692	64,557	46,559	20,848	0	
Total Solids, Total Solids Load (Ib-TS/d)	225,613	188,932	177,768	161,820	160,521	
Total Solids, Volatile Solids Load (Ib-VS/d)	190,937	159,612	150,078	136,459	135,228	
Total Flow (gpd) Primary sludge percent of VS Load (%)	389,500 28%	389,500 41%	389,500 46%	389,500 54%	420,073 63%	

WAS percent of VS Load (%)	16%	23%	26%	30%	35%	
FOG percent of VS Load (%)	2%	2%	2%	2%	2%	
SSO percent of VS Load (%)	55%	34%	26%	13%	0%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check Co-digestion HRT (days)	ok 15	0K 15	0K 15	ок 15	ok 14	
Co-Digestion OLR (lbs-VS/d-cf)	0.24	0.20	0.19	0.17	0.17	
Process Check	OK	OK	OK	OK	No Capacity	
	-		: Existing Mesophilic Solids and Biogas Proc	uction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (lb-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (lb-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d) Volatile Solids Effluent (Lbs-VS/d)	50,640	62,031 42,402	65,497	70,450	80,354	
Total Solids (% TS)	2.3%	2.3%	2 3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145 911.037	51,145 1.108.812	51,145 1,169.005	51,145 1,254,994	51,145 1.426.972	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037		1,169,005 Mesophilic Co-digestion Solids and Biogas Pi		1,426,972	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34.389	42,299	44,706	48,145	55,023	1000
WAS Volatile Solids Destroyed (lb-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (Ib-VSd/day)	94,700	49,425	35,646	15,962	0	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	145,882	111,718	101,321	86,467	80,167	Assumes that valums in squals values and
Total Sludge Effluent (gpd) Total Solids (Lbs-TS/d)	389,500	389,500	389,500	389,500	420,073	Assumes that volume in equals volume out
Volatile Solids (Lbs-VS/d)	45,055	47.894	48,758	49,992	55,061	
Total Solids (% TS)	2.5%	2.4%	2.4%	2.3%	2.3%	
Volatile Solids (% VS)	57%	62%	64%	66%	69%	
Dewatered Solids (Lbs-TS/d)	75,745	73,353	72,625	71,585	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	172	167	165	163	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (lb-VSd/day)	247,765	304,751	322,094 51,145	346,871	396,424 51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) SSO Biogas Production (scfd)	51,145 1,704,596	51,145 889.657	51,145 641.632	51,145 287.311	51,145 0	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	Assumes a biogas field of 10 sci/ 10-V30
Total Biogas Production (scfd)	2,615,633	1.998.469	1.810.637	1.542.304	1.426.972	
		Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat	es		
HSOW No 1	Annual Average	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day	es Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS)	0.063	Table Peak Month 0.063	Peak 14 day 0.063	es Peak 7 day 0.063	0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)		Peak Month	Peak 14 day	es Peak 7 day		Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d)	0.063 123,791 105,222	Peak Month 0.063 64,608 54,917	Peak 14 day 0.063 46,596 39,607	es Peak 7 day 0.063 20,865 17,735	0.063 0 0	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d) SSO Nitrogen Content (lb-N/lb-VS)	0.063	Peak Month	Peak 14 day 0.063	es Peak 7 day 0.063	0.063	Notes
SSO Organic Nitrogen Content (lb-N/lb-TS) SSO Total Solids Load (lb-TS/d) SSO Volatile Solids Load (lb-VS/d)	0.063 123,791 105,222	Peak Month 0.063 64,608 54,917	Peak 14 day 0.063 46,596 39,607	es Peak 7 day 0.063 20,865 17,735	0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatile Solids Load (Ib-VS/d) SS0 Nitrogen Content (Ib-N/Ib-VS) SS0 Ammonium-N Load (Ib-N/day)	0.063 123,791 105,222	Peak Month 0.063 64,608 54,917	Peak 14 day 0.063 46,596 39,607	es Peak 7 day 0.063 20,865 17,735	0.063 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatilis Solids Load (Ib-YS/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Ammonium-N Load (Ib-N/day) HSOW No 2 HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS)	0.063 123,791 105,222 0.053 5,031 	Peak Month 0.063 64,608 54,917 0.053 2,626 0.000 0	Peak 14 day 0.063 46.596 39.607 0.053 1.884 0.000 0	es Peak 7 day 0.063 20,865 17,735 0.053 848 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SSO Organic Nitrogen Content (b-N/lb-TS) SSO Total Solid Load (b-TS/d) SSO Valat Solid Load (b-TS/d) SSO Nitrogen Content (b-V/b-VS) SSO Nitrogen Content (b-V/b-VS) SSO Ammonium-NL (ada (b-N/day) HBOW No.2 Storman Content (b-N/lb-TS) HSOW No.2 Total Solids Load (b-TS/d) HSOW No.2 Total Solids Load (b-VS/d)	0.063 123,791 105,222 0.053 5,031	Peak Month 0.063 64,608 54,917 0.053 2,626	Peak 14 day 0.063 46,596 39,607 0.053 1,894	es Peak 7 day 0.063 20,865 17,735 0.053 848	0.063 0 0.000 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Violatilie Solids Load (Ib-YS/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Ammonium-VL Load (Ib-V/day) HBOW No. 2 HSOW No. 2: Colla Solids Load (Ib-TS/d) HSOW No. 2: Volatile Solids Load (Ib-TS/d)	0.063 123.791 105.222 0.053 5.031 0.000 0 0 0 0 0 0 0.000	Peak Month 0.063 64,608 54,917 0.053 2,626 0.000 0	Peak 14 day 0.063 46.596 39.607 0.053 1,894 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 20,865 17,735 0.053 848 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Total Solid Load (b-TS/d) SS0 Viatili Solid Load (b-TS/d) SS0 Viatili Solid Load (b-TS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Nitrogen Content (b-N/b-VS) SS0 Nitrogen Content (b-N/b-VS) SS0 Nitrogen Content (b-N/b-TS) HSOW No.2 Torganic Nitrogen Content (b-N/lb-TS) HSOW No.2 Torganic Altrogen Content (b-N/a) HSOW No.2 Torganic Nitrogen Content (b-N/a) HSOW No.2 Nitrogen Content (b-N/a) HSOW No.2 Nitrogen Content (b-N/a)	0.063 123,791 105,222 0.053 5,031 	Peak Month 0.063 64,608 54,917 0.053 2,626 0.000 0	Peak 14 day 0.063 46.596 39.607 0.053 1.884 0.000 0	es Peak 7 day 0.063 20,865 17,735 0.053 848 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Total Solid Load (b-TS/d) SS0 Violatile Solids Load (b-VS/d) SS0 Violatile Solids Load (b-VS/d) SS0 Namosium-N Load (b-V/day) HSOW No.2 HSOW No.2 ToSO No.2 (Total Coll and (b-TS/d) HSOW No.2 VIOL 2 Voiatile Solids Load (b-VS/d) HSOW No.2 HSOW No.2<	0.063 123.791 105.222 0.053 5.031 0.000 0 0 0 0 0 0 0.000	Peak Month 0.063 64,608 54,917 0.053 2,626 0.000 0	Peak 14 day 0.063 46.596 39.607 0.053 1,894 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 20,865 17,735 0.053 848 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nithogen Content (b-N/lb-TS) SS0 Total Solids and (b-TS/d) SS0 Visitile Solids Load (b-VS/d) SS0 Visitile Solids Load (b-VS/d) IBOW No2 SS0 Visitile Solids Load (b-VS/d) IBOW No2 SS0 Visitile Solids Load (b-V/day) IBOW No2 SS0 Visitile Solids Load (b-V/day) IBOW No2 SS0 Visitile Solids Load (b-VS/d) ISOW No. 2 Visitile Solids Load (b-VS/d) ISOW No. 2 Notatile Solids Load (b-V/day) Detempt Phaney Slidge	0.063 123.791 105.222 0.053 5.031 0.000 0 0 0 0 0 0 0.000	Peak Month 0.063 64,608 54,917 0.053 2,626 0.000 0	Peak 14 day 0.063 46.596 39.607 0.053 1,894 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 20,865 17,735 0.053 848 0.000 0	0.063 0 0.000 0 0 0.000 0	Notes
SS0 Organic Nithogen Content (b-H/lb-TS) SS0 Total Solids Load (b-TS/d) SS0 Visited Solids Load (b-VS/d) SS0 Visited Content ((b-H/b-VS)) SS0 Nitrogen Content ((b-H/b-VS)) SS0 Nitrogen Content ((b-H/b-VS)) SS0 Nitrogen Content ((b-H/b-TS)) MSOW No. 2 Organic Nitrogen Content ((b-H/b-TS)) MSOW No. 2 Organic Nitrogen Content ((b-H/b-TS)) MSOW No. 2 Visite Solids Load ((b-N/d)) MSOW No. 2 Visite Solids Load ((b-N/d)) MSOW No. 2 Nitrogen Content ((b-H/b-YS)) MSOW No. 2 Nitrogen Content ((b-H/b-TS)) Missor Nitrogen Content ((b-H/b-TS)) Primary Sludge Total Solids Load ((b-N/da)) Primary Sludge Total Solids Load ((b-N/da)) Primary Sludge Total Solids Load (b-N/da)	0.063 123,791 105,222 0.053 5,031 0.000 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64,608 54,917 0.053 2,626 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.0005 74,799	Peak 14 day 0.063 46.596 39.607 0.053 1.884 0.000 0 0 0 0 0 0 0 0 0 0 0 0	85 Peak 7 day 0.063 20.865 17,735 0.053 843 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/b-TS) SS0 Total Solids and (b-TS/d) SS0 Violatile Solids Land (b-VS/d) SS0 Nitrogen Content (b-N/b-VS) SS0 Ammonium-N Load (b-N/day) MSOW No. 2. Organic Nitrogen Content (b-N/b-TS) MSOW No. 2. Organic Nitrogen Content (b-N/b-TS) MSOW No. 2. Organic Nitrogen Content (b-N/b-TS) MSOW No. 2. Nitrogen Content (b-N/b-TS) MSOW No. 2. Nitrogen Content (b-N/b-TS) Missow No. 2. Nitrogen Content (b-N/b-TS) Missow No. 2. Nitrogen Content (b-N/b-TS) Minary Sludge Total Nitrogen Content (b-N/b-TS) Primary Sludge Total Solids Load (b-N5/d) Primary Sludge Total Solids Load (b-N5/d)	0.063 123,791 0.0522 5.031 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64,608 54,917 0.053 2,626 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.0005 74,799	Peak 14 day 0.063 46.596 39.607 0.053 1.884 0.000 0 0 0 0 0 0 0 0 0 0 0 0	85 Peak 7 day 0.063 20.865 17,735 0.053 843 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SSO Organic Nitrogen Content (b-N/lb-TS) SSO Varial Solid Load (b-TS/d) SSO Varial Solid Load (b-TS/d) SSO Nitrogen Content (b-V/b-VS) SSO Ammonium-N Load (b-V/day) HBOW No 2 Nitrogen Content (b-V/b-TS) HSOW No 2 Not Content (b-V/b-VS) HSOW No 2 Not Content (b-V/b-VS) Primary Sludge Total Nitrogen Content (b-N/lb-TS) Primary Sludge Total Solids Load (b-TS/d) Primary Sludge Total Solids Load (b-VS/d) Nitrogen Content (b-N/lb-VS) Ammonium-N Load (b-N/day)	0.063 123,791 0.0522 0.053 5,031 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64,608 54,917 0.053 2,626 0.0655 74,799 65,075	Peak 14 day 0.063 46.996 39.907 0.053 1.894 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 20.865 17,735 0.053 8.48 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Tortal Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) IBSW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) ISSW No. 2 Nitrogen Content (Ib-N/Ib-TS) ISSW No. 2 Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) TWAS Total Solids Load (Ib-TS/d) TWAS Total Solids Load (Ib-TS/	0.063 123,791 0.053 5.031 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64,608 64,608 54,917 0.053 2,626 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 0.057 0.057 2,007 0 0.065 45,534	Peak 14 day 0.063 46.596 33.607 0.053 1.894 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 20.865 17,735 0.053 8.48 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (b-TS/q) SS0 Vitalie Solids Load (b-VS/q) SS0 Nitrogen Content ((b-N/Ib-VS) SS0 Nitrogen Content ((b-N/Ib-VS) SS0 Nitrogen Content ((b-N/Ib-TS) MSOW No.2 Vision No.2 SS0 Nitrogen Content ((b-N/Ib-TS) MSOW No.2 Vision No.2 SS0 Nitrogen Content ((b-N/Ib-TS) MSOW No.2 Vision No.2 SS0 Nitrogen Content ((b-N/Ib-VS) HSOW No.2 Primary Suidge Total Nitrogen Content ((b-N/Ib-VS) Primary Suidge Total Solids Load (b-VS/d) Nitrogen Content ((b-N/Ib-TS) Primary Suidge Total Solids Load (b-VS/d) Nitrogen Content ((b-N/Ib-TS) Primary Suidge Total Solids Load (b-VS/d) Nitrogen Content ((b-N/Ib-TS) PMAS Tot	0.063 122,791 105,222 0.053 5,031 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64.008 54.917 0.053 2,626 0.000 0 0 0.000 0 0.000 0 0.005 74,799 0.0057 2,407 0.055 2,407 0.055 2,407 0.055 2,807 0.055 36,427 0.052 896 0.010 3,991 3,193 3,193	Peak 14 day 0.063 46.596 39.607 0.053 1.854 0.000 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 20.865 17,735 0.053 848 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Total Solids and (b-TS/d) SS0 Vintagen Content (b-N/lb-VS) SS0 Nitrogen Content (b-N/lb-VS) Primary Sludge Total Nitrogen Content (b-N/lb-VS) Primary Sludge Total Solids Load (b-VS/d) Primary Sludge Total Solids Load (b-VS/d) Nitrogen Content (b-N/lb-VS) Ammonium - N Load (b-N/day) TWAS TWAS Total Solids Load (b-VS/d) Nitrogen Content (b-N/lb-VS)	0.063 122,791 105,222 0.053 5,031 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 0.063 64,608 54.917 0.053 2,626 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 74,799 65,075 0.0057 2,407 0.0052 989 9 0.010 3,991 3,193 0.008 24 66	Pesk 14 day 0.063 46.996 39.607 0.053 1.894 0.000 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day 0.063 20.865 17,735 0.053 8.48 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (b-TS/d) SS0 Visitie Solids Load (b-VS/d) SS0 Visitie Solids Load (b-VS/d) SS0 Nitrogen Content (b-N/Ib-VS) SS0 Nitrogen Content (b-N/Ib-TS) Pitmary Studge Total Solids Load (b-N/G) Pitmary Studge Total Solids Load (b	0.063 122,791 105,222 0.053 5,031 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64.608 54.917 0.053 2,626 - 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 65.075 0.057 2,407 0.0654 45.534 0.052 896 0.010 3.991 3.193 0.008 24 66 7 666	Peak 14 day 0.063 46.596 39.607 0.053 1.894 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 20.865 17,735 0.053 8.848 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/Ib-TS) SS0 Total Solids and (b-TS/d) SS0 Visualitie Solids Load (b-VS/d) SS0 Visualitie Solids Load (b-VS/d) SS0 Mitorgen Content (b-N/Ib-VS) SS0 Mitorgen Content (b-N/Ib-TS) SS0 Mitorgen Content (b-N/Ib-TS) MSOW No. 2 Organic Nitrogen Content (b-N/Ib-TS) MSOW No. 2 Organic Nitrogen Content (b-N/Ib-TS) MSOW No. 2 Organic Nitrogen Content (b-N/Ib-TS) MSOW No. 2 Nationality Solids Load (b-VS/d) MSOW No. 2 Nationality Solids Load (b-VS/d) MSOW No. 2 Nationality Solids Load (b-VS/d) Mitorgen Content (b-N/Ib-VS) Primary Sludge Total Solids Load (b-VS/d) Mitorgen Content (b-N/Ib-VS) Ammonium-N Load (b-N/Vdy) MAS Total Solids Load (b-VS/d) Mitorgen Content (b-N/Ib-TS) MAS Total Nitrogen Content (b-N/Ib-TS) MSOW Total Solids Load (b-VS/d) MSOW Total Notagen Content (b-N/Ib-VS)	0.063 122,791 105,222 0.053 5,031 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64.608 54.917 0.053 2,626 - 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.065 65.075 0.057 2,407 0.0654 45.534 0.052 896 0.010 3.991 3.193 0.008 24 66 7 666	Peak 14 day 0.063 46.596 39.607 0.053 	es Peak 7 day 0.063 20.865 17,735 0.063 848 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Visitel Solids Load (b-TS/d) SS0 Visitel Solids Load (b-TS/d) SS0 Nitrogen Content (b-N/lb-TS) ISS0 Nitrogen Content (b-N/lb-TS) Primary Sludge Total Nitrogen Content (b-N/lb-TS) Primary Sludge Total Nitrogen Content (b-N/lb-TS) Primary Sludge Total Solids Load (b-TS/d) Nitrogen Content (b-N/lb-TS) Nitrogen Content (b-N/lb-TS) HSOW Total Nitrogen Content (b-N/lb-TS)	0.063 122,791 105,222 0.053 5,031 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 0.063 64,608 54.917 0.053 2,626 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.005 74,799 65,075 0.0057 2,407 0.0052 9896 9 0.010 3.991 3,193 0.008 24 66 7 9.22	Peak 14 day 0.063 46.596 39.607 0.053 	es Peak 7 day 0.063 20.865 17,735 0.063 848 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Varial Solid and (b-TS/d) SS0 Viatili Solid and (b-TS/d) SS0 Viatili Solid and (b-TS/d) SS0 Viatili Solid and (b-TS/d) SS0 Annonium-N Load (b-N/day) HS0W No 2 NS0W NO 2	0.063 122,791 105,222 0.053 5,031 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 54.917 0.053 2,626 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 46.596 39.607 0.053 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 20.865 20.865 17,735 0.053 8.84 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Varial Solid and (b-TS/d) SS0 Violatile Solid and (b-TS/d) SS0 Violatile Solid and (b-TS/d) ISS0 Violatile Solid and (b-TS/d) ISS0 Violatile Solid and (b-TS/d) ISS0 Violatile Solid and (b-S/d) ISS0 Violatile Solid Load (b-S/d) Primary Siudge Total Nitrogen Content (b-N/lb-YS) Primary Siudge Total Solids Load (b-S/d) Primary Siudge Total Solids Load (b-S/d) Primary Siudge Total Solids Load (b-S/d) Primary Siudge Total Solids Load (b-S/d) Nitrogen Content (b-N/lb-S) TWAS Total Solids Load (b-S/d) Nitrogen Content (b-N/lb-S) Histogen Co	0.063 122,791 105,222 0.053 5,031 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64.008 54.917 0.003 2,628 0.000 0 0.001 0 0.002 0.003 2,628 0.000 0 0 0.005 74,799 0.055 2,407 0.055 45,534 0.055 3,6427 0.055 3,991	Peak 14 day 0.063 46.596 39.607 0.053 1.854 0.000 0 0 0 0 0 0 0 0 0 0 0 0	23 Peak 7 day 0.063 20.065 20.065 17,735 0.053 8.88 	0.063 0 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (b-N/lb-TS) SS0 Visitel Solids Load (b-TS/d) SS0 Visitel Solids Load (b-TS/d) HBOW No 2 HSOW NO 2	0.063 122,791 105,222 0.053 5,031 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64,608 54.917 0.053 2,626 0.000 0 0.000 0 0.000 0 0.000 0 0.005 74,799 65,075 0.057 2,407 0.065 45,534 36,427 0.052 0.052 0.052 0.013 3,991 0.0052 0.013 3,993 0.008 24 0.022 5.992 0.391 3.306 3.306 3.306 3.306 12.31	Pek 14 day 0.063 46.996 39.607 0.053 1.894 0.000 0 0 0 0 0 0 0 0 0 0 0 0	25 Peak 7 day Peak 7 day 0.063 20.065 20.065 17,735 0.053 8.48 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0 0 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Valainic Sould (Ib-TS/d) SS0 Valainic Sould (Ib-TS/d) SS0 Valainic Sould (Ib-TS/d) SS0 Mitogen Content (Ib-N/Ib-TS) SS0 Mitogen Content (Ib-N/Ib-TS) SS0 No. 2 Valainic Solids Load (Ib-TS/d) SS0 No. 2 Valainic Solids Load (Ib-TS/d) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) Primary Sludge Total Solids Load (Ib-TS/d) TWAS Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Solids Load (Ib-TS/d) TWAS Total Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) Store Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Store Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Store Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) Store Solids Load (Ib-N/d) Store Solids L	0.063 122,791 105,222 0.053 5,031 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 64.008 54.917 0.003 2,628 0.000 0 0.001 0 0.002 0.003 2,628 0.000 0 0 0.005 74,799 0.055 2,407 0.055 45,534 0.055 3,6427 0.055 3,991	Peak 14 day 0.063 46.596 39.607 0.053 1.624 0.000 0 0 0 0 0 0 0 0 0 0 0 0	25 Pack 7 day 0.063 20.065 20.065 17,735 0.053 848 	0.063 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes

	Date Checked	Checked By	Job Number	Ву	Date	Calc No
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-004
Caldwall		Project				Subject
Caldwell	Encina Biosolids, Energy, and Emissio	ons		2030 Year - All Digester	s in Service	
and the second se						

15 day Thermophilic Digestion with All digesters in service

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	15	Assumed	Peaking Factors		
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSO	W (blank if not applicable)
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No	
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

- [Parameter	Input Values	Reference	Parameter	Input Values	Reference
ſ	Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
[TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
[FOG VSR (%)	90%	3			
	SSO VSR (%)	90%	3			
[Do not use this row					

Nutrients Speciation for Existing Conditions

Primar	ary Sludge		TWAS Existing HSOW (if applicable)					
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen	Speciation		Nitrogen Spe	ciation		Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		
	_							

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3.000	

	Table	X-X: Existing 15 day The	mophilic Digestion with All digesters in servi	ice Feed Assessment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	6.70	6.70	6.70	6.70	6.70	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299	
TWAS Total Solids Load (lb-TS/d)	37,020	45,534	48,125	51,827	59,231	
FOG Total Solids Load (Ib-TS/d)	3,991	3,991	3,991	3,991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	101,822	124,324	131,172	140,955	160,521	
Primary Sludge Volatile Solids Load (lb-VS/d)	52,906	65,075	68,778	74,069	84,650	
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385	
FOG Volatile Solids Load (lb-VS/d)	3,193	3,193	3,193	3,193	3,193	
Total Digester Feed, Volatile Solids Load (Ib-VS/d)	85,715	104,695	110,471	118,724	135,228	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
Total Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
Base HRT (days)	25	21	20	18	16	
Base OLR (lbsVS/d-cf)	0.10	0.12	0.12	0.13	0.15	
Hydraulic Capacity (HC) (gpd)	180.692	121.557	103.559	77.848	26.427	Assumes the minimum allowable HRT 15 days
HC as Equivalent VS Load (Ib-VS/day)	153,711	103,406	88.096	66.224	22,481	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	227.671	208.691	202,914	194.662	178.158	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Hydraulic	Hydraulic	Hydraulic	Hydraulic	Hydraulic	
		Table X-X	: Mesophilic Co-digestion Feed Assessment			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (Ib-VS/day)	153,711	103,406	88,096	66,224	22,481	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (Ib-VS/day)	153,711	103,406	88,096	66,224	22,481	
HSOW No. 2 Volatile Solids Load (Ib-VS/day)	0	0	0	0	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	153,711	103,406	88,096	66,224	22,481	
SSO Total Solids Load (Ib-TS/day)	180,836	121,654	103,642	77,911	26,448	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	180,836	121,654	103,642	77,911	26,448	
SSO (lb-wet/day)	1,506,968	1,013,783	863,683	649,255	220,398	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (Ib-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	1.506.968	1.013.783	863.683	649,255	220.398	
SSO (wtpd)	753	507	432	325	110	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	753	507	432	325	110	
SSO (gpd)	180,692	121,557	103,559	77,848	26,427	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	180.692	121.557	103,559	77.848	26,427	
Total Solids, Total Solids Load (Ib-TS/d)	282,658	245,978	234,814	218,865	186,969	
Total Solids, Volatile Solids Load (Ib-VS/d)	239,425	208,101	198,567	184,947	157,709	
Total Flow (gpd)	446,500	446,500	446,500	446,500	446,500	
Primary sludge percent of VS Load (%)	22%	31%	35%	40%	54%	
WAS percent of VS Load (%)	12%	18%	19%	22%	30%	
FOG percent of VS Load (%)	1%	2%	2%	2%	2%	
SSO percent of VS Load (%)	64%	50%	44%	36%	14%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	15	15	15	15	15	

	0.07	0.00	0.00	0.04	0.10	
Co-Digestion OLR (lbs-VS/d-cf) Process Check	0.27 OK	0.23 OK	0.22 OK	0.21 0K	0.18 OK	
	UN UN		sting Mesophilic Solids and Biogas Productio		- OK	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (lb-VSd/day) FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2.873	2.873	2.873	22,271	
Total Volatile Solids Destroyed (lb-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50,640	62,031	65,497	70,450	80,354	
Volatile Solids Effluent (Lbs-VS/d) Total Solids (% TS)	34,533 2.3%	42,402	44,797 2.3%	48,218 2.3%	55,061 2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd) WAS Biogas Production (scfd)	612,128 247,765	752,917 304,751	795,766 322,094	856,979 346,871	979,404 396,424	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scl/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
			philic Co-digestion Solids and Biogas Produc			
Drimony studge//eletile Selide Destroyed (Ib VSd /day)	Annual Average	Peak Month	Peak 14 day 44,706	Peak 7 day 48,145	Peak day 55,023	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day) WAS Volatile Solids Destroyed (lb-VSd/day)	34,389	42,299	18.095	48,145	22.271	
FOG Volatile Solids Destroyed (lb-VSd/day)	2,873	2,873	2,873	2,873	2,873	
SSO Volatile Solids Destroyed (lb-VSd/day)	138,340	93,065	79,286	59,602	20,233	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (lb-VSd/day) Total Sludge Effluent (gpd)	189,522 446,500	155,358 446,500	144,961 446,500	130,107 446,500	100,400 446,500	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	93,137	90,619	89,853	88,759	86,569	
Volatile Solids (Lbs-VS/d)	49,904	52,743	53,606	54,841	57,309	
Total Solids (% TS)	2.5%	2.4%	2.4%	2.4%	2.3%	
Volatile Solids (% VS) Dewatered Solids (Lbs-TS/d)	54% 88,480	58% 86.088	60% 85,361	62% 84,321	66% 82,241	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	201	196	194	192	187	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (lb-VSd/day) FOG Biogas Production (scfd)	247,765 51.145	304,751 51,145	322,094 51,145	346,871 51,145	396,424 51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	2 490 114	1.675.175	1.427.150	1.072.828	364.186	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
Total Biogas Production (scfd)	3,401,151	2,783,987	2,596,155	2,327,822	1,791,158	
HSOW No 1			: Nutrient Loading - Ammonia-N Estimates			N
SSO Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063	Peak Month 0.063	Peak 14 day	Peak 7 day 0.063	Peak day 0.063	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	Annual Average 0.063 180,836	Peak Month 0.063 121,654	Peak 14 day 0.063 103,642	Peak 7 day 0.063 77,911	Peak day 0.063 26,448	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	0.063 180,836 153,711	0.063 121,654 103,406	0.063 103,642 88,096	0.063 77,911 66,224	0.063 26,448 22,481	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	0.063 180,836 153,711 0.053	0.063 121,654 103,406 0.053	0.063 103,642 88,096 0.053	0.063 77,911 66,224 0.053	0.063 26,448 22,481 0.053	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 180,836 153,711	0.063 121,654 103,406	0.063 103,642 88,096	0.063 77,911 66,224	0.063 26,448 22,481	NOTES
SS 0 Granic Nitrogen Content (Ib-N/Ib-TS) SS 0 Total Solids cad (Ib-15/g) SS 0 Notatille Solids Load (Ib-15/g) SS 0 Nitrogen Content (Ib-1/b-15) SS 0 Amonium - N Load (Ib-1/day) HSOW No 2 Toganic Nitrogen Content (Ib-N/Ib-TS)	0.063 180,836 153,711 0.053 7,349 0.000	0.063 121,654 103,406 0.053 4,944 0.000	0.063 103,642 88,096 0.053 4,212 0.000	0.063 77,911 66,224 0.053 3,166 0.000	0.063 26,448 22,481 0.053 1,075 0.000	NOLES
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatilis Solids Load (Ib-YS/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Ammonium-Nad (Ib-N/dsy) HSOW No.2 HSOW No.2 MSOW No.2 MSOW No.2 MSOW No.2 MSOW No.2	0.063 180.836 153.711 0.053 7,349 0.000 0	0.063 121,654 103,406 0.053 4,944 0.000 0	0.063 103,642 88,096 0.053 4,212 0.000 0	0.063 77,911 66,224 0.053 3,166 0.000 0	0.063 26,448 22,481 0.053 1,075 0.000 0	NOTES
SSO 01ganic Nitrogen Content (Ib-N/Ib-TS) SSO 1rati Solito And (Ib-Ts/)d) SSO 1rati Solito And (Ib-Ts/)d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Annonium-N Load (Ib-N/ds) SSO Nator Solito And (Ib-N/ds) SSO Nator Solito Solito And (Ib-N/ds)	0.063 180,836 153,711 0.053 7,349 0.000 0 0	0.063 121,654 103,406 0.053 4,944 0.000	0.063 103.642 88.096 0.053 4.212 0.000 0 0	0.063 77,911 66,224 0.053 3,166 0.000 0 0	0.063 26,448 22,481 0.053 1,075 0.000 0 0	
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatilis Solids Load (Ib-YS/d) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Ammonium-Nad (Ib-N/dsy) HSOW No.2 HSOW No.2 MSOW No.2 MSOW No.2 MSOW No.2 MSOW No.2	0.063 180.836 153.711 0.053 7,349 0.000 0	0.063 121,654 103,406 0.053 4,944 0.000 0	0.063 103,642 88,096 0.053 4,212 0.000 0	0.063 77,911 66,224 0.053 3,166 0.000 0	0.063 26,448 22,481 0.053 1,075 0.000 0	NO(85
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SS0 Organic Nitrogen Content (Ib-V(b-TS) SS0 Traits Joilts caud (Ib-Ys/d) SS0 Visitilitie Solidis Laad (Ib-Vs/d) SS0 Nitrogen Content (Ib-V/b-VS) SS0 Visitilitie Solidis Laad (Ib-Vs/ds) SS0 Visitilitie Solidis Laad (Ib-Vs/ds) SS0 Winz 2 SS0 Visitilitie Solidis Laad (Ib-Vs/ds) SS0 Winz 2 Winz 3 SS0 Winz 2 SS0 W	0.063 180.836 183.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121,654 103,406 0.053 4,494 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.096 0.053 4.4212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77,911 66,224 0.053 3,166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 26.448 22.481 0.053 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N0(85
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids cod (Ib-TS/d) SS0 Viselan Collocat (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) Nitrogen Content (Ib-N/Ib-TS) <tr< td=""><td>0.063 190.836 157.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 121.654 103.406 0.053 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 103.642 88.096 0.053 4,212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.063 77.911 66.224 0.053 3,186 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td><td>0.003 26.448 22.481 0.053 1.075 0.000 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0.005 72.29 84.650 84.650 0.057 3.131 3.131 3.132 0.065 9.231 3.135 0.005</td><td>NO(85</td></tr<>	0.063 190.836 157.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.096 0.053 4,212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77.911 66.224 0.053 3,186 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26.448 22.481 0.053 1.075 0.000 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0.000 0 0 0.005 72.29 84.650 84.650 0.057 3.131 3.131 3.132 0.065 9.231 3.135 0.005	NO(85
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Traits Joilts cand (Ib-N/Jb-TS) SS0 Vinitialitie Solids Load (Ib-N/Jb-TS) SS0 Nitrogen Content (Ib-N/Ib-YS) SS0 Winzer Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) Primary Sildge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sildge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sildge Total Nitrogen Content (Ib-N/Ib-TS) Wits Gaute (Ib-N/Ib-VS) Wits Gaute (Ib-N/Ib-TS) Wits Caute (Ib-N/Ib-TS) Wits Valids Valids Load (Ib-VS/d) Wits Valids Valids Load (Ib-V/ds) Wits Valids Valids Load (Ib-VS/d) Wits Valids Valids Load (I	0.063 180.836 183.711 0.053 7.349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121,654 103,406 0.053 4,494 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.096 0.053 4.4212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77,911 66,224 0.053 3,166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 26.448 22.481 0.053 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Traits Joilts Acad (Ib-Ts/A) SS0 Traits Joilts Acad (Ib-Ts/A) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Ammonium-R Laad (Ib-N/Ib-TS) SS0 Ammonium-R Laad (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 ST0 Nitrogen Content (Ib-N/Ib-TS) SS0 SS0 ST0 Nitrogen Content (Ib-N/Ib-TS) SS0 SS0 ST0	0.063 190.836 195.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.944 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.096 0.053 4.212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77.911 66.224 0.053 3,166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26.448 22.481 0.053 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	N0(85
S80 Organic Nitrogen Content (Ib-N/Ib-TS) S80 Organic Nitrogen Content (Ib-N/Ib-TS) S80 Violatile Solids Load (Ib-TS/d) S80 Nitrogen Content (Ib-N/Ib-TS) S80 Amonium-N Load (Ib-N/dby) MSOW No 2. Organic Nitrogen Content (Ib-N/Ib-TS) MSOW No 2. Violatile Solids Load (Ib-TS/d) MSOW No 2. Violatile Solids Load (Ib-TS/d) MSOW No 2. Violatile Solids Load (Ib-TS/d) MSOW No 2. Annonium-N Load (Ib-N/dby) MSOW No 2. Annonium-N Load (Ib-N/dby) MSOW No 2. Annonium-N Load (Ib-N/dby) Many Sladge Total Nitrogen Content (Ib-N/Ib-TS) Minary Sladge Total Nitrogen Content (Ib-N/Ib-TS) Minary Sladge Total Nitrogen Content (Ib-N/Ib-TS) Minary Sladge Total Solids Load (Ib-TS/d) Primary Sladge Total Solids Load (Ib-YS/d) Minary Sladge Total Solids Load (Ib-YS/d) Minary Sladge Total Solids Load (Ib-YS/d) Minary Sladge Total Solids Load (Ib-YS/d) WKS Total Solids Load (Ib-Y/d) WKS Total Solids Load (Ib-YS/d) WKS Total Solids Load (Ib-YS/d) Mixes Total Solids Load (Ib-Y/d) Mixes Total Solids Load (Ib-YS/d) Mixes Total Solids Load (Ib-YS/d) Mixes Total Solids Load (Ib-YS/d) Mixes Total Solids Load (Ib-Y/d) Mixes Total Load Lob-Y/d) Mixes Total Solids Lod (Ib-Y/d) Mixes Total Solids Lod (Ib-Y/d) Mixes Total Load Lob-Y/d) Mixes Total Solids Lod Lob-Y/d) Mixes Total S	0.063 190.836 195.711 0.053 7,249 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.944 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0.053 0.053 0.053 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77,911 66,224 0.053 3.186 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,448 22,481 0.053 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NO(85
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Traits Joilds could (Ib-S7/d) SS0 Visualitie Solids Load (Ib-N/ds) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Witrogen Content (Ib-N/Ib-TS) Primary Siludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Siludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Siludge Total Nitrogen Content (Ib-N/Ib-TS) Witrogen Content (Ib-N/Ib-TS) <	0.063 180.836 185.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.944 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.096 0.053 4.212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77.911 66.224 0.053 3,166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26.448 22.481 2.0.05 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
S30 Organic Nitrogen Content (Ib +/Ib-TS) S30 Oradia Solids coda (Ib-Ts/d) S30 Visabilite Solids Load (Ib-Ts/d) S30 Visabilite Solids Load (Ib-Ts/d) S30 Nitrogin Content (Ib-H/Ib-TS) S50 Wisson S50 Wisson S50 Mitrogin Content (Ib-H/Ib-TS) S50 Wisson	0.063 190.836 195.711 0.053 7,249 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.944 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.996 0.053 4.212 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77,911 66,224 0.053 3.186 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,448 22,481 0.053 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NO(85
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Oralis Jolids coda (Ib-Ts/d) SS0 Visalitie Solids Load (Ib-Ts/d) SS0 Visalitie Solids Load (Ib-Ts/d) SS0 Amonium-N Load (Ib-N/Ib-TS) SS0 Amonium-N Load (Ib-N/Ib-TS) SS0 Amonium-N Load (Ib-N/Ib-TS) SS0 MP D2 SS0	0.063 180.836 182.711 0.053 7,249 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.944 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0.053 0.053 0.053 0.053 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77,911 66,224 0.053 3,186 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,448 22,441 0.053 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Traits Joilds could (Ib-TS/d) SS0 Vitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) Primary Studge Total Nitrogen Content (Ib-N/Ib-TS) Primary Studge Total Nitrogen Content (Ib-N/Ib-TS) Whas Y and Solids Load (Ib-N/Jc) Nitrogen Content (Ib-N/Ib-TS) Whas Y and Solids Load (Ib-N/Jc) Nitrogen Content (Ib-N/Ib-TS) Whas Y and Solids Load (Ib-N/Jc) Nitrogen Content (Ib-N/Ib-TS) Whas Y and Solids Load (Ib-N/Jc) Nitrogen Content (Ib-N/Ib-TS) Whas Y and Solids Load (Ib-N/Jc) Nitrogen Content (Ib-N/Ib-TS) Strol Solids Load (Ib-S/Jc) Strol Solids Load (Ib-S/Jc) Strol Solids Load (Ib-TS/Jc)	0.063 180.836 157.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.4944 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.096 0.053 4,212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77.911 66.224 0.053 3,166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,443 22,441 0.053 1.075 0.000 0 0 0.005 0 0.000 0 0 0 0 0 0 0	
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SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Organical Nitrogen Content (Ib-N/Ib-TS) SS0 Visalite Solids Load (Ib-YS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Amonium N Load (Ib-N/day) HSWI No 2 SS0 Amonium N Load (Ib-N/day) HSWI No 2 SS0 Xintogen Content (Ib-N/Ib-TS) SSW No 2, Visalite Solids Load (Ib-YS/d) SSW No 2, Visalite Solids Load (Ib-YS/d) Wisagen Content (Ib-N/Ib-TS) SSW No 2, Visalite Solids Load (Ib-YS/d) Wisagen Content (Ib-N/Ib-TS) SSW Total Nitrogen Content (Ib-N/Ib-TS) SSW Total Solids Load (Ib-YS/d) SSW Total Nitrogen Content (Ib-N/Ib-TS) SSW Total Solids Load (Ib-YS/d) SSW Total Nitrogen Content (Ib-N/Ib-TS) SSW Total Solids Load (Ib-YS/d) SSW Total Nitrogen Content (Ib-N/Ib-TS) SSW Total Solids Load (Ib-YS/d) SSW Total Solids Load (Ib-YS/d) SSW Total Solids Load (Ib-YS/d) SSW Total Solids Load (Ib-YS/d) SSW Total Solids Load (Ib-TS/d) SSW Total Solids Load (I	0.063 180.836 157.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.4944 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.096 0.053 4,212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77.911 66.224 0.053 3,166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,448 22,441 0.053 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Traits Joilds could (Ib-TS/d) SS0 Vitrogen Content (Ib-N/Ib-TS) SS0 Nitrogen Content (Ib-N/Ib-TS) Primary Studge Total Nitrogen Content (Ib-N/Ib-TS) Primary Studge Total Stolds Load (Ib-TS/d) WAS Total Stolds Load (Ib-Y/d) WMS Total Stolds Load (Ib-TS/d) Stolds Total Stolds Load (Ib-TS/d) WSV Total Stolds Load (Ib-TS/d) Stolds Total Stolds Load (Ib-TS/d) Stolds Load (Ib-TS/d)	0.063 190.836 157.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.4944 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 0.053 0.053 0.053 4.212 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77.911 66.224 0.053 3,166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,448 22,441 0.053 1.075 0.000 0 0 0.000 0 0 0.000 0 0 0 0 0 0	
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids coad (Ib-TS/d) SSO Visabile Solids Load (Ib-YS/d) SSO Visabile Solids Load (Ib-YS/d) SSO Amonium-N Load (Ib-N/VbS) SSO Amonium-N Load (Ib-N/Ib-TS) SSO Amonium-N Load (Ib-N/Ib-TS) SSO Marco Content (Ib-N/Ib-YS) SSO Marco Content (Ib-N/Ib-TS) Was Total Solids Load (Ib-YS/d) Was Total Solids Load (Ib-YS/d) SSO WTotal Solids Load (Ib-YS/	0.063 150.836 153.711 0.053 7,249 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.944 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.996 0.053 4.212 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77,911 66,224 0.053 3.186 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,448 22,481 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NO(85
SSO Organic Nitrogen Content (Ib-Y(Ib-TS) SSO Orala Solids cod (Ib-TS/d) SSO Viabilité Solids Load (Ib-Y/d) SSO Viabilité Solids Load (Ib-Y/d) SSO Amonium-N Load (Ib-N/dby) MSWM b2 ENSW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Viabilité Solids Load (Ib-VS/d) SSO Among Content (Ib-N/Ib-YS) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) Primary Sildge Total Solids Load (Ib-Y/d) Primary Sildge Loa	0.063 190.836 157.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.4944 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.996 0.053 4.212 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77.911 66.224 0.053 3.166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,445 22,441 0.053 1.075 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Orala Solids Load (Ib-TS/d) SS0 Vabilité Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Amonium-N Load (Ib-N/day) IBSW No. 2. Organic Nitrogen Content (Ib-N/Ib-TS) IBSW No. 2. Organic Nitrogen Content (Ib-N/Ib-TS) IBSW No. 2. Volutile Solids Load (Ib-TS/d) IBSW No. 2. Volutile Solids Load (Ib-TS/d) IBSW No. 2. Annonium-N Load (Ib-N/day) IBSW No. 2. Annonium-N Load (Ib-N/day)	0.063 150.836 153.711 0.053 7,249 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.944 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.996 0.053 4.212 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77,911 66,224 0.053 3,186 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,448 22,481 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NO(85
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Orala Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) SS0 Amonium-N Load (Ib-N/Ib-TS) SS0 Amonium-N (Ib-N/Ib-TS) SS0 Am	0.063 150.836 153.711 0.053 7,349 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 121.654 103.406 0.053 4.4944 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 103.642 88.996 0.053 4.212 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 77.911 66.224 0.053 3.166 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.003 26,448 22,481 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
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Brown AND Caldwell	
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Date Checked	Checked By	Job Number	By	Date	Calc No
9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-004
	Pro	ject			Subject
Encina Biosolids, Energy, and Emiss	ions		2030 Year - All Digeste	ers in Service	

10 day Thermophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days) 10 Assumed Peaking Factors					
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference	
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable)			
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1	
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1	
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1	
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2	
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No		
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1	

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dof

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Slud	Primary Sludge					Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Specia	ation		Nitrogen Spec	Nitrogen Speciation Nitrogen Speciation				
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

	Table X-X: Existing 10 day Thermophilic Digestion Feed Assessment									
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes				
Peaking Factors	1.00	1.23	1.30	1.40	1.60					
Digester Volume (MG)	5.84	5.84	5.84	5.84	5.84	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process				
J		3.64		5.84	3.64	inefficiencies.				
Primary Sludge Total Solids Load (lb-TS/d)	60,812	74,799	79,056	85,137	97,299					
TWAS Total Solids Load (Ib-TS/d)	37,020	45,534	48,125	51,827	59,231					
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991					
Total Digester Feed, Total Solids Load (Ib-TS/d)	101,822	124,324	131,172	140,955	160,521					
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650					
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385					
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193					
Total Digester Feed, Volatile Solids Load (lb-VS/d)	85,715	104,695	110,471	118,724	135,228					
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%					
WAS percent of VS Load (%)	35%	35%	35%	35%	35%					
FOG percent of VS Load (%)	4%	3%	3%	3%	2%					
Total Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073					
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%					
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%					
Base HRT (days)	22	18	17	16	14					
Base OLR (lbsVS/d-cf)	0.11	0.13	0.14	0.15	0.17					
Hydraulic Capacity (HC) (gpd)	318,442	259,307	241,309	215,598	164,177	Assumes the minimum allowable HRT 10 days				
HC as Equivalent VS Load (Ib-VS/day)	270,892	220,587	205,277	183,405	139,662	Equivalent load of HSOW, based on hydraulic capacity				
Organic Load Capacity (Ib-VS/day)	187,664	168,684	162,908	154,655	138,151	Difference between max OLR (0.35 lbs-VS/cf-d) and current load				
Process Limitation										
FIOLESS LIIIILADOII	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load					
FIOLOSS LIIIILADON	Organic Load		Organic Load X-X: Mesophilic Co-digestion Feed Assess		Organic Load					
FIGUESS Limitad001	Organic Load Annual Average				Organic Load Peak day	Notes				
Process Limitation Total HSOW Volatile Solids Load (Ib-VS/day)		Table	X-X: Mesophilic Co-digestion Feed Assess	ment		Notes Calculated available organic load, based on defined limit				
	Annual Average	Table Peak Month	X-X: Mesophilic Co-digestion Feed Assess Peak 14 day	ment Peak 7 day	Peak day					
Total HSOW Volatile Solids Load (Ib-VS/day)	Annual Average 187,664	Table Peak Month 168,684	X-X: Mesophilic Co-digestion Feed Assess Peak 14 day 162,908	ment Peak 7 day 154,655	Peak day 138,151					
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day)	Annual Average 187,664 187,664	Table Peak Month 168,684 168,684	X-X: Mesophilic Co-digestion Feed Assess Peak 14 day 162,908 162,908	ment Peak 7 day 154,655 154,655	Peak day 138,151 138,151					
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day)	Annual Average 187,664 187,664 0	Table Peak Month 168,684 168,684 0	X-X: Mesophilic Co-digestion Feed Assess Peak 14 day 162,908 162,908 0	ment Peak 7 day 154,655 154,655 0	Peak day 138,151 138,151 0					
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day)	Annual Average 187,664 187,664 0 187,664	Table Peak Month 168,684 168,684 0 168,684	X-X: Mesophilic Co-digestion Feed Assess Peak 14 day 162,908 162,908 0 162,908	ment Peak 7 day 154,655 154,655 0 154,655	Peak day 138,151 138,151 0 138,151	Calculated available organic load, based on defined limit				
Total HSOW Volatile Solids Load (Ib-V5/day) SSO Volatile Solids Load (Ib-V5/day) HSOW No. 2 Volatile Solids Load (Ib-V5/day) Total HSOW Volatile Solids Load (Ib-V5/day) SSO Total Solids Load (Ib-T5/day)	Annual Average 187,664 187,664 0 187,664 220,782	Table Peak Month 168,684 168,684 0 168,684	X-X: Mesophilic Co-digestion Feed Assess Peak 14 day 162,908 162,908 0 162,908 191,656	ment Peak 7 day 154,655 154,655 0 154,655 181,948	Peak day 138,151 138,151 0 138,151 162,531	Calculated available organic load, based on defined limit				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day)	Annual Average 187,664 187,664 0 187,664 220,782 0	Table Peak Month 168,684 0 168,684 0 168,684 0 168,684 0 168,684 0	XX: Mesophilic Co-digestion Feed Assess Peak 14 day 162,908 0 162,908 0 162,908 191,856 0	ment Peak 7 day 154,655 154,655 0 154,655 181,948 0	Peak day 138,151 138,151 0 138,151 162,531 0	Calculated available organic load, based on defined limit				
Total HSDW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSDW No. 2 Volatile Solids Load (Ib-VS/day) Total HSDW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSDW No. 2 Total Solids Load (Ib-TS/day) HSDW No. 2 Total Solids Load (Ib-TS/day)	Annual Average 187,664 0 187,664 220,782 0 220,782	Table Peak Month 168,684 0 168,684 198,452 0 198,452	XX: Mesophilic Co-digestion Feed Assess Peek 14 day 162,908 162,908 0 162,908 191,856 0 191,856 0 191,856	Peak 7 day 154,655 0 154,655 181,948 0 181,948	Peak day 138,151 138,151 0 138,151 162,531 0 162,531	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Viotalite Solids Load (Ib-VS/day) FSOW No.2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO Viotal Solids Load (Ib-TS/day) SSO Wo.2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wel/day)	Annual Average 187,664 0 187,664 0 187,664 220,782 0 220,782 1,839,846	Table Peak Month 168,684 0 168,684 198,452 0 198,452 1,653,767	XX: Mesophilic Oc-digestion Feed Assess Peak 14 day 162,908 0 162,908 0 162,908 191,656 191,656 1,567,134	Peak 7 day 154,655 0 154,655 0 154,655 0 154,655 0 181,948 1,516,230	Peak day 138,151 138,151 0 138,151 162,531 0 162,531 1,354,422	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Voratile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day)	Annual Average 187,664 187,664 0 187,664 220,782 0 220,782 1,839,846 0	Table Peak Month 168,684 168,684 0 168,684 198,452 0 198,452 0 198,452 0 198,452 0 198,452 0 198,452 0	XX: Mesophilic Co-digestion Feed Assess Peek 14 day 162,908 162,908 0 152,908 153,656 0 191,656 1,997,134 0	Peak 7 day 154,655 0 154,655 0 154,655 0 181,948 0 181,948 0 0 0	Peak day 138,151 138,151 0 138,151 162,531 0 162,531 1,354,422 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Violatile Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) HSOW No. 2 Total Load (Ib-MS/day)	Anual Average 157,664 157,664 0 187,664 220,782 0 220,782 1,839,846 0 1,839,846 920 0 0	Table Peak Month 168,684 168,684 0 168,684 198,452 0 198,452 1,653,767 0 1,653,767 827 0 0	XX: Mesophilic Co-digestion Feed Assess Peak 14 day 162,908 0 162,908 0 162,908 191,656 0 191,656 1,597,134 799 0 191,034 0 191,035 0 1,597,134 0 0 0 0 0 0 0 0 0 0 0 0 0	ment Peak 7 day 154,655 0 154,655 181,948 0 181,948 1,516,230 0 1,516,230 758 0	Peak day 138,151 138,151 0 138,151 162,531 0,554,422 0 1,354,422 677 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-V5/day) S50 Viotilie Solids Load (Ib-V5/day) HSOW No. 2 Volatile Solids Load (Ib-V5/day) S50 Total Solids Load (Ib-V5/day) S50 Total Solids Load (Ib-T5/day) HSOW No. 2 Total Solids Load (Ib-T5/day) S50 Total Load (Ib-T5/day) S50 (Ib-tay) S50 (Ib-tay) S50 (Ib-tay)	Annual Average 187,664 187,664 0 187,664 220,782 0 220,782 1,839,846 0 1,839,846 920	Table Peak Month 168,684 168,684 198,452 0 198,452 1,653,767 0 1,653,767 827	XX: Mesophilic Co-digestion Feed Assess Peek 14 day 102,908 102,908 102,908 102,908 101,056 101,056 1,597,134 0 1,597,134 789	Peak 7 day P6ak 7 day 154,655 154,655 0 154,655 154,655 181,948 0 181,948 1,516,230 0,558	Peak day 138,151 138,151 138,151 162,531 1,354,422 0 1,354,422 677	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-Wet/day) SSO (Ib-wet/day)	Anual Average 157,664 157,664 0 187,664 220,782 0 220,782 1,839,846 0 1,839,846 920 0 0	Table Peak Month 168,684 168,684 0 168,684 198,452 0 198,452 1,653,767 0 1,653,767 827 0 0	XX: Mesophilic Co-digestion Feed Assess Peak 14 day 162,908 0 162,908 0 162,908 191,656 0 191,656 1,597,134 799 0 191,034 0 191,035 0 1,597,134 0 0 0 0 0 0 0 0 0 0 0 0 0	ment Peak 7 day 154,655 0 154,655 181,948 0 181,948 1,516,230 0 1,516,230 758 0	Peak day 138,151 138,151 0 138,151 162,531 0,554,422 0 1,354,422 677 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Viotalite Solids Load (Ib-VS/day) SSO Viotalite Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wel/day) HSOW No. 2 Total Load (Ib-wel/day) SSO (Ib-wel/day) SSO (Ib-wel/day) SSO (Ib-wel/day) SSO (wtpd) HSOW No. 2 (wtpd)	Annual Avenge 187,664 187,664 0 187,664 220,782 0 220,782 1.833,846 0 1.833,846 920 0 920	Table Peak Month 168,684 168,684 168,684 198,452 0 198,452 1,653,767 0 1,653,767 827 0 827	XX: Mesophilic Co-digestion Feed Assess Peak 14 day 105,908 105,908 105,908 105,908 111,656 0 131,656 1,597,134 0 1,597,134 799 0 799 0 799	ment Peak 7 day 154,655 0 154,655 0 154,655 181,948 0 181,948 1,516,230 0 1,516,230 758	Peak day 138,151 138,151 0 138,151 162,531 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 0 1,354,422 0 0 0 1,354,422 0 0 0 1,354,422 0 0 0 1,354,422 0 0 0 0 1,354,422 0 0 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-V5/day) SSO Volatile Solids Load (Ib-V5/day) HSOW No. 2 Volatile Solids Load (Ib-V5/day) SSO Total Load (Ib-V6/day) SSO (Ib-wet/day)	Anual Average 187,664 187,664 187,664 220,782 0 220,782 0 1,833,846 0 1,839,846 \$20 0 220,605	Table Peak Month 168,684 0 168,684 198,452 0 198,452 198,452 0 198,452 0 198,452 0 198,452 0 1,653,767 827 0 827 198,293	XX: Mesophilic Co-digestion Feed Assess Peek 14 day 162,908 0 162,908 0 162,908 191,656 191,656 1,597,134 0 1,597,134 799 0 799 19,503	Peak 7 day 154,655 154,655 0 154,655 181,948 0 181,948 1,516,230 0 1,516,230 0 758 0 758 181,802	Peak day 138,151 138,151 0 138,151 162,531 0 162,531 1,354,422 0 1,354,422 677 0 677 162,401	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) HSOW No. 2 Volat Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) HSOW No. 2 Total Load (Ib-wet/day) SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) SSO (Ib-wet/day)	Annual Average 187,664 187,664 0 187,664 220,782 0 0 220,782 1.839,846 0 1.839,846 320 0 920 220,605 0 0	Table Peak Month 168,684 168,684 168,684 198,452 198,452 1,653,767 827 0 1,653,767 827 0 827 198,293 0	XX: Mesophilic Oc-digestion Feed Assess Peak 14 day 162,908 0 162,908 0 191,656 1.65,008 191,656 1.65,014 0 1.97,134 0 1.97,134 799 0 799 0 799 191,503 0	Peak 7 day 154,655 154,655 0 154,655 154,655 154,655 138,1948 0 181,948 1,516,230 758 758 758 181,802 0	Peak day 138,151 138,151 138,151 162,531 1,354,422 0 1,354,422 677 0 1,354,422 677 0 677 0 0 0 0 0 0 0 0 0 0 0 0 0	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Volatile Solids Load (Ib-VS/day) HSOW No. 2 Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Load (Ib-MS/day) SSO Total Solids Load (Ib-VS/day) SSO (Ibroh)	Anual Average 187,664 187,664 187,664 220,782 0 220,782 0 1,839,846 0 0 0 0 920 220,605 0 220,605	Table Peak Month 168,684 168,684 198,452 0 198,452 0 1,653,767 827 198,293 0 198,293	XX: Mesophilic Od-digestion Feed Assess Peek 14 day 162,908 0 162,908 0 162,908 0 151,656 1,597,134 0 1,597,134 799 799 191,503 0 191,503	ment Peak 7 day Peak 7 day 154,655 154,655 0 154,655 181,948 0 181,948 0 1,516,230 758 0 758 181,802 0 181,802	Peak day 138,151 138,151 138,151 162,531 0 162,531 1,354,422 677 0 1,354,422 677 162,401 0 162,401	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) SSO Violatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Valota dIb (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Load (Ib-TS/day) SSO (Ib-wet/day) SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-TS/day) SSO (Ib-wet/day) SSO (Ib-wet/day)	Anual Average 187,664 187,664 0 187,664 187,664 220,782 0 220,782 1.833,846 920 0 1.833,846 920 0 220,005 0 220,005 0 220,005 0 220,005 0 220,005 0 220,005 0 220,005 0 220,005 0 220,005 0 220,005 0 220,005 0 0 220,005 0 0 220,005 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 168,684 168,684 168,684 198,452 0 198,452 1,653,767 827 0 1,653,767 827 0 198,293 0 198,293 322,776	XX: Mesophilic Oc-digestion Feed Assess Peak 14 day 162,908 0 162,908 0 162,908 191,656 1,597,134 0 1,597,134 799 0 799 191,503 0 191,503 322,828	Peak? day 154,655 154,655 0 154,655 181,948 0 181,948 0 15,6530 0 15,6530 758 758 181,802 0 181,802 0 181,802 0	Peak day 138,151 138,151 138,151 162,531 0 162,531 1,354,422 0 1,354,422 677 0 1,354,422 677 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,354,422 0 0 1,554,422 0 0 1,554,422 0 0 1,554,422 0 0 1,554,422 0 0 1,554,422 0 0 1,554,422 0 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,422 0 1,554,425 0 1,554,455 0 1,554,45	Calculated available organic load, based on defined limit Conversion to Total Solids load based on SSO %VS				

WAS percent of VS Load (%)	11%	13%	14%	15%	17%	
FOG percent of VS Load (%)	1%	1% 62%	1%	1% 57%	1%	
SSO percent of VS Load (%) HSOW No. 2 percent of VS Load (%)	69%	62%	0%	57%	51%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	12	11	11	11	10	
Co-Digestion OLR (lbs-VS/d-cf)	0.35	0.35	0.35	0.35	0.35	
Process Check	OK	OK	OK	ОК	OK	
1	Annual Average	Peak Month	: Existing Mesophilic Solids and Biogas Proc Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	Alliludi Average	42.299	44,706	48.145	55.023	NULES
WAS Volatile Solids Destroyed (Ib-VSd/day)	13.919	17.121	18.095	19,487	22,271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2,873	
Total Volatile Solids Destroyed (Ib-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	265,808	324,943 62,031	342,941	368,652	420,073 80 354	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d) Volatile Solids Effluent (Lbs-VS/d)	50,640	62,031	65,497	70,450	80,354	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128 247,765	752,917 304,751	795,766 322,094	856,979 346.871	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd) FOG Biogas Production (scfd)	247,765	51.145	51.145	51.145	51.145	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
		Table X-X: I	Mesophilic Co-digestion Solids and Biogas P	roduction		
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day) FOG Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
SSO Volatile Solids Destroyed (Ib-VSd/ day)	168,898	2,873	2,873	139,190	2,873	
HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day)	0	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	220,080	214,109	212,291	209,695	204,503	
Total Sludge Effluent (gpd)	486,413	523,237	534,444	550,454	582,474	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	102,524	108,667	110,537 61,088	113,207 63,684	118,549	
Volatile Solids (Lbs-VS/d) Total Solids (% TS)	2.5%	2.5%	2.5%	2.5%	2.4%	
Volatile Solids (% VS)	52%	55%	55%	56%	58%	
Dewatered Solids (Lbs-TS/d)	97,398	103,234	105,010	107,547	112,622	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	221	235	239	244	256	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751 51 145	322,094 51 145	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) SSO Biogas Production (scfd)	3,040,162	2,732,685	2.639.105	2.505.419	2.238.047	Assumes a biogas yield of 17.8 scl/lb-VSd Assumes a biogas yield of 18 scf/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	· · · · · · · · · · · · · · · · · · ·
Total Biogas Production (scfd)	3,951,199	3,841,497	3,808,109	3,760,413	3,665,020	
		Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat	es		
HSOW No 1	Annual Average	Tabl Peak Month	3,808,109 e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.053		Peak day	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)		Tabl	e X-X: Nutrient Loading - Ammonia-N Estimat	es		Notes
HSOW No 1	Annual Average 0.063	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day	Notes
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Tatal Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	Annual Average 0.063	Tabl Peak Month	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063	es Peak 7 day 0.063	Peak day	Notes
NSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO trata Solidis Ladd (TS-Jd) SSO Viratile Solidis Ladd (Ib-Yg-d) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Ammonium-N Ladd (Ib-N/day)	Annual Average 0.063 220,782 187,664	Tabl Peak Month 0.063 198,452 168,684	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 191,656 162,908	es Peak 7 day 0.063 181,948 154,655	Peak day 0.063 162,531 138,151	Notes
HSOW No 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Viotalis Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-VS) SS0 Antonohum-H Load (Ib-N/day) HSOW No 2 SS0 Antonohum-H Load (Ib-N/day)	Annual Average 0.063 220,782 187,664 0.053 8,973	Tabl Peak Month 0.063 198,452 168,684 0.053 8,065	e X-X: Nutrient Loading - Ammonia-N Estimat Pesk 14 day 0.063 191,866 162,908 0.053 7,789	es Peak 7 day 0.063 181,948 154,655 0.053 7,394	Peak day 0.063 162,531 138,151 0.053 6,605	Notes
HSOW No.1 SSO Organic Mitorgen Content (Ib: N/Ib:TS) SSO Total Solids Load (Ib:TS/d) SSO Violatile Solids Load (Ib:TS/d) SSO Miroutine VIOL And (Ib: N/Ib:TS) SSO Annoulum: Alad (Ib: N/Ib:TS) HSOW No.2 HSOW No.2 HSOW No.2	Annual Average 0.063 220,782 187,664	Tabl Peak Month 0.063 198,452 168,684	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 191,656 162,908	es Peak 7 day 0.063 181,948 154,655	Peak day 0.063 162,531 138,151	Notes
HSOW No 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Viotalis Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-VS) SS0 Antonohum-H Load (Ib-N/day) HSOW No 2 SS0 Antonohum-H Load (Ib-N/day)	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000	Tabl Peak Month 0.063 198,452 168,684 0.053 8,065	e X-X: Nutrient Loading - Ammonia-N Estimat Pesk 14 day 0.063 191,866 162,908 0.053 7,789	es Peak 7 day 0.063 181,948 154,655 0.053 7,394	Peak day 0.063 162,531 138,151 0.053 6,605	Notes
HSOW No. 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Visatils Solids Load (Ib-TS/d) SS0 Normalic Solids Load (Ib-TS/d) SS0 Montaline Solids Load (Ib-TS/d) HSOW No. 2 HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No. 2 Volatile Solids Load (Ib-TS/d)	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0.000	Table Peak Month 0.063 198,452 168,684 0.053 8,065 0.000 0 0 0.000	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 191,666 162,908 0.053 7,789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 181,948 154,655 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,531 162,531 0.053 6,605 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No.1 SS0 Organic Nitrogen Content (Ib: N/Ib: TS) SS0 Total Solid Load (Ib: TS/d) SS0 Volatile Solids Load (Ib: TS/d) SS0 Volatile Solids Load (Ib: TS/d) SS0 Nomeolm-N Load (Ib: N/d-Vs) SS0 Amnotim-N Load (Ib: N/d-Vs) ISOV No.2 ISOV No.2 <t< td=""><td>Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0</td><td>Tabl Peak Month 0.063 198,452 168,684 0.053 8,065 0.000 0</td><td>e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 191.666 162.908 0.053 7,789 0.000 0 0</td><td>es Peak 7 day 0.063 181,948 154,655 0.053 7,394 0.000 0</td><td>Peak day 0.063 162,531 138,151 0.053 6,605 0.000 0</td><td>Notes</td></t<>	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0	Tabl Peak Month 0.063 198,452 168,684 0.053 8,065 0.000 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 191.666 162.908 0.053 7,789 0.000 0 0	es Peak 7 day 0.063 181,948 154,655 0.053 7,394 0.000 0	Peak day 0.063 162,531 138,151 0.053 6,605 0.000 0	Notes
HSOW No. 1 SSG Organic Nitrogen Content (Ib-N/Ib-TS) SSG Total Solids Load (Ib-TS/d) SSG Total Solids Load (Ib-TS/d) SSG Noracialitie Solids Load (Ib-TS/d) SSO Namoulamic ML Load (Ib-N/Ib-TS) HSOW No. 2 HSOW No. 2 VISOW No. 2 TSOW No.2 TSOW No.2	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0.000	Table Peak Month 0.063 198,452 168,684 0.053 8,065 0.000 0 0 0.000	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 191,666 162,908 0.053 7,789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 181,948 154,655 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,531 162,531 0.053 6,605 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No.1 SSO Organic Nitrogen Content (Ib: N/Ib: TS) SSO Total Solid (Ib: TS/d) SSO Violatile Solids Load (Ib: V5/d) SSO Nitrogen Content (Ib: V/ dv: V9) SSO Namoulm-N Load (Ib: N/dv) HSOW No.2 HSOW NO	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0.000	Table Peak Month 0.063 198,452 168,684 0.053 8,065 0.000 0 0 0.000	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 191,666 162,908 0.053 7,789 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 181,948 154,655 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,531 132,531 0.053 6,605 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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HSDW No. 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Visatils Solids Load (Ib-TS/d) SS0 Normalic Solids Load (Ib-TS/d) SS0 Total Solids Load (Ib-TS/d) SS0 Wratils Solids Load (Ib-TS/d) HSOW No. 2 HSOW No. 2 Non 2. Visatile Solids Load (Ib-TS/d) HSOW No. 2: A Load (Ib-N/Ib-TS) HSOW No. 2: A Load (Ib-TS/d) HYDER DE Total Solids Load (Ib-TS/d) Primary Sludge Total Solids Load (Ib-TS/d)	Annual Average 0.063 220,782 187,664 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 198,452 168,684 0.053 8,065 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0	8 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 111.856 0.053 7.7.83 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0	83 Peak 7 day 0.063 181,948 154,655 0.053 7,394 	Peak day 0.063 162,531 138,151 0.053 6,605 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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HSOW No. 1 SSO Organic Nitrogen Content (Ib. N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Viotalie Solids Load (Ib-TS/d) SSO Viotalie Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Total Nitrogen Content (Ib-N/Ib-TS) Primary Sludge Volatils Solids Load (Ib-TS/d) Nitrogen Content (Ib-N/Ib-TS) WXB Stotal Nitrogen Content (Ib-N/Ib-TS) WXB Stotal Sludis Load (Ib-TS/d) WXB Stotal Sludis Load (Ib-TS/d) WXB Stotal Sludis Load (Ib-TS/d)	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 198,452 168,684 0.053 8,065 0.000 0 0 0 0 0 0 0 0 0 0 0 0	8 X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 191.856 0.053 7.789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	65 Peak 7 day 0.063 181,948 154,685 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,531 138,151 0.053 6,605 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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HSOW No. 1 SSO Organic Nitrogen Content (Ib. N/Ib-TS) SSO Total Solida (ad (Ib-TS/d) SSO Volatile Solida Load (Ib-VS/d) SSO Volatile Solida Load (Ib-VS/d) SSO Nancolum-N Load (Ib. N/ay) HSOW No. 2 Total Solida Load (Ib-TS/d) HSOW No. 2 Total Solida Load (Ib-TS/d) HSOW No. 2 Total Solida Load (Ib-VS/d) HSOW No. 2 Nitrogen Content (Ib-V/Ib-TS) HSOW No. 2 Nitrogen Content (Ib-V/Ib-TS) Primary Sludge Total Solida Load (Ib-TS/d) Primary Sludge Total Solida Load (Ib-TS/d) Primary Sludge Total Solida Load (Ib-VS/d) Nitrogen Content (Ib-V/Ib-TS) WAS Total Solida Load (Ib-TS/d) TWAS Total Solida Load (Ib-TS/d) TWAS Volatile Solida Load (Ib-VS/d) Nitrogen Content (Ib-V/Ib-TS) TWAS Volatile Solida Load (Ib-TS/d) TWAS Volatile Solida Load (Ib-TS/d) TWAS Volatile Solida Load (Ib-TS/d) Nitrogen Content (Ib-V/Ib-TS) Ammonium-N Load (Ib-V/day)	Annual Average 0.063 220,762 187,864 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 198,452 158,584 0.053 8,065 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 191.866 192.908 0.053 7.789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 181,948 154,685 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 102.331 138,151 0.053 0.053 0.050 0 0 0 0 0 0 0 0 0 0 0.065 97.299 84.650 0.057 3.131 0.065 99.231	Notes
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HSOW No.1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) HSOW No.2 HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 HSOW No.2 <td>Annual Average 0.061 220,782 187,684 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Teb/ Peak Month 0.063 1188,482 108,684 0.053 8,065 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>e X-X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 191.656 102.908 0.053 7.789 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>e3 Peak 7 day 0.063 181,948 154,665 0.063 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Peak day 0.063 162,311 138,151 0.053 0.055 0.000 0 0 0 0 0 0 0 0 0 0 0 0</td> <td>Notes</td>	Annual Average 0.061 220,782 187,684 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Teb/ Peak Month 0.063 1188,482 108,684 0.053 8,065 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	e X-X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 191.656 102.908 0.053 7.789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 181,948 154,665 0.063 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,311 138,151 0.053 0.055 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib: N/Ib: TS) SSO Total Solids Load (Ib: TS/d) SSO Violattile Solids Load (Ib: VS/d) SSO Nitrogen Content (Ib: V/Ib: VS) SSO Nitrogen Content (Ib: V/Ib: VS) HSOW No. 2 HSOW N	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 106,682 1168,684 106,652 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 191,856 191,856 192,908 0,063 7,789 0 0 0 0,053 7,789 0.055 0.956 0.957 2,544 0 0.052 947 0.010 3.991 3.193	65 Peak 7 day 0.063 181,948 194,865 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 162.531 162.531 0.053 6.609 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Voizelite Solids Load (Ib-TS/d) SS0 Voizelite Solids Load (Ib-TS/d) SS0 Nonzolite Load (Ib-TS/d) HSOW No. 2 H	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Teb/ Peak Month 0.063 1188,684 0.053 8.065 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	* X-X Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 1191.856 152.908 0.053 7.789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	65 Peak 7 day 0.063 181,948 194,865 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,311 138,151 0.053 0.055 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib: N/Ib: TS) SSO Total Solids Load (Ib: TS/d) SSO Violattile Solids Load (Ib: VS/d) SSO Nitrogen Content (Ib: V/Ib: VS) SSO Nitrogen Content (Ib: V/Ib: VS) HSOW No. 2 HSOW N	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 106,682 1168,684 106,652 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 191,856 191,856 192,908 0,063 7,789 0 0 0 0,053 7,789 0.055 0.956 0.957 2,544 0 0.052 947 0.010 3.991 3.193	65 Peak 7 day 0.063 181,948 194,865 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 162.531 162.531 0.053 6.609 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib: N/Ib: TS) SSO Volatile Solids Load (Ib: V5/d) SSO Volatile Solids Load (Ib: V5/d) SSO Volatile Solids Load (Ib: V5/d) SSO Namoulm-N Load (Ib: N/Ib: V5) HSOW No. 2 HSOW NO	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 106,682 1168,684 106,652 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 191,856 191,856 192,908 0,063 7,789 0 0 0 0,053 7,789 0.055 0.956 0.957 2,544 0 0.052 947 0.010 3.991 3.193	65 Peak 7 day 0.063 181,948 194,865 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 162.531 162.531 0.053 6.609 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SSO Organic Nitrogen Content (Ib. N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Vioritie Solids Load (Ib-TS/d) SSO Norgen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 HSOW NO	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 106,682 1168,684 106,652 0,000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 191,856 191,856 192,908 0,063 7,789 0 0 0 0,053 7,789 0.055 0.956 0.957 2,544 0 0.052 947 0.010 3.991 3.193	65 Peak 7 day 0.063 181,948 194,865 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 162.531 162.531 0.053 6.609 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) HSOW No. 2 HSOW No	Annual Average 0.063 220,762 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.063 1188,482 108,684 0.053 8,065 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 191,636 102,908 0.053 7,789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e3 Peak 7 day 0.063 181,948 154,665 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,351 138,151 0.053 0.055 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No.1 SS0 Organic Nitrogen Content (Ib. N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Total Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/Ib-TS) HSOW No.2	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.063 169,6452 168,645 0.053 8,065 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	2 XX. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 10.2506 0.053 7.789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	63 Peak 7 day 0.063 161,948 154,685 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 162.531 162.531 0.053 6.609 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
How No 1 SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) HSOW No. 2	Annual Average 0.061 220,782 187,864 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.063 1188,482 108,684 0.053 8,065 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2 X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 191,636 102,908 0.053 7,789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 181,948 154,655 0.063 7,334 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,351 138,151 0.053 0.055 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No.1 SS0 Organic Nitrogen Content (Ib. N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Visitilie Solids Load (Ib-TS/d) SS0 Visitilie Solids Load (Ib-TS/d) SS0 Visitilie Solids Load (Ib-TS/d) HSOW No.2 HSOW No.2 TSOW Notal Solids Load (Ib-Yd) TWAS	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month 0.063 1169,452 1169,452 1169,645 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	2 XX. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.0635 10.2506 0.053 17.259 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	63 Peak 7 day 0.063 161,948 154,685 0.053 7,394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 162.531 138,151 0.053 0.060 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No.1 SSO Organic Nitrogen Content (Ib. N/Ib-TS) SSO Total Solids Laad (Ib-TS/d) SSO Total Solids Ladd (Ib-TS/d) SSO Voiatile Solids Ladd (Ib-TS/d) SSO Voiatile Solids Ladd (Ib-TS/d) SSO Nancolam-N Ladd (Ib. N/Ib-TS) HSOW No.2 Total Solids Ladd (Ib-TS/d) HSOW No.2 Total Solids Ladd (Ib-TS/d) HSOW No.2 HSOW NO.HSOW NO.HSO HSOH NO.HSOH NO.HSOH NO.HSOH NO.HSOH NO	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tebl Peak Month 0.063 169,6452 168,645 0.053 8,065 0.000 0 0 0.000 0 0 0 0 0 0 0 0 0 0 0 0	2 X: Nutrient Loading - Amonia-N Estimat Peak 14 day 0.063 191,636 102,908 0.053 7,789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	es Peak 7 day 0.063 181,948 154,655 0.063 7,334 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 162,351 138,151 0.053 0.055 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SS0 Cross Content (Ib-N/Ib-TS) SS0 Cross Content Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Total Solids Load (Ib-TS/d) SS0 Total Solids Load (Ib-TS/d) HSOW No. 2	Annual Average 0.063 220,782 187,864 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 0.005 0.005 0.057 1,957 0.065 37.020 226.16 0.052 0.051 3.991 3.193 0.008 24 66 7 9.22 11.681 0.49 2.80	Tabl Peak Month 0.063 1198,452 1168,684 0.053 8,065 0.000 0 0 0 0 0 0 0 0 0 0 0 0	2 X-X Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 191,636 102,908 0.053 7,789 0.000 0 0 0 0 0 0 0 0 0 0 0 0	e5 Peak 7 day 0.063 181,948 154,655 0.063 154,655 0.063 7,394 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak day 0.063 102,511 138,151 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Notes
BOW No.1 SS 0 Granic Nitrogen Content (Ib N/Ib-TS) SS O Valatile Solids Load (Ib-TS/d) SS O Valatile Solids Load (Ib-TS/d) SS O Valatile Solids Load (Ib-TS/d) SS 0 Valatile Solids Load (Ib-TS/d) HSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 Norgen Content (Ib-N/Ib-TS) HSOW No.2 Norgen Content (Ib-N/Ib-TS) HTMary Studge Total Nitrogen Content (Ib-N/Ib-TS) Primary Studge Total Solids Load (Ib-TS/d) Whose Content (Ib-N/Ib-TS) WAS Total Nitrogen Content (Ib-N/Ib-TS) WAS Total Solids Load (Ib-TS/d) WAS Total Solids Load (Ib-YG/d) TOXES Norgen Content (Ib-N/Ib-TS) HSOW No.2 Norgen Content (Ib-N/Ib-TS) HSOW No.2 Norgen Content (Ib-N/Ib-TS) HSOW No.2 Norgen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-N/G/d) TOXES Norgen Content (Ib-N/Ib-TS) HSOW Total Solids Load (Ib-N/G/d) Hotagen Content (Ib-N/Ib-TS) Hotagen C	Annual Average 0.063 220,782 187,664 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Tabl Peak Month Peak Month 168,684 105,652 0,000 0 0 0 0 0 0 0 0 0 0 0 0	X-X. Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 191,836 191,836 0.063 0.063 0.053 7,789 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.005 68,778 0.057 2,544 0 0.057 2,544 0.052 947 0.010 3,991 3,193 0.006 2 66 7 9,22 11,303 0.53 2,536 0,53 2,536 0,53 2,536	63 Pack 7 day 0.063 181.948 194.655 0.053 7.394 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0.063 162.531 162.531 0.053 6.605 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
HSOW No. 1 SS0 Cross Content (Ib-N/Ib-TS) SS0 Cross Content Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Total Solids Load (Ib-TS/d) SS0 Total Solids Load (Ib-TS/d) HSOW No. 2 HSOW NO. A	Annual Average 0.063 220,782 187,864 0.053 8,973 0.000 0 0 0 0 0 0 0 0 0 0 0.000 0 0.005 0.005 0.005 0.057 1,957 0.065 37.020 226.16 0.052 0.051 3.991 3.193 0.008 24 66 7 9.22 11.681 0.49 2.80	Tabl Peak Month 0.063 1198,452 1168,684 0.053 8,065 0.000 0 0 0 0 0 0 0 0 0 0 0 0	X-X: Nutrient Loading - Amonie-N Estimat Peak 14 day 0.063 19.836 19.836 0.063 0.631 7.789 0 0 0 0 0 0 0 0 0 0 0 0 0.000 0 0.000 0 0.000 0 0.005 68,778 0.065 45,125 38,500 0.627 0.010 3.991 3.193 0.006 2.24 66 7 9.22 11.303 0.53 2.536	e5 Peak 7 day 0.063 181,948 154,655 0.063 154,655 0.063 7,394 0 0 0 0 0 0 0 0 0 0 0 0 0	Pesk day 0,063 162,531 162,531 0,053 0,000 0 0,000 0 0,000 0 0,000 0 0,000 0 0,000 0 0,000 0 0 0,000 0 0 0 0 0 0 0 0 0 0 0 0	Notes Notes Notes

Brown	Date Checked	Checked By	Job Number	By	Date	Calc No			
	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-004			
Caldwall		Project		Subject					
Caldwell	Encina Biosolids, Energy, and Emissi	Encina Biosolids, Energy, and Emissions				2030 Year - All Digesters in Service			
and the second se									

10 day Thermophilic Digestion with All digesters in service

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days) 10 Assumed		Peaking Factors			
Number of Secondary Digesters	3	1	Maxium OLR (lbs-VS/cf-d)	0.35	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1				Peak Month	1.23	2
Volume of Secondary Digesters (MG)	0.3	1	Digester Temperature (F)	151	1	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference	
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable)			
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1	
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1	
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1	
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2	
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No		
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1	

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SS0	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Existing Conditions

Primary Sludge			TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speciation			Nitrogen Spe	ciation		Nitrogen Speciation		
PS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (Ib-N/Ib-TS)	0.010	6 (TKN Content)
PS Org. Nitrogen (Ib-N/Ib-TS)			TWAS Org. Nitrogen (Ib-N/Ib-TS)			Existing HSOW Org. Nitrogen (Ib-N/Ib-TS)		
PS Soluble Nitrogen (Ib-N/Ib-TS)			TWAS Soluble Nitrogen (Ib-N/Ib-TS)			Existing HSOW Soluble Nitrogen (Ib-N/Ib-TS)		

Nutrients Speciation for HSOW

Parameter	Input Values	Reference
Nitrogen S	Speciation	
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (Ib-N/Ib-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (Ib-N/Ib-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/I)	3.000	

	Table	X-X: Existing 10 day The	rmophilic Digestion with All digesters in serv	ice Feed Assessment		
	Annual Average	Peak Month	Peak Month	Peak 7 day	Peak day	Notes
Peaking Factors	1.00	1.23	1.30	1.40	1.60	
Digester Volume (MG)	6.70	6.70	6.70	6.70	6.70	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.
Primary Sludge Total Solids Load (Ib-TS/d)	60,812	74,799	79,056	85,137	97,299	
TWAS Total Solids Load (lb-TS/d)	37.020	45.534	48.125	51.827	59.231	
FOG Total Solids Load (lb-TS/d)	3.991	3.991	3.991	3.991	3,991	
Total Digester Feed, Total Solids Load (lb-TS/d)	101,822	124.324	131.172	140.955	160.521	
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65.075	68.778	74,069	84,650	
TWAS Volatile Solids Load (Ib-VS/d)	29.616	36.427	38,500	41,462	47,385	
FOG Volatile Solids Load (lb-VS/d)	3.193	3.193	3.193	3.193	3,193	
Total Digester Feed, Volatile Solids Load (Ib-VS/d)	85,715	104,695	110,471	118,724	135,228	
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%	
WAS percent of VS Load (%)	35%	35%	35%	35%	35%	
FOG percent of VS Load (%)	4%	3%	3%	3%	2%	
Total Digester Feed Flow (gpd)	265,808	324,943	342,941	368,652	420,073	
Total Percent Solids Load (%)	4.6%	4.6%	4.6%	4.6%	4.6%	
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%	
Base HRT (days)	25	21	20	18	16	
Base OLR (lbsVS/d-cf)	0.10	0.12	0.12	0.13	0.15	
Hydraulic Capacity (HC) (gpd)	403.942	344.807	326,809	301.098	249,677	Assumes the minimum allowable HRT 10 days
HC as Equivalent VS Load (Ib-VS/day)	343.625	293.320	278.010	256,138	212,395	Equivalent load of HSOW, based on hydraulic capacity
Organic Load Capacity (Ib-VS/day)	227,671	208.691	202,914	194,662	178,158	Difference between max OLR (0.35 lbs-VS/cf-d) and current load
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load	
		Table X-X	: Mesophilic Co-digestion Feed Assessment			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Total HSOW Volatile Solids Load (lb-VS/day)	227.671	208.691	202.914	194,662	178.158	Calculated available organic load, based on defined limit
SSO Volatile Solids Load (lb-VS/dav)	227,671	208.691	202.914	194,662	178.158	
HSOW No. 2 Volatile Solids Load (lb-VS/dav)	0	0	0	0	0	
Total HSOW Volatile Solids Load (Ib-VS/day)	227,671	208,691	202,914	194,662	178,158	
SSO Total Solids Load (Ib-TS/day)	267,848	245,519	238,723	229,014	209,597	Conversion to Total Solids load based on SSO %VS
HSOW No. 2 Total Solids Load (Ib-TS/day)	0	0	0	0	0	
SSO Total Solids Load (Ib-TS/day)	267,848	245,519	238,723	229,014	209,597	
SSO (lb-wet/day)	2,232,069	2,045,990	1,989,357	1,908,453	1,746,645	Conversion to Wet Solids load based on SSO %TS
HSOW No. 2 Total Load (lb-wet/day)	0	0	0	0	0	
SSO (lb-wet/day)	2.232.069	2.045.990	1.989.357	1.908.453	1,746,645	
SSO (wtpd)	1.116	1.023	995	954	873	
HSOW No. 2 (wtpd)	0	0	0	0	0	
SSO (wtpd)	1,116	1,023	995	954	873	
SSO (gpd)	267,634	245,322	238,532	228,831	209,430	
HSOW No. 2 (gpd)	0	0	0	0	0	
SSO (gpd)	267,634	245,322	238,532	228,831	209,430	
Total Solids, Total Solids Load (Ib-TS/d)	369,671	369,842	369,895	369,969	370,119	
Total Solids, Volatile Solids Load (lb-VS/d)	313,386	313,386	313,386	313,386	313,386	
Total Flow (gpd)	533,443	570,266	581,473	597,483	629,503	
Primary sludge percent of VS Load (%)	17%	21%	22%	24%	27%	
WAS percent of VS Load (%)	9%	12%	12%	13%	15%	
FOG percent of VS Load (%)	1%	1%	1%	1%	1%	
SSO percent of VS Load (%)	73%	67%	65%	62%	57%	
HSOW No. 2 percent of VS Load (%)	0%	0%	0%	0%	0%	
Check	ok	ok	ok	ok	ok	
Co-digestion HRT (days)	13	12	12	11	11	

Co-Digestion OLR (lbs-VS/d-cf) Process Check	0.35 OK	0.35 OK	0.35 OK	0.35 OK	0.35 OK	
FIDDESS CHECK	UK		ting Mesophilic Solids and Biogas Productio		UK	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (lb-VSd/day) Total Volatile Solids Destroyed (lb-VSd/day)	2,873 51.182	62,293	2,873 65,674	2,873	2,873 80,167	
Total Sludge Effluent (gpd)	265,808	324,943	342,941	368,652	420,073	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50,640	62,031	65,497	70,450	80,354	
Volatile Solids Effluent (Lbs-VS/d)	34,533	42,402	44,797	48,218	55,061	
Total Solids (% TS)	2.3%	2.3%	2.3%	2.3%	2.3%	
Volatile Solids (% VS) Dewatered Solids (Lbs-TS/d)	48.108	58,929	62.222	66.927	76.337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd) Biogas Production (scfd)	51,145 911,037	51,145 1,108,812	51,145 1,169.005	51,145 1.254,994	51,145 1,426,972	Assumes a biogas yield of 17.8 scf/lb-VSd
biogas ritodacaon (scia)	311,031		hilic Co-digestion Solids and Biogas Produc		1,420,512	
l.	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (lb-VSd/day)	13,919	17,121	18,095	19,487	22,271	
FOG Volatile Solids Destroyed (lb-VSd/day) SSO Volatile Solids Destroyed (lb-VSd/day)	2,873 204,904	2,873 187,822	2,873 182,623	2,873 175,196	2,873 160,342	
HSOW No. 2 Volatile Solids Destroyed (Ib-VSd/day)	204,904	0	0	0	0	
Total Volatile Solids Destroyed (Ib-VSd/day)	256,086	250,115	248,297	245,701	240,509	
Total Sludge Effluent (gpd)	533,443	570,266	581,473	597,483	629,503	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	113,585	119,728	121,597	124,268	129,610	
Volatile Solids (Lbs-VS/d) Total Solids (% TS)	57,300 2.6%	63,271	65,088	67,684	72,877	
Volatile Solids (% VS)	2.6%	2.5%	2.5%	2.5%	2.5%	
Dewatered Solids (Lbs-TS/d)	107,906	113,741	115,517	118,055	123,129	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	245	259	263	268	280	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (Ib-VSd/day)	612,128 247,765	752,917 304,751	795,766 322,094	856,979 346,871	979,404 396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (lb-VSd/day) FOG Biogas Production (scfd)	51,145	304,751 51,145	51,145	346,871 51,145	396,424 51,145	Assumes a biogas yield of 17.8 scf/lb-VSd Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scrd)	3,688,271	3,380,793	3,287,213	3,153,527	2,886,156	Assumes a biogas yield of 18 scl/lb-VSd
HSOW No. 2 Biogas Production (scfd)	0		0	0	0	
Total Biogas Production (scfd)	4,599,308	4,489,605	4,456,218	4,408,521	4,313,128	
	Annual Annuals	Table X-X: I	Nutrient Loading - Ammonia-N Estimates	Deals 7 day	Da alı davı	Nata
HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average	Table X-X: I Peak Month 0.063	Peak 14 day	Peak 7 day	Peak day	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS)	Annual Average 0.063 267,848	Peak Month	Nutrient Loading - Ammonia-N Estimates Peak 14 day 0.063 238,723	Peak 7 day 0.063 229,014	Peak day 0.063 209,597	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d)	0.063 267,848 227,671	Peak Month 0.063 245,519 208,691	Peak 14 day 0.063 238,723 202,914	0.063 229,014 194,662	0.063 209,597 178,158	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Volatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS)	0.063 267,848 227,671 0.053	Peak Month 0.063 245,519 208,691 0.053	Peak 14 day 0.063 238,723 202,914 0.053	0.063 229,014 194,662 0.053	0.063 209,597 178,158 0.053	Notes
SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Violatile Solids Load (Ib-VS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day)	0.063 267,848 227,671	Peak Month 0.063 245,519 208,691	Peak 14 day 0.063 238,723 202,914	0.063 229,014 194,662	0.063 209,597 178,158	Notes
SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatil Solids Load (Ib-VS/d) SS0 Nitrogen Content (Ib-N/Ib-VS) SS0 Amonjum-N Load (Ib-N/day) NSOV Mo2	0.063 267,848 227,671 0.053 10,886	Peak Month 0.063 245,519 208,691 0.053 9,978	Peak 14 day 0.063 238,723 202,914 0.053 9,702	0.063 229,014 194,662 0.053 9,307	0.063 209,597 178,158 0.053 8,518	Notes
SS0 Organic Nitrogen Content (Ib-N/b-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatils Solids Load (Ib-N/c) SS0 Nitrogen Content (Ib-N/Ib-NS) SS0 Ammonium- NLoad (Ib-N/day) HSOW No. 2 HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2	0.063 267,848 227,671 0.053	Peak Month 0.063 245,519 208,691 0.053	Peak 14 day 0.063 238,723 202,914 0.053	0.063 229,014 194,662 0.053	0.063 209,597 178,158 0.053	Notes
SSO 01ganic Nitrogen Content (Ib-N/Ib-TS) SSO 10tal Solito And (Ib-157) SSO 10tal Solito And (Ib-157) SSO Nitrogen Content (Ib-N/1b-VS) SSO Minorigum-N Load (Ib-N/dor) ISSO MR 02 No 20 (Ib-16 (Ib	0.063 267,848 227,671 0.053 10,886 0.000 0 0	Peak Month 0.063 245.519 208,691 0.053 9,978 0.000 0 0 0	Peak 14 day 0.063 238,723 202,914 0.053 9,702 0.000 0 0	0.063 229,014 194,662 0.053 9,307 0.000 0 0	0.063 209,597 178,158 0.053 8,518 0.000 0 0	Notes
SS0 Organic Nitrogen Content (Ib-N/b/TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatils Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/b-YS) SS0 Nitrogen Content (Ib-N/b-YS) SS0 Nitrogen Content (Ib-N/b-YS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No.2 Volatile Solids Load (Ib-TS/d) HSOW No.2 Volatile Solids Load (Ib-TS/d) HSOW No.2 Volatile Solids Load (Ib-TS/d)	0.063 267,848 227,671 0.053 10,886 	Peak Month 0.063 245,519 208,691 0.053 9,978 0 0 0 0 0.000 0 0 0.000	Peak 14 day 0.063 238,723 202,914 0.053 9,702 	0.063 229,014 194,662 0.053 9,307 0.000 0 0 0.000	0.063 209,597 178,158 0.053 8,518 0.000 0 0 0 0.000	Notes
SS0 Organic Nitrogen Content (Ib-N/b/TS) SS0 Total Solids Load (Ib-TS/d) SS0 Volatils Solids Load (Ib-TS/d) SS0 Nitrogen Content (Ib-N/b-YS) SS0 Nitrogen Content (Ib-N/b-YS) SS0 Nitrogen Content (Ib-N/b-YS) HSOW No. 2 Total Solids Load (Ib-TS/d) HSOW No.2 Volatile Solids Load (Ib-TS/d) HSOW No.2 Volatile Solids Load (Ib-TS/d) HSOW No.2 Volatile Solids Load (Ib-TS/d)	0.063 267,848 227,671 0.053 10,886 0.000 0 0	Peak Month 0.063 245.519 208,691 0.053 9,978 0.000 0 0	Peak 14 day 0.063 238,723 202,914 0.053 9,702 0.000 0 0	0.063 229,014 194,662 0.053 9,307 0.000 0 0	0.063 209,597 178,158 0.053 8,518 0.000 0 0	Notes
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SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Total Solids Load (Ib-TS/d) SS0 Valoitile Salids Load (Ib-YS/d) SS0 Writegen Content (Ib-N/Ib-YS) SS0 Mitrogen Content (Ib-N/Ib-TS) Sol Mitrogen Content (Ib-N/Ib-TS) Sol Mitrogen Content (Ib-N/Ib-TS) Primary Studge Total Nitrogen Content (Ib-N/Ib-TS)	0.063 267.848 227.671 0.053 10,886 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 245.519 208.691 0.053 9.978 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 238,723 202,914 0.053 9,702 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 229,014 194,662 0.053 9,307 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 209,597 178,158 0.053 8,518 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
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SS0 Organic Nitrogen Content (Ib-N/Ib-TS) SS0 Oralis Solids Load (Ib-TS/d) SS0 Volsitle Solids Load (Ib-TS/d) SS0 Volsitle Solids Load (Ib-TS/d) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Volsitle Solids Load (Ib-TS/d) HSOW No. 2 Annonium-N Load (Ib-N/dw) HSOW Total Solids Load (Ib-N/dw)	0.063 267.848 227.671 0.053 10.886 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 245.519 208.691 0.053 9.978 0.000 0 0.000 0 0.000 0 0.000 0 0.000 0 0.005 74,799 0.065 74,797 0.065 45,534 0.065 45,534 0.065 36,427 0.065 3,919 3,193 0.003 24 66 7 9.22 13,344 0.57	Peak 1 day 0.063 238,723 202.914 0.053 9,702 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 220.014 194.662 0.053 9.307 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 209.597 178.158 0.003 8.518 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (D+ V/b.TS) SS0 Orala Solids Load (D+TS/d) SS0 Valatile Solids Load (D+TS/d) SS0 Valatile Solids Load (D+TS/d) SS0 Armonium-N Load (D+V/dsy) HSOW No. 2 Organic Nitrogen Content (D+V/h-TS) HSOW No. 2 Organic Nitrogen Content (D+V/h-TS) HSOW No. 2 Valatile Solids Load (D+TS/d) HSOW No. 2 Valatile Solids Load (D+TS/d) HSOW No. 2 Annonium-N Load (D+V/hOTS) HSOW No. 2 Annonium-N Load (D+V/hOTS) HSOW No. 2 Annonium-N Load (D+V/dsy) HSOW NO. 2 Annoni	0.063 267.848 227.671 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.063 245.519 208.691 0.053 9.978 0.000 0 0 0 0 0 0 0 0 0 0.000 0 0.000 0 0.005 74.799 0.065 45.534 0.657 2.407 0.055 45.534 0.655 45.534 0.055 3.61.27 0.055 4.534 0.051 3.991 0.008 24 66 7 9.22 13.304 0.57 2.797 0.20	Peak 14 day 0.063 238,723 202.914 0.053 9,702 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0.063 220.014 194.662 0.053 9.307 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 209.597 178.158 0.063 8.518 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes
SS0 Organic Nitrogen Content (Ib. Y/Ib-TS) SS0 Total Solids. Load (Ib. TS/d) SS0 Total Solids. Load (Ib. TS/d) SS0 Violatile Solids. Load (Ib. TS/d) SS0 Winzgen Content (Ib. Y/Ib-TS) SS0 Nitrogen Content (Ib. Y/Ib-TS) SS0 Winz (Ib. TS/Ib-TS) SS0 Nitrogen Content (Ib-Y/Ib-TS) SS0 Winz (Ib. TS/d) SS0 Nitrogen Content (Ib-Y/Ib-TS) SS0 Winz 2. Total Solids Load (Ib-TS/d) SS0 Violatile Solids Load (Ib-S/d) SS0 Winz 2. Total Solids Load (Ib-S/d) SS0 Violatile Solids Load (Ib-S/d) SS0 Winz 2. Total Solids Load (Ib-S/d) SS0 Violatile Solids Load (Ib-S/d) SS0 Winz 2. Total Solids Load (Ib-V/ds) SS0 Violatile Solids Load (Ib-V/ds) Phany Studge Phany Studge	0.063 267.848 227.671 0.053 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Peak Month 0.053 245.519 208.691 0.053 9.978 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Peak 14 day 0.063 238,723 202,914 0.053 9,702 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 229.014 194.662 0.053 9.307 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0.063 209.597 178.158 0.053 8.518 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Notes

	Date Checked	Checked By	Job Number	Ву	Date	Calc No	
Brown	9/22/2017	Chris Muller	150871	Tracy Chouinard	9/15/2017	C-004	
Oaldwall		Pro	ject	Subject			
Caldwell	Encina Biosolids, Energy, and Emissi	ons		2030 Year - All Digest	ers in Service		

Thermal Hydrolysis with Mesophilic Digestion

Digester and Process Information

Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Number of Primary Digesters	3	1	Minium HRT (days)	12	Assumed	Peaking Factors		
Number of Secondary Digesters			Maxium OLR (lbs-VS/cf-d)	0.4	Assumed	Annual Average	1	2
Volume of Primary Digesters (MG)	2.05	1	Percent Solids Content of Digester Feed	9%	Assumed	Peak Month		2
Volume of Secondary Digesters (MG)			Digester Temperature (F)	102	Assumed	Peak 14 day	1.3	2
Digester Effliency Allowance (%)	5%	Assumed	Dewatering Total Solids (%TS)	22%	1	Peak 7 day	1.4	2
Digester pH	7.05	1	Dewatering Capture Rate (%)	95%	1	Peak day	1.6	2

Digester Sludge Feed

Parameter	Input Values	Reference	Parameter	Input Values	Reference		
Primary Sludge Flow (gpd)	177,844	1	Use if facility already receives HSOW (blank if not applicable)				
Primary Sludge Total Solids (%)	4.1%	1	HSOW Name	FOG	1		
Primary Sludge Volatile Solids (%)	87%	1	FOG Flow (gpd)	8,700	1		
TWAS Flow (gpd)	79,264	1	FOG Total Solids (%)	5.5%	1		
TWAS Total Solids (%)	6%	1	FOG Volatile Solids (%)	80%	2		
TWAS Volatile Solids (%)	80%	1	Are peaking factors applied to FOG?	No			
Domestic Sludge Biogas production yield (scf/lb-VS d)	18	1	FOG Biogas production yield (scf/lb-VSd)	17.8	1		

High Strength Organic Waste (HSOW)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
HSOW No. 1 Name	SSO	0	Percent of SSO (%)	100%	Assumed
HSOW No. 2 Name			Percent of (%)	0%	
SSO Total Solids (%)	12%	4	SSO Biogas production yield (scf/lb-VSd)	18	Assumed
SSO Volatile Solids (%)	85%	4	HSOW No. 2 Biogas production yield (scf/lb-VSd)		
HSOW No. 2 Total Solids (%)					
HSOW No. 2 Volatile Solids (%)					

Dofo

Digester Volatile Solids Reduction (VSR)

Parameter	Input Values	Reference	Parameter	Input Values	Reference
Primary Sludge VSR (%)	65%	3	Account for Synergystic Affects?	No	
TWAS VSR (%)	47%	3	Synergystic Increase in Solids Reduction (%)		
FOG VSR (%)	90%	3			
SSO VSR (%)	90%	3			
Do not use this row					

Nutrients Speciation for Edsting Conditions

Primary Sludge			TWAS			Existing HSOW (if applicable)		
Parameter	Input Values	Reference	Parameter	Input Values	Reference	Parameter	Input Values	Reference
Nitrogen Speciation			Nitrogen Speciation			Nitrogen Speciation		
PS Total Nitrogen (lb-N/lb-TS)	0.065	6 (TKN Content	TWAS Total Nitrogen (Ib-N/Ib-TS)	0.065	6 (TKN Content)	Existing HSOW Total Nitrogen (lb-N/lb-TS)	0.010	6 (TKN Content)

Nutrients Speciation for HSOW

Parameter	input values	Reference
Nitrogen Specia	ation	-
SSO Total Nitrogen (Ib-N/Ib-TS)	0.063	4
HSOW No. 2 Total Nitrogen (Ib-N/Ib-TS)		
SSO Org. Nitrogen (lb-N/lb-TS)	0.058	4
HSOW No. 2 Org. Nitrogen (lb-N/lb-TS)		
SSO-Soluble Nitrogen (Ib-N/Ib-TS)	0.005	4
HSOW No. 2 Non-Soluble Nitrogen (Ib-N/Ib-TS)		
Maximum alloawable ammonia-N concentration (mg-N/L)	3,000	

Table X-X: Existing Thermal Hydrolysis with Mesophilic Digestion Feed Assessment							
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes	
Peaking Factors	1.00	1.23	1.30	1.40	1.60		
Digester Volume (MG)	5.84	5.84	5.84	5.84	5.84	Service condition assumes largest digester is out of service with the active volume of each digeser reduced to account for process inefficiencies.	
Primary Sludge Total Solids Load (Ib-TS/d)	60,812	74,799	79,056	85,137	97,299		
TWAS Total Solids Load (lb-TS/d)	37,020	45,534	48,125	51,827	59,231		
FOG Total Solids Load (lb-TS/d)	3,991	3,991	3,991	3,991	3,991		
Total Digester Feed, Total Solids Load (Ib-TS/d)	101,822	124,324	131,172	140,955	160,521		
Primary Sludge Volatile Solids Load (Ib-VS/d)	52,906	65,075	68,778	74,069	84,650		
TWAS Volatile Solids Load (lb-VS/d)	29,616	36,427	38,500	41,462	47,385		
FOG Volatile Solids Load (Ib-VS/d)	3,193	3,193	3,193	3,193	3,193		
Total Digester Feed, Volatile Solids Load (Ib-VS/d)	85,715	104,695	110,471	118,724	135,228		
Primary sludge percent of VS Load (%)	62%	62%	62%	62%	63%		
WAS percent of VS Load (%)	35%	35%	35%	35%	35%		
FOG percent of VS Load (%)	4%	3%	3%	3%	2%		
Total Digester Feed Flow (gpd)	135,655	165,632	174,756	187,790	213,857		
Total Percent Solids Load (%)	9.0%	9.0%	9.0%	9.0%	9.0%		
Total Percent Volatile Solids Load (%)	84.2%	84.2%	84.2%	84.2%	84.2%		
Base HRT (days)	43	35	33	31	27		
Base OLR (lbsVS/d-cf)	0.11	0.13	0.14	0.15	0.17		
Hydraulic Capacity (HC) (gpd)	351.220	321.243	312.119	299.085	273.018	Assumes the minimum allowable HRT 12 days	
HC as Equivalent VS Load (Ib-VS/day)	298,776	273.275	265,513	254,426	232.251	Equivalent load of HSOW, based on hydraulic capacity	
Organic Load Capacity (Ib-VS/day)	226,718	207.738	201.962	193,710	177.205	Difference between max OLR (0.4 lbs-VS/cf-d) and current load	
Process Limitation	Organic Load	Organic Load	Organic Load	Organic Load	Organic Load		
		Table	X-X: Mesophilic Co-digestion Feed Assessn				
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes	
Total HSOW Volatile Solids Load (Ib-VS/day)	226,718	207,738	201,962	193,710	177,205	Calculated available organic load, based on defined limit	
SSO Volatile Solids Load (lb-VS/dav)							
	226.718	207.738	201.962	193,710	177.205		
HSOW No. 2 Volatile Solids Load (lb-VS/dav)	226,718	207,738	201,962 0	193,710 0	177,205 0		
HSOW No. 2 Volatile Solids Load (Ib-VS/day) Total HSOW Volatile Solids Load (Ib-VS/day)							
Total HSOW Volatile Solids Load (lb-VS/day)	0 226,718	0 207,738	0 201,962	0	0	Conversion to Total Solids load based on SSO %VS	
	0	0	0	0 193,710	0 177,205	Conversion to Total Solids load based on SSO %VS	
Total HSOW Volatile Solids Load (lb-VS/day) SSO Total Solids Load (lb-TS/day) HSOW No. 2 Total Solids Load (lb-TS/day)	0 226,718 266,728 0	0 207,738 244,398 0	0 201,962 237,602	0 193,710 227,894	0 177,205 208,477 0	Conversion to Total Solids load based on SSO %VS	
Total HSOW Volatile Solids Load (lb-VS/day) SSO Total Solids Load (lb-TS/day)	0 226,718 266,728	0 207,738 244,398	0 201,962 237,602 0	0 193,710 227,894 0	0 177,205 208,477	Conversion to Total Solids load based on SSO %VS Conversion to Wet Solids load based on SSO %TS	
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day)	0 226,718 266,728 0 266,728	0 207,738 244,398 0 244,398	0 201,962 237,602 0 237,602	0 193,710 227,894 0 227,894	0 177,205 208,477 0 208,477		
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wet/day)	0 226,718 266,728 0 266,728 2,222,730	0 207,738 244,398 0 244,398 2,036,651	0 201,962 237,602 0 237,602 1,980,018	0 193,710 227,894 0 227,894	0 177,205 208,477 0 208,477 1,737,306		
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day)	0 226,718 266,728 0 266,728 2,222,730 0	0 207,738 244,398 0 244,398 2,036,651 0	0 201,962 237,602 0 237,602 1,980,018 0	0 193,710 227,894 0 227,894 1,899,114 0	0 177,205 208,477 0 208,477 1,737,306 0		
Total HSON Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day) HSOW No. 2 Total Load (Ib-wet/day)	0 226,718 266,728 0 266,728 2,222,730 0 2,222,730	0 207,738 244,398 0 244,398 2,036,651 0 2,036,651	0 201,962 237,602 0 237,602 1,980,018 0 1,980,018	0 193,710 227,894 0 227,894 1,899,114 0 1,899,114	0 177,205 208,477 0 208,477 1,737,306 0 1,737,306		
Total ISON Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) ISON No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day) SSO ID-wet (day) HSOW No. 2 Total Load (Ib-wet/day) SSO (Ib-wet/day)	0 226,718 266,728 0 266,728 2,222,730 0 2,222,730 1,111	0 207,738 244,398 0 244,398 2,036,651 0 2,036,651 1,018	0 201.962 237.602 0 237.602 1.980.018 0 1.980.018 990	0 193,710 227,894 0 227,894 1,899,114 0 1,899,114 950	0 177,205 208,477 0 208,477 1,737,306 0 1,737,306 869		
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-TS/day)	0 226,718 266,728 0 266,728 2,222,730 0 2,222,730 1,111 0	0 207,738 244,398 0 244,398 2,036,651 0 2,036,651 1,018 0	0 201,962 237,602 0 237,602 1,980,018 0 1,980,018 990 0	0 193,710 227,894 0 227,894 1,899,114 0 1,889,114 950 0	0 177,205 208,477 0 208,477 1,737,306 0 1,737,306 869 0		
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No. 2 Total Solids Load (Ib-TS/day) SSO Ib-met/day	0 226,718 266,728 0 266,728 2,222,730 0 2,222,730 1,111 0 1,111	0 207,738 244,398 0 244,398 2,036,651 0 2,036,651 1,018 0 1,018	0 201.962 237.602 0 237.602 1.080.018 0 1.980.018 990 0 990 990	0 193,710 227,894 0 227,894 1,899,114 0 1,899,114 950 0 950	0 177,205 208,477 0 208,477 1,737,306 0 1,737,306 869 0 869	Conversion to Wet Solids load based on SSO %15	
Total HSOW Volatile Solids Load (Ib-VS/day) SSD Total Solids Load (Ib-TS/day) SSD (Ib-wel/day) HSOW No. 2 Total Load (Ib-wel/day) SSD (Ib-wel/day) SSD (Ib-wel/day) HSOW No. 2 Total Load (Ib-wel/day) SSD (Ib-wel/day) SSD (Ib-wel/day) HSOW No. 2 (wpd) HSOW No. 2 (wpd) SSD (wpd)	0 226,718 266,728 0,728 0,266,728 2,222,730 0 2,222,730 1,111 0 1,111 3,55,553	0 207,738 244,398 0 244,398 2,036,651 0 2,036,651 1,018 0 1,018 325,604	0 201,962 237,602 0 237,602 1,980,018 0 1,980,018 990 0 990 316,550	0 193,710 227,894 0 227,894 1,899,114 950 0 950 950 303,615	0 177,205 208,477 0 208,477 1,737,306 1,737,306 869 0 869 277,747	Conversion to Wet Solids load based on SSO %TS Conversion to Wet Solids load based on SSO %TS Assume 9% TS	
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No.2 Total Solids Load (Ib-TS/day) SSO Ib-Ts/day SSO Total Solids Load (Ib-Ts/day) <	0 226,718 266,728 0 266,728 2,222,730 0 2,222,730 1,111 0 1,111 335,553 0	0 207,738 244,398 0 244,398 2,036,651 0 2,036,651 1,018 0 1,018 325,604 0	0 201.962 237.602 0 237.602 1.080.018 0 1.980.018 990 0 990 990 316.550 0	0 193,710 227,894 0 227,894 1,899,114 0 1,899,114 950 0 950 303,615 0	0 177.205 208,477 0 208,477 1,737,306 0 1,737,306 869 0 869 0 869 277,747 0	Conversion to Wet Solids load based on SSO %15 Assume 9% 15 Assume 9% 15	
Total ISSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) SSO Total Solids Load (Ib-Wet/day) SSO Ib-wet/day	0 226,718 266,728 0 266,728 2,222,730 0 2,222,730 1,111 0 1,111 355,553 0 355,553	0 207,738 244,398 0 244,398 2,036,651 1,018 0 2,036,651 1,018 325,604 0 325,604	0 201,962 237,602 0 237,602 1,980,018 0 1,980,018 990 0 990 316,550 0 316,550	0 193,710 227,894 0 227,894 1,889,114 950 0 950 303,615 0	0 177,205 208,477 0 208,477 1,737,306 869 0 869 869 277,747 0 277,747	Conversion to Wet Solids load based on SSO %75 Conversion to Wet Solids load based on SSO %75 Assume 9% 75 Assume 9% 75	
Total HSOW Volatile Solids Load (Ib-VS/day) SSO Total Solids Load (Ib-TS/day) HSOW No.2 Total Solids Load (Ib-TS/day) SSO Ib-Ts/day SSO Total Solids Load (Ib-Ts/day) <	0 226,718 266,728 0 266,728 2,222,730 0 2,222,730 1,111 0 1,111 355,553 0 355,353 266,514	0 207,738 244,398 0 244,398 2,036,651 1,018 325,604 0 325,604 0 325,604 244,203	0 201,962 237,602 0 237,602 1,980,018 0 1,980,018 990 0 316,550 237,412	0 193,710 227,894 0 227,894 1,899,114 950 0 950 950 303,615 227,712	0 177,205 208,477 0 208,477 1,737,306 869 0 1,737,306 869 277,747 0 277,747 208,310	Conversion to Wet Solids load based on SSO %TS Conversion to Wet Solids load based on SSO %TS Assume 9% TS Assume 9% TS Assume 9% TS Assume 9% TS	

Total Solids, Volatile Solids Load (Ib-VS/d)	312,433	312,433	312,433	312,433	312,433	
Total Flow (gpd)	491,007	491,236	491,306	491,405	491,604	
Primary sludge percent of VS Load (%)	17%	21%	22%	24%	27%	
WAS percent of VS Load (%)	9%	12%	12%	13%	15%	
FOG percent of VS Load (%)	1%	1%	1%	1%	1%	
SSO percent of VS Load (%)	73%	66%	65%	62%	57%	
HSOW No. 2 percent of VS Load (%) Check	0%	0% ok	0% 0k	0%	0% 0k	
Check Co-digestion HRT (days)	12	0K 12	0K 12	0K 12	0K 12	
Co-digestion HRT (days) Co-Digestion OLR (lbs-VS/d-cf)	0.40	0.40	0.40	0.40	0.40	
	0.40	0.40 OK	0.40 OK	0.40 OK	0.40 OK	
Process Check	UK UK		: Existing Mesophilic Solids and Biogas Prod	uction	UK	
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34 389	42.299	44,706	48.145	55 023	1005
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919	17.121	18.095	19,487	22.271	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873	2.873	
Total Volatile Solids Destroyed (Ib-VSd/day)	51,182	62,293	65,674	70,505	80,167	
Total Sludge Effluent (gpd)	135,655	165,632	174,756	187,790	213,857	Assumes that volume in equals volume out
Total Solids Effluent (Lbs-TS/d)	50,640	62,031	65,497	70,450	80,354	
Volatile Solids Effluent (Lbs-VS/d)	34,533	42,402	44,797	48,218	55,061	
Total Solids (% TS)	4.5%	4.5%	4.5%	4.5%	4.5%	
Volatile Solids (% VS)	68%	68%	68%	68%	69%	
Dewatered Solids (Lbs-TS/d)	48,108	58,929	62,222	66,927	76,337	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	109	134	141	152	173	Assumes biosolids cake has a solids content of 22% TS
Primary sludge Biogas Production (scfd)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Biogas Production (scfd)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
Biogas Production (scfd)	911,037	1,108,812	1,169,005	1,254,994	1,426,972	
	1 A 22		Mesophilic Co-digestion Solids and Biogas Pr			
	Annual Average	Peak Month	Peak 14 day	Peak 7 day	Peak day	Notes
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	34,389	42,299	44,706	48,145	55,023	
WAS Volatile Solids Destroyed (Ib-VSd/day)	13,919 2.873	17,121	18,095 2.873	19,487	22,271 2.873	
FOG Volatile Solids Destroyed (Ib-VSd/day)	2,873	2,873	2,873	2,873 174,339	2,873	
SSO Volatile Solids Destroyed (lb-VSd/day) HSOW No. 2 Volatile Solids Destroyed (lb-VSd/day)	204,047	186,965	181,766	114,338	159,485	
Total Volatile Solids Destroyed (Ib-VSd/day)	255,228	249,257	247,440	244,844	239,652	
Total Sludge Effluent (gpd)	491,007	491,236	491,306	491,405	491,604	Assumes that volume in equals volume out
Total Solids (Lbs-TS/d)	113.321	119,464	121.334	124,005	129.346	noonneo ant ronnno m equalo ronnne out
Volatile Solids (Lbs-VS/d)	57.205	63.176	64,993	67.589	72,781	
Total Solids (% TS)	2.8%	2.9%	3.0%	3.0%	3.2%	
Volatile Solids (% VS)	50%	53%	54%	55%	56%	
Dewatered Solids (Lbs-TS/d)	107,655	113,491	115,267	117,804	122,879	Dewatered cake assumes 95% capture rate
Biosolids Cake (wtpd)	245	258	262	268	279	Assumes biosolids cake has a solids content of 22% TS
Primary sludgeVolatile Solids Destroyed (lb-VSd/day)	612,128	752,917	795,766	856,979	979,404	Assumes a biogas yield of 17.8 scf/lb-VSd
WAS Volatile Solids Destroyed (Ib-VSd/day)	247,765	304,751	322,094	346,871	396,424	Assumes a biogas yield of 17.8 scf/lb-VSd
FOG Biogas Production (scfd)	51,145	51,145	51,145	51,145	51,145	Assumes a biogas yield of 17.8 scf/lb-VSd
SSO Biogas Production (scfd)	3.672.839	3.365.362	3.271.782	3.138.096	2.870.724	Assumes a biogas yield of 18 scf/lb-VSd
		-,,	5,211,102	3,138,090	2,010,124	
HSOW No. 2 Biogas Production (scfd)	0	0	0	0	0	
HSOW No. 2 Biogas Production (scfd) Total Biogas Production (scfd)	0 4,583,876	0 4,474,174	0 4,440,787	0 4,393,090	0 4,297,697	······································
Total Biogas Production (scfd)	_	Table	0 4,440,787 e X-X: Nutrient Loading - Ammonia-N Estimat	0 4,393,090 es	0 4,297,697	
Total Biogas Production (scfd) HSOW No 1	Annual Average	Table Peak Month	0 4,440,787	0 4,393,090 es Peak 7 day	0	Notes
Total Biogas Production (scfd) H HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS)	_	Table	0 4,440,787 e X-X: Nutrient Loading - Ammonia-N Estimat	0 4,393,090 es	0 4,297,697	
Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d)	Annual Average	Table Peak Month 0.063 244,398	0 4,440,787 e X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 237,602	0 4,393,090 es Peak 7 day 0.063 227,894	0 4,297,697 Peak day 0.063 208,477	
Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Voiatlie Solids Load (Ib-VS/d)	Annual Average 0.063 266,728 226,718	Table Peak Month 0.063 244,398 207,738	0 4,440,787 e X-X: Nutrient Loading - Anmonia-N Estimat Peak 14 day 0.063 237,602 201,962	0 4,393,090 es Peak 7 day 0.063 227,894 193,710	0 4,297,697 Peak day 0.063	
Total Biogas Production (scfd) HSDW No. 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Total Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Nitrogen Content (Ib-N/Ib-VS)	Annual Average 0.063 266,728 226,718 0.053	Table Peak Month 0.063 244,398 207,738 0.053	0 440,787 2 X-X: Nutrient Loading - Aimonia-N Estimat Peak 14 day 0.063 237.602 201.902 0.053	0 4,393,090 es Peak 7 day 0.063 227,894 193,710 0.053	0 4,297,697 Peak day 0.063 208,477 177,205 0.053	
Total Biogas Production (scfd) HSOW No.1 SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solid Load (Ib-TS/d) SSD Total Solid Load (Ib-TS/d) SSD Voltatile Solids Load (Ib-TS/d) SSD Normolan-VL Load (Ib-M/day)	Annual Average 0.063 266,728 226,718	Table Peak Month 0.063 244,398 207,738	0 4,440,787 e X-X: Nutrient Loading - Anmonia-N Estimat Peak 14 day 0.063 237,602 201,962	0 4,393,090 es Peak 7 day 0.063 227,894 193,710	0 4,297,697 Peak day 0.063 208,477 177,205	
Total Biogas Production (scfd) HBOW No 1 SSO Organic Witnegen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Vitalife Solids Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-VS) SSO Ammonium-N Load (Ib-N/day) HBOW No 2	Annual Average 0.063 266,728 226,718 0.053	Table Peak Month 0.063 244,398 207,738 0.053	0 440,787 2 X-X: Nutrient Loading - Aimonia-N Estimat Peak 14 day 0.063 237.602 201.902 0.053	0 4,393,090 es Peak 7 day 0.063 227,894 193,710 0.053	0 4,297,697 Peak day 0.063 208,477 177,205 0.053	
Total Biogas Production (scfd) HSOW No.1 SSD Organic Nitrogen Content (Ib-N/Ib-TS) SSD Total Solid Load (Ib-TS/d) SSD Total Solid Load (Ib-TS/d) SSD Voltatile Solids Load (Ib-TS/d) SSD Normolan-VL Load (Ib-M/day)	Annual Average 0.063 266,728 226,718 0.053 10,840	Table Peak Month 0.063 244,398 207,738 0.053 9,932	0 4,40,787 2 X-X: Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 237.602 201.962 0.053 9,656	0 4,393,090 85 Peak 7 day 0.063 227,894 193,710 0.053 9,262	0 4,297,697 Peak day 0.063 208,477 177,205 0.053	
Total Biogas Production (scld) HSOW No 1 SSO Ofganic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solid Load (Ib-TS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-YS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Total Solids Load (Ib-YS/d) HSOW No.2 Total Solids Load (Ib-YS/d)	Annual Average 0.063 266.728 226.718 0.053 10.840 0.000 0 0 0	Table Peak Month 0.063 244,398 207,738 0.053 9,932 0.000 0 0 0	0 4.440.787 5.X2. Nutrient Loading 4 Ammonia-N Estimati Peak 14 day 0.063 237.602 201.902 0.053 0.656 0.000 0 0 0	0 4,393,090 es Peak 7 day 0.063 227,894 193,710 0.053 9,262 0.000 0 0 0	0 4,297,697 Peak day 0.063 208,477 177,205 0.053 8,473 0.000 0 0	
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Total Biogas Production (scld) HSOW No.1 SSO Orbati Solid Rogen Content (Ib-N/Ib-TS) SSO Total Solid Load (Ib-TS/d) SSO Vitages Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Nitrogen Content (Ib-N/Ib-TS) HSOW No.2 Organic Nitrogen Content (Ib-N/Ib-TS) SSOW No.2 Total Solids Load (Ib-TS/d) HSOW No.2 Violatie Solids Load (Ib-VS/d) HSOW No.2 Notatie Solids Load (Ib-VS/d) HSOW No.2 Notatie Solids Load (Ib-VS/d) HSOW No.2 Notatie Solids Load (Ib-VS/d)	Annual Average 0.063 266.728 226.718 0.053 10.840 0.000 0 0 0	Table Peak Month 0.063 244,398 207,738 0.053 9,932 0.000 0 0 0	0 4.440.787 5.X2. Nutrient Loading 4 Ammonia-N Estimati Peak 14 day 0.063 237.602 201.902 0.053 0.656 0.000 0 0 0	0 4,393,090 es Peak 7 day 0.063 227,894 193,710 0.053 9,262 0.000 0 0 0	0 4,297,697 Peak day 0.063 208,477 177,205 0.053 8,473 0.000 0 0	
Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solid Load (Ib-TS/d) SSO Vital Solid Load (Ib-TS/d) SSO Vital Solid Load (Ib-TS/d) SSO SO Amonium- Load (Ib-N/b-VS) SSO Amonium- Load (Ib-N/dor) HSOW No. 2 Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Altrogen Content (Ib-N/Ib-TS) HSOW No. 2 Organic Altrogen Content (Ib-N/Ib-VS) HSOW No. 2 Nitrogen Content (Ib-N/Ib-VS) HSOW No. 2 Nitrogen Content (Ib-N/Ib-VS) HSOW No. 2 Autononium-N Load (Ib-N/dor) Externet	Annual Average 0.063 266,728 226,718 0.053 10,840 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 244,398 207,738 0.053 9,932 0 0 0 0 0.000	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4,393,090 55 Peak 7 day 0.063 227,894 193,710 0.053 9,262 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4,297,697 Peak day 0.063 208,477 177,205 0.053 8,473 0.000 0 0 0 0.000	
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Total Biogas Production (scfd) HSOW No 1 SSO Organic Nitrogen Content (Ib-N/Ib-TS) SSO Total Solids Load (Ib-TS/d) SSO Valatile Solids Load (Ib-YS/d) SSO Nitrogen Content (Ib-N/Ib-TS) SSO Ammonium-N Load (Ib-N/A Vg) HSOW No 2. Organic Nitrogen Content (Ib-N/Ib-TS) HSOW No. 2. Valatile Solids Load (Ib-N/S/d) HSOW No. 2. Valatile Solids Load (Ib-N/Jb-TS) HSOW No. 2. Nitrogen Content (Ib-N/Ib-TS) HIMany Sludge Total Solids Load (Ib-N/C)	Annual Average 0.063 266,728 226,718 0.053 10,840 0 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 244,398 207,738 0.053 9,932 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4,440,787 2 X-X. Nutrient Loading - Ammonia-N Estimat Peak 14 day 0.063 237,602 201.962 0.053 9,656 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 4,393,090 33 Peak 7 day 0.063 227,894 193,710 0.053 9,262 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4,297,697 0.063 208,477 177,205 0.053 8,473 0.000 0 0 0.000 0 0 0 0.000 0 0 0 0.000 0 0 0.000 0 0 0.005 97,299	
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Total Biogas Production (scld) HSOW No 1 SS0 Orbard Solids Load (b-TS/d) SSO Total Solids Load (b-TS/d) SSO Vitals Solids Load (b-TS/d) SSO Witegen Content (b-N/b-TS) SSO Witegen Content (b-N/b-VS) SSO Mitegen Content (b-N/b-TS) HSOW No. 2 HSOW No. 2. Organic Nitrogen Content (b-N/b-TS) HSOW No. 2. Organic Nitrogen Content (b-N/b-TS) HSOW No. 2. Volatile Solids Load (b-VS/d) HSOW No. 2. Volatile Solids Load (b-VS/d) HSOW No. 2. Norgen Content (b-N/b-TS) HSOW No. 2. Norgen Content (b-N/b-VS) HSOW No. 2. Norgen Content (b-N/b-TS) Primary Sludge Total Nitrogen Content (b-N/b-TS) Primary Sludge Total Solids Load (b-TS/d) Primary Sludge Total Nitrogen Content (b-N/b-TS) Primary Sludge Total Nitrogen Content (b-N/b-TS) Nitrogen Content (b-N/b-VS) Ammonium N-Load (b-TS/d) Nitrogen Content (b-N/b-VS) Ammonium N-Load (b-N/by)	Annual Average 0.083 266,728 226,718 0.053 10,840 0.000 0 0 0 0 0 0 0 0 0 0 0 0	Table Peak Month 0.063 244.398 207,738 0.053 9,932 - 0.065 74,799 65,075	0 4.440.787 2.X. Nutrient Loading ≤ Ammonia-N Estimat Peak 14 day 0.063 237.602 201.962 0.053 9.556 0.000 0 0 0 0 0 0 0 0 0 0 0 0	0 4,393,090 35 Peak 7 day 0.063 227,894 193,710 0.053 9,262 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4,297,697 208,477 177,205 0.063 8,473 0.063 8,473 0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
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Technical Memorandum

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- Project Title: Biosolids, Energy and Emissions
- Project No.: 150871.005.001

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- Date: December 22, 2017
- To: Scott McClelland, Assistant General Manager
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Limitations:

This document was prepared solely for Encina Wastewater Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between Encina Wastewater Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by Encina Wastewater Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Encina Wastewater Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Table of Contents

List of Figures	iii
List of Tables	iii
Executive Summary	1
Section 1: Introduction 1.1 Purpose and Scope 1.2 Background Information	1
Section 2: Identification of Technologies for Waste Heat Utilization Production	
2.2 Thermophilic Digestion or Thermal Hydrolysis Process2.3 Absorption and Adsorption Chillers	5
2.4 Organic Rankine Cycle2.5 Gasification of Biosolids	6 7
 2.6 Fatal Flaw Conclusions Section 3: Ranking of Screened Technologies 3.1 Introduction 	8
3.2 Criteria Descriptions and Weightings3.3 Results and Discussion	
Section 4: Conclusions and Next Steps	11
Attachment A: Workshop Meeting Minutes	A-1



List of Figures

Figure 2-1. Small-scale steam turbine system process flow diagram	4
Figure 2-2. Small-scale steam turbine system and composite boiler process flow diagram	4
Figure 2-3. Absorption cooling process flow diagram.	6

List of Tables

Table 1-1. Projected Biogas Production	2
Table 1-2. Heat Production and Usage	
Table 2-1. Waste Heat Technology Fatal Flaw Evaluation	
Table 3-1. Criteria and Weight for Technology Screening ¹	9
Table 3-2. Waste Heat Technologies Evaluation	. 10



Executive Summary

The Encina Water Pollution Control Facility (EWPCF) currently has four 750-kilowatt (kW) (nameplate) internal combustion (IC) engines and a biosolids dryer, both of which produce heat. Recovered heat is utilized by the anaerobic digesters and an absorption chiller serving the Power Building while the remaining heat is wasted to plant effluent and atmosphere. This Technical Memorandum (TM) 5 provides an evaluation of alternative technologies for increasing heat utilization. The waste heat utilization technologies evaluated in this TM include:

- Absorption and adsorption chillers
- Organic Rankine Cycle (ORC)
- Small-scale steam turbines
- Gasification of biosolids
- Thermophilic digestion or thermal hydrolysis process (THP)

Screening and ranking of technologies was performed in a workshop with Encina Wastewater Authority (EWA) staff on August 16, 2017. The project team applied a fatal-flaw test to all alternatives and technologies that did not pass the fatal-flaw filter were eliminated. Technologies that passed the fatal-flaw filter, namely thermophilic digestion/thermal hydrolysis process (THP) and small-scale steam turbines, were assessed using evaluation criteria developed to reflect EWA's values and goals for the project (Table ES-1). Heat utilization alternatives that received an overall score of 3 or higher in the scoring evaluation will be further refined and analyzed using Brown and Caldwell's (BC's) Solids Water Energy Evaluation Tool (SWEET).

Section 1: Introduction

EWA has undertaken a Biosolids Energy and Emissions Plan (BEE Plan) which will be used to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan. The BEE Plan has several goals:

- 1. Provide a comprehensive analysis of all project elements including biosolids treatment, gas use, energy generation, and waste heat;
- 2. Address capacity limitations in the solids handling process at the EWPCF;
- 3. Assess which alternative is likely to be the most cost effective and sustainable solution for EWA;
- 4. Move the EWPCF toward greater energy independence; and
- 5. Reduce greenhouse gas emissions.

The purpose of TM 5 is to conduct a technology screening for increasing heat utilization for a beneficial purpose rather than wasting it. This TM does not provide an alternatives analysis, but does provide insight to the methodology and rationale used to select alternatives which will move forward for further analysis in the SWEET model development.

1.1 Purpose and Scope

This TM is preceded by TM 1 which addressed the baseline energy and heat profiles and projections, established a mass balance for the solids handling system, and evaluated sludge flows and loads projections performed under the Process Master Plan. Screening and evaluation of solids processing and



power production technologies are described in TMs 1, 2 and 3, including derivation of the heat projections used in the alternatives evaluation presented in this TM.

TM 5 summarizes the methodology for screening and evaluating heat utilization technologies, the technologies evaluated, and how these alternatives were ranked to determine which would move forward in the SWEET analysis. Recommended technologies will be advanced for further analysis and will be combined with the solids handling and waste heat alternatives presented in TMs 2 and 3. Screening and ranking of technologies were performed in a workshop with EWA staff on August 16, 2017. Meeting minutes from this workshop have been provided as Attachment A.

1.2 Background Information

The EWA cogeneration system has four Caterpillar 3516 IC engine-generators installed in the Power Building; each engine-generator has a nameplate electrical output of 750 kW. One of the four IC engines at the EWPCF serves as a standby unit in the event another IC engine must be shut down. Thus, three IC engines are available for cogeneration.

IC engine operation is permitted by San Diego Air Pollution Control District. EWA received a revised air permit, dated November 8, 2017, allowing utilization for a total of 280 million standard cubic feet (scf) of digester gas (DG) and natural gas (NG) per year to fuel the IC engines. The permit limits NG consumption to 28 million scf per year (scf/year)—or 10 percent by volume. Under the previous air permit, EWA was allowed to utilize 224 million scf of DG and NG per year for the IC engines, and NG consumption could not exceed 22.4 million scf/year. The fuel consumption limits of the previous permit allowed only two of the four IC engines to be used during typical operation. However, there were times when the plant ran a third engine and physically disconnected from the grid during peak demand periods to avoid high power charges.

EWA pursued modifications to its air permit to allow the entire use of the current biogas in the IC engines and increase the generating capacity of the plant. A summary of current and future EWPCF biogas projections is shown in Table 1-1. These projections assume high strength waste (HSW) quantities do not increase and are discussed in greater detail in TM 1. The new air permit increases the DG and NG usage limit to approximately 533 scf per minute (scfm), which exceeds the current biogas production with the increased quantities of HSW the plant recently began accepting. As a result, the equivalent of 2.5 engines may be operated continuously; thus, increasing the amount of waste heat that can be recovered.

Table 1-1. Projected Biogas Production						
Unit Measurement	Current	2020	2030	2040		
scfm	501	528	619	709		
therms/year ¹	1,581,000	1,666,000	1,951,000	2,235,000		

1. Based on 600 Btu/ft³ LHV

Following TM 1, BC reevaluated the current heat production and demand values. The reevaluation suggests the existing mesophilic digesters likely require 2.1 to 2.4 million British thermal units (MMBtu) per hour (MMBtu/hr), total, rather than the initially estimated 1.2 MMBtu/hr. With the old permit, the engines recover around 5.3 MMBtu/hr rather than the initially estimated 6 MMBtu/hr. When the new permit conditions are applied, approximately 6 to 7 MMBtu/hr of heat can be recovered from the engines. A summary of these projections is provided in Table 1-2. Excess heat can be beneficially used for various purposes, which will be discussed in Section 2.



Table 1-2. Heat Production and Usage					
	Baseline	eTM 1	Revised Projections		
	Production, MMBtu/hr	Usage, MMBtu/hr	Production, MMBtu/hr Usage, MMBtu/I		
Engines	6.0	-	6.0 - 7.0	-	
Dryer/RT0	1.4	-	1.4	-	
Digesters	-	1.2	-	2.3	
Total	7.4	1.2	7.4 - 8.4	2.3	

Section 2: Identification of Technologies for Waste Heat Utilization Production

The BC team identified and evaluated technologies to utilize the excess heat generated by the IC engines. Alternative technologies include the following:

- Small scale steam turbines
- Thermophilic digestion or THP
- Absorption and adsorption chillers
- ORC
- Gasification of biosolids

These technologies are discussed in subsequent sections in further detail. The waste heat technologies were first screened using four fatal flaw criteria that were developed in conjunction with EWA staff. The four fatal flaw screening criteria include the following:

- 1. At least one successful North American installation of technology. There must be at least one full-scale installation of the technology at a wastewater treatment plant (WWTP) in North America.
- 2. At least one successful installation and operation in a facility of similar size. The technology should be sufficiently developed that it is applicable at a facility of comparable size to EWPCF to ensure compatibility.
- 3. Available space. The technology must be accommodated within the limited available footprint at EWPCF.
- 4. **Compatibility with plant site and any existing equipment.** The technology must be capable of being integrated into the existing treatment plant infrastructure.

For an alternative to be considered for the ranking process, it must pass all four fatal flaw criteria.

2.1 Small-Scale Steam Turbines

A small-scale steam turbine system uses a steam boiler to combust any excess DG and produce steam. Instead of using a pressure regulator to reduce the pressure of the outlet steam, a small back-pressure steam turbine and generator is installed to generate electricity. After passing through the turbine, steam can be used to transfer excess heat to the digesters or a THP system. A basic diagram of this process is presented in Figure 2-1. If steam is not consumed, it can be recycled in a Rankine cycle, which would require a condenser unit, waste heat removal, a pump, and other associated equipment.



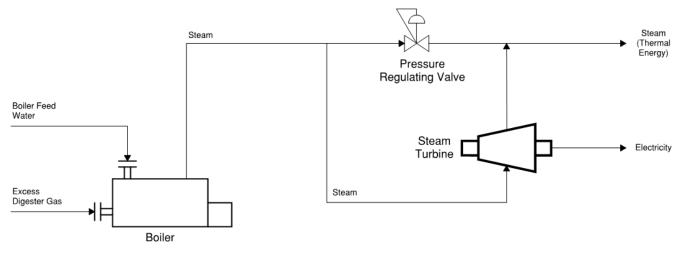


Figure 2-1. Small-scale steam turbine system process flow diagram.

Engine waste heat can also be utilized in this process in a composite boiler to preheat boiler feed water upstream of where the water enters the DG or NG fired chamber. Preheating the feed water reduces DG or NG consumption. A simplified flow diagram of the small-scale steam turbine system with a composite boiler is shown in Figure 2-2.

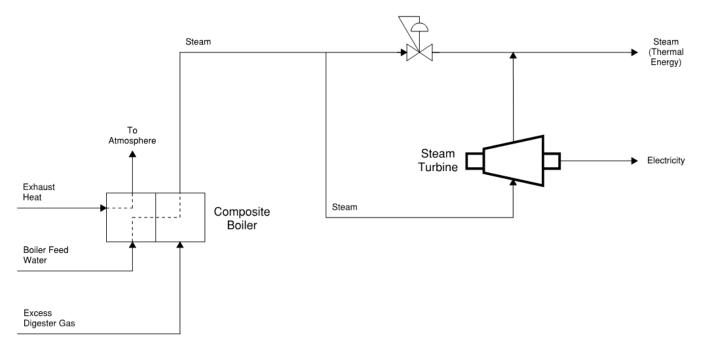
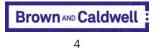


Figure 2-2. Small-scale steam turbine system and composite boiler process flow diagram.

This type of small-scale steam turbine system has not been employed at any WWTPs in the U.S., but this process can be readily applied. These systems have been successfully installed by NLine Energy at hospitals and other large-scale industrial settings to take the place of pressure regulators in the steam heat systems. In addition, boilers and steam turbines are proven technologies, are available at competitive market prices,



and have a relatively small footprint. Small-scale steam turbines can be cost effective when paired with an existing steam system, but EWPCF only uses hot water for heating services. Adding a steam system for the sole purpose of running a steam turbine is not cost effective; a conceptual order of magnitude cost estimate for adding a steam system and steam turbine is \$1 million. Such a system would only be compatible at EWPCF if a process that requires steam, such as THP, is installed.

2.2 Thermophilic Digestion or Thermal Hydrolysis Process

Thermophilic digestion or THP would allow for additional utilization of engine waste heat, as well as benefits to the digestion process. These alternate solids stabilization technologies are summarized in greater detail in TM 2.

Thermophilic digestion, which selects organisms with favorable digestion kinetics at thermophilic temperatures targeted at 135 degrees Fahrenheit, is an alternative to the existing mesophilic digestion which operates between 95 and 100 degrees Fahrenheit. To achieve thermophilic temperatures, additional engine exhaust heat would need to be recovered through the plant hot water loop and transferred to the digesters via installing more heat exchangers and larger hot water pumps. It should also be noted that the temperature of the hot water needed for thermophilic digestion is generally higher than for mesophilic digestion, and recoverable heat drops as the recovery temperature rises. A more detailed evaluation should be performed to determine how much heat would be available from the existing engines if thermophilic digestion is considered further. Changes to the overall heat loop may be required, as well. Other treatment plants that recover engine waste heat for thermophilic digestion include Hyperion in Los Angeles, California; East Bay Municipal Utilities District in Oakland, California; Oceanside Treatment Plant in San Francisco, California; and the Annacis Island Treatment Plant in Vancouver, British Columbia.

In THP, sludge is heated to around 165 degrees Celsius (330 degrees Fahrenheit) at an elevated pressure using direct steam injection, followed by a sudden drop in pressure. This process improves digestion performance by breaking down sludge to make it more accessible to microbes during digestion. In general, IC engine exhaust heat is a poor source for making steam, while boilers and gas turbines have had more success. Exhaust heat from IC engines can, however, be utilized to preheat feedwater prior to producing steam in a boiler for THP or in a composite boiler.

Modifying EWPCF to accommodate a THP system would require a larger footprint than upgrading the mesophilic digesters to thermophilic digesters because THP requires additional ancillary equipment. However, as stated in TM 2, the EWPCF has room to accommodate the additional footprint of a THP system. Heat recovery equipment that would be associated with THP (i.e., steam or composite boilers) would have a relatively minor footprint. If steam boilers are used, a heat exchanger would be required to transfer waste heat from the IC engine to the boiler feedwater. If a composite boiler is used, engine exhaust could be introduced directly to the boiler to increase the feedwater temperature and reduce the DG or NG requirement. Multiple manufacturers have developed THP systems (Cambi, Veolia, etc.) at municipal WWTPs in the U.S. and Europe. For example, the District of Columbia Water and Sewer Authority (DC Water) in Washington, D.C. has a Cambi THP system which uses cogeneration steam to provide heat for the Cambi process.

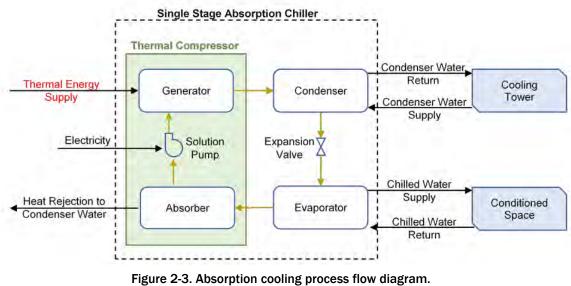
There are multiple plants that operate thermophilic digesters or THP systems using waste heat from IC engines that have been in operation for longer than 5 years. The additional heat recovery equipment required for THP (e.g., heat exchangers, pumps, and boilers) has a relatively small physical footprint and can be installed within available space at EWPCF. If advanced digestion technologies are selected as part of the stabilization technology, waste heat from the engines can be recovered for a beneficial purpose. For these reasons, thermophilic digestion or THP passes the fatal flaw filter.



2.3 Absorption and Adsorption Chillers

Recovered heat from IC engines can also be used as part of the refrigeration cycle of absorption and adsorption chillers. Hot water or steam gaining energy from the IC engine waste heat is used to vaporize a refrigerant which has been absorbed or adsorbed in the chiller so that it can be recycled after subsequent condensation.

Absorption and adsorption chillers operate under similar principles; the primary difference is the sorbent compound that is used to capture the vaporized refrigerant. Absorption chillers use a fluid absorbent whereas adsorption chillers use a solid adsorbent. A general absorption cycle process flow diagram is presented in Figure 2-3. Other important differences to consider are that adsorption chillers are typically more expensive and less efficient but have significantly longer life expectancies.



Source: U.S. Department of Energy Fact Sheet.

Absorption and adsorption chillers can be applied as air conditioning systems or as chilling systems for equipment and processes. These two types of systems can be provided in various sizes and configurations with cooling capacities ranging from 4.5 kW to 5 megawatts (MW). The wide range of cooling capacities allows for adsorption and absorption chillers to utilize as much waste heat as needed. These technologies are proven and have been applied in various forms and industrial settings since the early 1900s.

BC understands that the plant is moving from adsorption chillers to a centralized heating, ventilation, and air conditioning (HVAC) systems; therefore, this alternative fails the fatal flaw filter on compatibility and will no longer be evaluated moving forward.

2.4 Organic Rankine Cycle

ORC is a thermodynamic process in which waste heat is transferred to an organic fluid with a boiling point lower than water at a constant pressure. The organic fluid then vaporizes and expands in a vapor turbine to drive a generator, producing electricity. Cooled vapor is then condensed back to liquid state and recycled through the system via a pump. Figure 2-4 shows a schematic of how the ORC process operates when interconnected with an IC engine. As presented in Figure 2-4, ORC systems require a substantial cooling water stream to condense the organic working fluid after it exits the turbine. Overall, ORC systems have a



relatively low efficiency in converting excess thermal energy to electrical power. Average overall ORC efficiencies are between 10 and 12 percent when applied at WWTPs for waste heat usage.

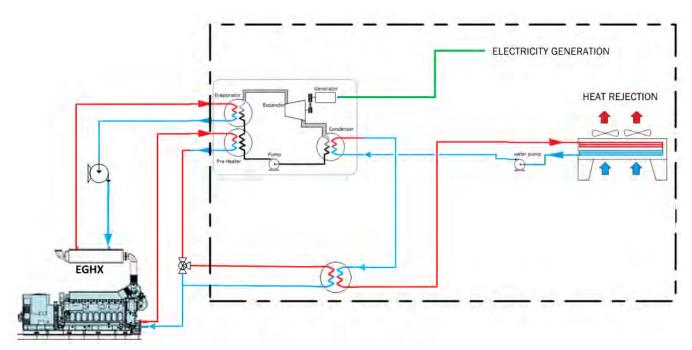


Figure 2-4. Process flow diagram detailing the ORC.

Source: ElectraTherm.

Turboden (Italian brand) and ElectraTherm (U.S. brand) are the two main manufacturers that supply ORC systems to the U.S. ORC systems have been installed at multiple WWTPs in Europe. In the U.S., ORC systems have been installed at biomass processing plants and oil and gas operations but only one WWTP—the Albany County Sewer District (ACSD) North Plant in New York. The ACSD North Plant is a 35-million gallons per day (mgd) WWTP, similar in size to the EWPCF, and waste heat is generated by sludge combustion in an incinerator. The generated waste heat is used to create steam and run ACSD North Plant's Turboden ORC system, which has an installed capacity of 925 kW. The ACSD North Plant ORC application is not analogous to an ORC process that uses waste heat from an internal combustion engine because engine cogeneration produces significantly less heat than incineration at this scale.

The ORC is still considered an emerging technology with limited operating experience at WWTPs similar in size to EWA's; therefore, ORC does not pass the fatal flaw filter. Additionally, the parasitic loads associated with the large cooling water flow requirement significantly reduce the benefits provided by an ORC system.

2.5 Gasification of Biosolids

Gasification of biosolids is a high temperature, thermal conversion process that produces a combustible gas mixture of hydrogen, carbon monoxide, and carbon dioxide. Gasification at EWPCF would take biosolids exiting the thermal dryer and combine them with waste heat from the IC engines to perform the reaction. The end products of gasification are ash and syngas, which is a combustible gas with a lower heating value between 100 and 300 Btu per standard cubic foot. Syngas can likely be used in the IC engines but would require upstream conditioning and engine modification for the very low Btu fuel.



Gasification of biosolids is still considered an emerging technology because there are not full-scale installations at municipal WWTPs. The plant in Sanford, Florida, recently ceased operations because the solids processing company (Maxwest Environmental) filed for bankruptcy. With the limited operating history, gasification of biosolids does not pass the fatal flaw filter.

2.6 Fatal Flaw Conclusions

Waste heat technologies that pass the fatal flaw criteria include small-scale steam turbines and recovery of waste heat for thermophilic digestion or thermal hydrolysis. Both technologies have been successfully operated at WWTPs and align with the existing systems at EWPCF and available plant area. These alternatives are ranked using the evaluation and scoring criteria in Section 3 to determine if they should be analyzed further using BC's SWEET tool.

Absorption and adsorption chillers fail the fatal flaw filter because EWA plans to replace the existing adsorption chillers with a central HVAC system. ORC systems and biosolids gasification fail the fatal flaw filter because both technologies have limited operating experience at large-scale WWTPs.

Table 2-1. Waste Heat Technology Fatal Flaw Evaluation							
Technology Maturity Successful Operation Available Space Compatibility							
Small-Scale Steam Turbines	Pass	Pass	Pass	Pass			
Use for Thermophilic Digestion/THP	Pass	Pass	Pass	Pass			
Absorption and Adsorption Chillers	Pass	Pass	Pass	Fail			
ORC	Fail	Fail	Pass	Pass			
Gasification of Biosolids	Fail	Fail	Pass	Pass			

The results of the fatal flaw evaluation are provided in Table 2-1.

Section 3: Ranking of Screened Technologies

This section describes the results of applying the evaluation criteria described in Section 2 to further screen and rank the technologies that passed the fatal flaw filter.

3.1 Introduction

Following application of the fatal flaw filter, Table 3-1 summarizes the technologies that were further evaluated using established criteria. The final scores and weightings were fixed in Workshop 2 with EWA staff. In this analysis, a weighted average score of 3 or less led a technology to be eliminated from further consideration. The rationale behind the scoring for each technology area is described in this section.

3.2 Criteria Descriptions and Weightings

Alternatives that passed the fatal flaw filter were further evaluated and ranked based on both economic and non-economic screening criteria. The BC team worked with EWA staff to develop a series of evaluation criteria that reflect the project goals, EWA's values, and EWA's general operational practices. Criteria weights were assigned in Workshop 2 with EWA staff. Criteria and weightings are presented in Table 3-1.



	Table 3-1. Criteria and Weight for T		M. 1.4.1
Criterion	Description	Scoring Description	Weight
Proven Technology Performance	Proven and reliable technology with same configuration intended at Encina. Long successful operating track record.	Low score indicates no successful large-scale operating installations in North America or Europe, no successful demonstration scale installations in North America or Europe, and unknown safety or reliability record. High score indicates more than one successful operating installation in North America or Europe, more than one operating installation at a WWTP of at least 40 mgd in North America or Europe, track record duration greater than 5 years, and vendors in Western U. S.	20%
Minimize Life-Cycle Costs	Qualitative metric of program cost. Capital and O&M costs based on existing EWA data or similar experience at other WWTPs.	Low score indicates high capital cost to build on- site facilities and high O&M costs. High score indicates low capital cost to build on- site facilities and low O&M costs.	10%
Energy/Resource Recovery	Increases biogas production through advanced digestion. Supports co-digestion of organic waste. Recovery of renewable energy.	Low score indicates high energy requirement for on-site technology, no increase in biogas production, technology does not recover energy as biogas, no recovery of renewable energy in biosolids, and no biosolids resource recovery. High score indicates a higher biogas production, compatible with co-digestion of organic waste, and biosolids resource recovery.	25%
D&M Impacts	Impacts to existing plant O&M staff levels. Complexity of new technology O&M and control systems. Reliability of new technology (potential downtime). Minimal impacts to plant safety.	Low score indicates more O&M time required, complex mechanical and control systems required compared with existing plant facilities, potential equipment downtime, and new chemicals or hazards. High score indicates reduction in O&M staff time required, new technology is simple to operate and maintain, reliable with minimal downtime, and no new chemicals or hazards.	10%
Environmental Impacts	Impacts to carbon footprint and air permitting.	Low score indicates high carbon footprint for technology, and new permitting for environmental regulatory requirements. High score indicates low carbon footprint for technology and no additional permitting for environmental regulatory requirements.	15%
Community and Stakeholder Impacts	Minimize nuisance impacts such as dust, odors, vectors, aesthetics, noise and traffic. Assess impacts to partner agency issues/values as well as local planning codes and requirements.	Low score indicates nuisance factors for on-site technology are difficult to mitigate. High score indicates nuisance factors can be mitigated at plant site.	10%
Project Site Compatibility	Assess compatibility of technology with available plant footprint. Incorporation into existing treatment process.		10%

1 Criteria are scored on a scale of 1-5, with 5 being the highest.

O&M = operations and maintenance



3.3 Results and Discussion

Table 3-2 shows the scoring results for the waste heat utilization technologies that passed the fatal flaw filter. Use of waste heat for advanced digestion technologies received a higher score in every rating criteria over small-scale steam turbines. Rationale behind the scoring for each alternative is described below.

Thermophilic digestion is a proven process that could increase the plant's capacity to accept high strength waste. Because the additional heat demands can be satisfied by the existing cogeneration system, this specific use of waste heat minimizes life-cycle costs by generating tipping fee revenue and increasing DG production with few negative impacts.

THP in conjunction with mesophilic digestion can produce a Class A biosolids product, but requires steam to bring the inlet sludge up to high process temperatures. Waste heat from the cogeneration process can help offset this heat demand.

Small-scale steam turbines are an emerging technology. Newer versions of this equipment are more efficient than historical models, which makes the technology cost effective in place of traditional pressure regulating valves. The small-scale steam turbine may be most effective if combined with a THP system because both require steam.

Utilizing engine waste heat for either thermophilic digestion or THP is an established practice at several large WWTPs in the U.S. The process for thermophilic digestion is similar in concept to mesophilic digestion, with a hot water loop and heat exchangers. At the DC Water plant, heat is recovered in the form of steam to satisfy the high-quality heat demand of THP.

Recovering additional heat for use in thermophilic digestion does not have a significant capital cost, nor does it add a major O&M burden. Because EWPCF does not have an existing steam heat system, recovering heat for THP requires significant capital investment to install equipment for generating steam for and delivering steam to the THP system. In comparison, the cost to install a small-scale steam turbine relative to the increased power production has a higher cost to benefit ratio.

An air permit is required for both THP and small-scale steam turbines because a new boiler is required to produce steam. Air permitting requirements for boilers are presented in TM 6.

Table 3-2. Waste Heat Technologies Evaluation						
Criterion	Small-Scale Steam Turbines	Thermophilic Digestion/THP				
Proven Technology Performance	2	5				
Minimize Life-Cycle Costs	3	5				
Energy/Resource Recovery	4	4				
0&M Impacts	3	3				
Environmental Impacts	3	4				
Community and Stakeholder Impacts	3	4				
Project Site Compatibility	3	4				
Weighted Score	3.05	4.20				



Section 4: Conclusions and Next Steps

Screening of heat utilization alternatives resulted in a final selection of technologies to be included in end-toend alternatives and are summarized in the list below. These technologies will be combined with the results of Tasks 2, 3, and 4 for the creation of end-to-end alternatives for analysis in the SWEET model. Factors influencing solids stabilization will be paired with the heat utilization technologies, if applicable, to aid in selection of the best overall alternative. Development of end-to-end alternatives will be performed in cooperation with EWA staff prior to analysis. The shortlist of alternatives to be carried forward in SWEET analysis consists of small-scale steam turbines, in conjunction with THP, and providing heat to thermophilic digestion or THP.



Use of contents on this sheet is subject to the limitations specified at the beginning of this document. SC07044_Final_Encina_TM5_Waste Heat Technologies.docx

Attachment A: Workshop Meeting Minutes

Screening and Ranking of Technologies, August 16, 2017



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A-1



Meeting Minutes

9665 Chesapeake Drive, Suite 201 San Diego, CA 92123

T: 858.571.8822 F: 858.571.8833

Prepared for:Encina Wastewater AuthorityProject Title:Energy & Emissions Strategic Plan & Biosolids Management Plan UpdateProject No.:150871

Purpose of Meeting:	Workshop #2	Date: August 16, 2017
Meeting Location:	Encina Wastewater Authority	Time: 1:30 - 5:00 PM
Minutes Prepared by:	Hari Seshan and Jocelyn Lu, Brown and Caldwell	

Attendees:Doug Campbell, Encina, JPAAScott McClelland, Encina JPAHJimmy Kearns, Encina JPAHMike Steinlicht, Encina JPAHOctavio Navarrete, Encina JPASNathan Chase, RMCH

Adam Ross, Brown and Caldwell Hari Seshan, Brown and Caldwell Jocelyn Lu, Brown and Caldwell Natalie Sierra, Brown and Caldwell Scott Lacy, Brown and Caldwell Tom Chapman, Brown and Caldwell

Attachments:

• Workshop #2 Presentation Slides

Decisions

The following is a list of decisions made as a result of the meeting discussion:

- BC team to evaluate RDTs against the current status quo of primary clarifier and DAFT.
- Stabilization technologies that moved to the next round of evaluation: Mesophilic Digestion, Mesophilic Digestion with High Solids, Thermophilic Digestion, and Traditional CAMBI.
- Dewatering technologies that moved to the next round of evaluation: Centrifuges and Belt Presses.
- Post-dewatering technology that moved to the next round of evaluation: Thermal Drying High Quality (Drum Dryer).
- Alternative power production technologies that moved to the next round of evaluation: Internal Combustion Engines (Status Quo), Internal Combustion Engines – with Gas Conditioning, Internal Combustion Engines – with Exhaust Treatment, Digester Upgrading – Pipeline Injection, Micro-Turbines, Biosolids Drying – Direct Use of Biogas, Large Scale Photovoltaics (PV), Small Scale Rooftop PV.
- Waste heat technologies that moved to the next round of evaluation: Small-Scale Steam Turbines, and Thermo/THP.

Action Required

The following is a list of actions required as a result of the meeting discussion:

- Jimmy to send Adam maintenance schedule costs.
- Octavio to send WAS daily flow data to Hari Seshan (Hari).
- Scott L to send list of additional data/document requests over to Scott M after updating based on discussion.
- Scott M to send a list of EWA attendees for the Waste Haulers Meeting to BC.
- Adam to send a draft agenda of the Waste Haulers meeting to EWA and finalize per any EWA comments.
- Octavio to send EWA's SDG&E point of contact to Adam. EWA and BC to discuss initial contact with SDG&E regarding biomethane pipeline injection.
- Octavio to send Hari lab data on the performance of the centrifuges.
- Tom to work with Octavio on refining the solids mass balance.
- Adam to present a big picture view of the power production alternatives at the next workshop.
- BC to identify technologies that would be beneficial to visit at WEFTEC.
- BC will set up a meeting with Anaergia to discuss project goals and opportunities. This meeting will be separate from the Waste Hauler meeting.
- Scott L and Scott M will schedule Workshop 3 for mid-September aim for conducting the Waste Hauler meeting on the same day.
- EWA will take the dryer out of service in September/October. BC requests that any condition assessment results be shared with the team particularly related to the increased use of digester gas (siloxane or hydrogen sulfide issues).
- BC to check in with EWA to confirm is any support is needed related to the next board meeting on Oct 11.

Summary

Workshop #2 was held for the Encina Water Authority (EWA) Energy & Emissions Strategic Plan & Biosolids Management Plan Update. The purpose of this Workshop was to review pending administrative tasks and provide task updates. A summary of the discussion is provided below:

Introductory Items

BC started off the meeting by reviewing the schedule and goals for the meeting. The goals are to generate content and direction for the project team moving forward.

- This month, the Brown and Caldwell (BC) team will be:
 - Preparing a baseline report, to be reviewed by EWA in September.
 - o BC will also be preparing report sections of Tasks 2 and 3 by September.
 - In October and November, BC will be developing SWEET alternatives and providing more clarity on how the pieces interact.
- Adam Ross (Adam) stated that he expects to have more questions about permitting, cogeneration (cogen), electrical rates, and where to send digester gas, and would appreciate dialogue between now and the next workshop. EWA staff recommended for him to work with Octavio Navarrete (Octavio).

New Data Request Items

BC reviewed new data request items with EWA. They included:

- Trussell food waste capacity report Scott McClelland (Scott M) stated that he has the data, but not the report, on the Trussell study. Preliminary conclusions of the report indicate that EWA could accept an additional 80,000 gal/week of FOG and 25,000 gal/week of brewery waste. EWA expect it'll take about another month before the report is ready. Imported wastes are received Monday – Friday/Saturday. A constant feed to the digesters is provided until around Saturday afternoon. A potential limitation to high strength waste acceptance is truck offloading capacity. A food waste pilot program began on Monday, 9/14.
- O&M costs for cogen engines Adam asks if EWA has annual O&M costs for the engines. Jimmy Kearns (Jimmy) states that EWA has annual costs for the maintenance schedule.
 - ACTION: Jimmy to send Adam maintenance schedule costs.
- WAS flow data
 - o BC requests the WAS flow data, and Octavio indicates that EWA does have that data.
 - ACTION: Octavio to send WAS daily flow data to Hari Seshan (Hari).
- Air permitting summaries or progress
 - o Doug Campbell (Doug) sent Adam the latest email from Don King (Don).

Outstanding Data Requests

BC reviewed outstanding data requests with EWA. They included:

- Cogen drawing and cut-sheets
 - o Natalie Sierra (Natalie) points out that BC has received drawings from Andritz.
- Information on energy management
- High strength waste storage (typical day operating procedure)
- ACTION: Scott L to send list of additional data/document requests over to Scott M after updating based on discussion.

There was a subsequent discussion on wasted gas that was being flared. Octavio explains that the operators need to manually control the digester gas flow to the dryer, which results in some flaring. Operators generally try to set the digester gas flow rate to avoid drawing down the gas system and triggering natural gas blending at cogen. This typically results in a conservative offtake of digester gas to the dryer which results in some flaring. Mike Steinlicht (Mike) asks how much is being flared, and Adam calculated that about 180 kW of gas was being flared (averaged over a month) in current operation.

Cogeneration operation was discussed. EWA operates two engines on digester gas 24/7. A third engine operates on natural gas during peak power rates. EWA physically disconnects from the power grid to avoid demand and consumption charges.

FOG is fed to the digesters at a constant rate of 12 gallons per minute. FOG is fed to only one or two digesters, not all. The FOG feeding begins on Monday with first deliveries of the week, and continues into Saturday to pump down material from the last deliveries on Friday.



Meeting with Waste Haulers

BC reviewed the timing, attendees, and goals of the Waste Haulers Meeting. Below is a summary of the discussion:

- Scott L reviewed the potential list of attendees, which included: EWA representatives, BC representatives, Waste Management (WM), Republic, EDCO, and potentially LES or Anaergia.
 - ACTION: Scott M to send a list of EWA attendees for the Waste Haulers Meeting to BC.
- Scott M stated that the intent of the meeting is to develop a public-private partnership and noted increase grant eligibility by having this kind of relationship.
- Mike emphasized that the elected officials want all of the waste haulers at the table, especially those that operate within EWA's service area.
- Adam reviewed the draft Waste Hauler Agenda, which would cover background on the plant, current operation, and a discussion of potential capacity.
- Scott M stated that he would like to have an agenda finalized and sent out to each waste hauler 30 days in advance of the meeting, to give them adequate prep time.

• ACTION: Adam to send a draft agenda of the Waste Haulers meeting to EWA and finalize per any EWA comments 30-days in advance of the meeting.

• Adam stated that another discussion point for the meeting is the waste haulers potential interest in accepting compressed natural gas (CNG). Scott M stated that SDG&E should be involved in these conversations as well. A meeting should be arranged with SDG&E.

• ACTION: Octavio to send EWA's SDG&E point of contact to Adam.

Different gas delivery options, tube trailer vs. pipeline, were discussed. Adam stated that a tube trailer has less stringent standards than a pipeline, but there would be tube trucks coming in and out of the facility. However, the pipeline would have more stringent sampling/reporting requirements and the investment for an interconnection for the pipeline could cost \$1 – 2 million dollars. This will be developed as the alternatives analysis is advanced.

Other Outstanding Items

BC reviewed their understanding of the discussion with Anaergia:

Adam stated that Anaergia is promoting Omnivore as a process treatment option, which may
or may not be the right fit at EWA. However, there might be opportunity for Anaergia to work
with waste haulers for pre-processing food waste.

Review of Mass Balance and Project Flows and Loads

BC presented the project flows and loads:

- Mass Balance
 - Hari reviewed the assumptions made to calculated WAS. Octavio responded that the actual WAS flow is around 0.75 MGD, and that he could send that data to BC (ACTION above).
 - Adam stated that the VSR value of 65% seemed suspiciously high. Octavio stated that EWA's VSR value was closer to 55%.
 - Hari stated that the centrifuge % capture right now is 78%. Octavio responded that the capture rate for the centrifuges is consistently 95%, and that the calculated value is probably lower because of values during start-up and shut-down.
 - ACTION: Octavio to send Hari lab data on the performance of the centrifuges.

- Tom requested that the BC team review the data with Octavio after he send is to BC.
 - ACTION: Tom to send up conference call with Octavio after reviewing the data.
- Solids Mass Balance Comparison
 - Tom presented a graph that shows that BC's calculated solids loading was higher than the calculated values in the Process Master Plan (2016).
 - Octavio stated that one reason for the increase might be a 2015 change in how EWA sampled the influent flow.
 - ACTION: Tom to work with Octavio on refining the solids mass balance.
- Power Loads and Gas Usage
 - Adam reviewed the gas usage graphs with EWA.
 - Digester Gas Usage Summary Total gas production is trending up, probably due to the increase in high strength waste deliveries. Adam pointed out that the yellow "Total Gas Production" line didn't match up with the top of the bars, which is normal. Scott M pointed out that the important part is that the yellow line followed the same trend as the bars.
 - Natural Gas Usage Summary Most of the natural gas is being used for the heat dryer and cogen, which is expected.
 - Power Production and Import Currently, EWA is making about 80% of their electricity needs. This means that EWA could potentially export power. A look into the SDG&E power bills also showed that the actual kWh power that EWA is purchasing only constitutes \$10,000 out of a \$70,000 bill. The majority of the bill is non-coincident and standby power.
 - Mike stated that he had talked to SDG&E about the standby charges and haven't been able to get around them.
- Engine Fuel Use
 - Octavio explained that the increase in natural gas in November 2015 was because they needed to switch to natural gas to stay below emission limits.

Screening of Technologies

BC the fatal flaw filter and evaluation criteria, and then evaluated each process technology against that criteria. The results of the evaluation are summarized below and more details are included in the attached Workshop #2 PowerPoint slides.

- There were four fatal flaw filters:
 - o At least one successful North American installation of the technology
 - o At least one successful installation in a facility of similar size
 - o There is available space to implement that technology
 - Compatibility with plant size and any existing equipment
- The technologies that passed the fatal flaw filter were then scored for each evaluation criteria, which included: end use market compatibility, proven technology performance, life cycle costs, energy/resource recovery, O&M impacts, environmental impacts, community and stakeholder impacts, and project site combability.
 - Each evaluation criteria was then weighted to reflect EWA's priorities.

- Technologies that scored lower than a 3 were eliminated, and technologies that scored greater than a 3 would be evaluated through the SWEET model.
- O&M impacts criteria will be clarified to describe reduction in O&M staff time.
- Thickening Technologies
 - Prior planning efforts recommended evaluating rotary drum thickeners (RDTs) against the existing primary clarifier and dissolved air flotation thickeners (DAFTs). EWA concurred with that recommendation.
 - Natalie asked if the team should add Anaergia's Omnivore to the list of technologies to evaluate. Scott L proposed that that decision to be made after a meeting with Anaergia takes place.
 - DECISION: BC team to evaluate RDTs against the current status quo of primary clarifier and DAFT.
- Stabilization Technologies
 - Technologies that failed the fatal filter: Staged Digestion, Acid/Gas Phased Digestion, Temperature Phased Anaerobic Digesion, Enzymatic Hydrolysis, Chemical Hydrolysis, THP – DLD, and Solid Stream CAMBI.
 - Technologies that scored lower than a 3 in the evaluation criteria: Lystek.
 - (DECISION) Stabilization technologies that moved to the next round of evaluation: Mesophilic Digestion, Mesophilic Digestion with High Solids, Thermophilic Digestion, and Traditional CAMBI.
- Dewatering Technologies
 - Technologies that failed the fatal filter: Bucher Press.
 - Technologies that scored lower than a 3 in the evaluation criteria: Screw Press, Rotary Press, and Volute Press.
 - (DECISION) Dewatering technologies that moved to the next round of evaluation: Centrifuges and Belt Press.
- Post-Dewatering Technologies
 - Technologies that failed the fatal filter: Thermal Drying: Low Quality (Indirect Dryer), Gasification, and Pyrolysis.
 - o Technologies that scored lower than a 3 in the evaluation criteria: N/A
 - (DECISION) Post-dewatering technologies that moved to the next round of evaluation: Thermal Drying: High Quality (Drum Dryer).
- Alternative Power Production Technologies
 - Technologies that failed the fatal filter: Fuel Cells and Wind Turbines.
 - Technologies that scored lower than a 3 in the evaluation criteria: Energy Storage (Batteries), Large Scale Solar Photovoltaics
 - (DECISION) Alternative power production technologies that moved to the next round of evaluation: Internal Combustion Engines (Status Quo), Internal Combustion Engines – with Gas Conditioning, Internal Combustion Engines – with Exhaust Treatment, Digester Upgrading – Pipeline Injection, Micro-Turbines, Biosolids Drying – Direct Use of Biogas, Large-Scale Solar Photovoltaics (PV), and Small Scale Rooftop PV.
- Waste Heat Technologies
 - Technologies that failed the fatal filter: Absorption and Adsorption Chillers, Organic Rankine Cycle, and Gasification of Biosolids.

- o Technologies that scored lower than a 3 in the evaluation criteria: N/A
- (DECISION) Waste heat technologies that moved to the next round of evaluation: Small-Scale Steam Turbines, and Thermo/THP.

Creation of End to End Alternatives

The BC team reviewed initial alternatives that were to be evaluated, as well as different power production alternatives. The power production alternatives included:

- Baseline: existing cogen and drying
- Baseline with gas conditioning
- Existing cogen with vehicle fuel (via pipeline injection or tube trailer)
- Existing cogen with microtubines
- Existing cogen with steam boiler/turbine
- New cogen permit, CO catalyst and selective catalytic reduction (SCR), with gas conditioning
- Vehicle fuel (primary use of digestive gas) with existing cogen
- ACTION: Adam to present a big picture view of the power production alternatives at the next workshop.

Grant Updates

BC provided an overview of different grant programs, and explained how the program would fit into the SWEET model. The programs included:

- Self-Generation Incentives Program
- Low Carbon Fuel Standard
- Renewable Fuel Standard
- Organics Grant Program
- Healthy Soils Program
- Green Project Reserve

Air Permitting Discussion

BC and EWA discussed the current efforts of the air permit modification. EWA is submitting a request for permit modification in one week. If successful, it would increase the permitted cogen capacity by \sim 20%.

Look Ahead & Wrap-Up

The meeting ended with a look ahead and reviewing pending action items.

- Workshop #3 will take place in mid-September, and the team will try to schedule the Waste Hauler Meeting on the same day.
- The team will present the following in Workshop #3:
 - Baseline SWEET model
 - o Conceptual layouts and details of alternatives for consensus and feedback
 - o Air permitting impacts on power production alternatives
 - o Grant updates
- WEFTEC is also taking place in early-October. Mike stated that it would be beneficial to walk the floor together with BC to look at potential technologies.
 - ACTION: BC to identify technologies that would be beneficial to visit at WEFTEC.

• ACTION: BC to check in with EWA to confirm is any support is needed related to the next board meeting on Oct 11.





Energy & Emissions Strategic Plan & Biosolids Management Plan Update



Workshop #2 – August 16, 2017 &

Encina Water Pollution Control Facility



Project Schedule

- Progress On Schedule
- Task 1 Energy Baseline Complete
- Other Tasks (except 7) are Under Way,
- Workshop #2 Today

 Task 1 Energy Base 	eline	Comp	lete						
 Other Tasks (exception) 	ot 7) a	re Un	der V	Vay					
 Workshop #2 Toda 	у								
 Task 1 Energy Base Other Tasks (exception) Workshop #2 Toda Q.EX Combined Project Schedule TASK 1 - Baseline Energy 				ent h					
Combined Project Schedule	JUL '17	AUG '17	SEP '17	OCT '17	NOV '17	DEC '17	JAN '18	FEB '18	MAR '18
TASK 1 - Baseline Energy			-	1000					8
TASK 2 - Biosolids Tech	ler-	_			L				
TASK 3 - Power Tech									-
TASK 4 - Biogas Tech									
TASK 5 - Waste Heat Tech					-				
TASK 6 - Air Emissions Evaluation		-		-	-			-	I
TASK 7 - Alternatives and Evaluation TASK 8 - Grants/Incentives		-		-		-			-
TASK 9 - Management/QC		-				-	1		
Workshops	W 1	◆ W2	🔶 W:	3		W 4	◆ W5	-	W6
	COLOR KEY	/:	Evaluation	Analyze	Report	Client R	leview	Final Repo	*

Agenda

- Administrative (20 min)
 - Status of data requests
 - Comments on waste hauler agenda
 - Discussion with Anaergia
- Review Mass Balance and Projected Flows and Loads (45 min)
- Review Fatal Flaw and Screening Criteria (30 min)
- Screen Technologies (1 hr)
- Discussion of Preliminary End to End Alternatives (30 minutes)
- Grants Update (10 min)
- Air Emissions Review (5 min)
- Wrap-Up/Review Action Items (10 min)

New Data Requests

- Trussell food waste capacity report
- O+M costs for the engines (have costs for electricity for the system, but not for gas treatment, upkeep, general maintenance, etc.)
- WAS daily flow data (back-calculated for mass balance)
- FOG TS and VS data (used assumptions from 2016 PMP for mass balance)
- Any air permitting summaries or progress between EWA and Don King

Outstanding Data Requests

- Cogen and solids systems drawings, engine cut sheets
- Dryer system drawings and cut sheets
- Recent air permitting efforts progress, memos, contact info
- Copies of current air permits (SDAPCD and Title V)
- Energy Management typical day operating procedure:
 - Cogen strategy
 - Peak period disconnect from utility
 - HSW storage and feed strategy

Waste Hauler Agenda

- Timing: September (coordinate with Workshop 3) nissions Strategic Plan & Nagement Plan Update
- Attendees:
 - EWA Scott, Jimmy
 - BC Adam, Ari
 - WM
 - Republic
 - EDCO
 - LES?
 - ids Mana Anaergia?
- Goals:
- and Caldwell Workshop #2 Provide background info to haulers about EWA's goals and BEE effort
 - Determine availability of pre-processed food waste, market demand for an EWA initiative to receive more material, tipping fee range for SWEET analysis
 - Gauge interest in a renewable CNG partnership
 - Discuss "next steps" such as letter of intent, future coordination

Other Outstanding Items

- Discussion with Anaergia
 - Omnivore as an alternative
 - plan & Orex or Biorex for food waste pre-processing
 - Just with Republy Just dried product? Status of food waste receiving project(s) with Republic
 - Capacity at Rialto facility for dried product? Riosolids N

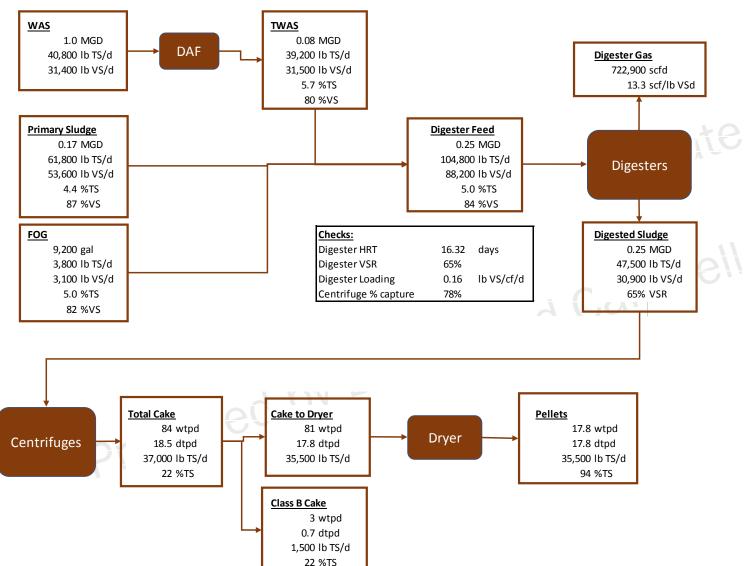


Review of Mass Balance and Projected Flows and Loads



Mass Balance

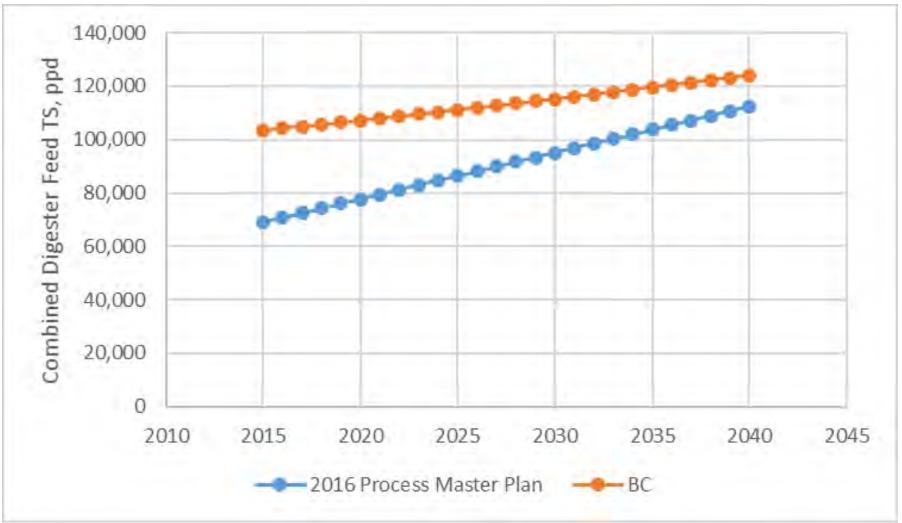




Mass Balance Assumptions

- TWAS flows that were zero and subsequent loads when TWAS flow was zero were excluded. Assumed percent capture rate for the DAFTs is 95%.
- TWAS flows were taken from DAFT totalizer data and digester feed meters.
- The digester feed flow from July 1, 2016 to June 2017 were subtracted daily to obtain a daily digester feed volume. This was based on the assumption that the flow values were cumulative from a meter reading starting 7/1/16.
- The Class B cake data were averaged with zero data to obtain an annualized daily average.
- FOG data were a daily average of the volumes received. This assumes FOG is fed 24/7/365. Assumes %TS and %VS are 5% and 82%, respectively.
- To calibrate the mass balance as shown, 2,300 lbs TS/d and 1,900 lbs VS/d were added to Primary Sludge.

Solids Mass Balance Comparison



Brown and Caldwel

Sludge Production Peaking Factors

	Max Month	Peak 2-Week	Peak Week	Peak Day
Primary Sludge	1.23	1.3	1.4	1.60
WAS	1.23	1.3	1.4	1.60
Combined Sludge	1.23	1.3	1.4	1.60

Notes:

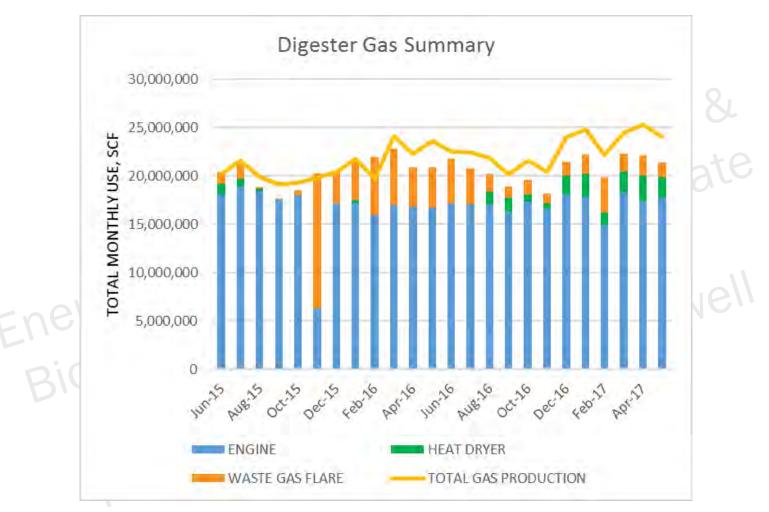
- us rkchon # Peaking factors for maximum month and peak day conditions are developed based • on 2016 PMP solids projections.
- Peaking factors for maximum 2-week and maximum week conditions are proposed ٠ based on historical data.

Power Loads and Gas Usage

• Power:

- Monthly production: 1,500 kW (2, 750 kW engines full output) - 80% of total electrical demand)
- Monthly import: 385 kW equivalent (1,390 MWh per year)
- Digester gas:
 - Average production: 1,645,000 therms per year Caldwell
 - Engines: 1,263,000 therms per year
 - Waste gas: 229,000 therms per year
 - Heat dryer: 57,000 therms per year
- Natural gas: 856,000 therms per year
 - Engines: 156,000 therms/year
 - Other plant use: 700,000 therms/year

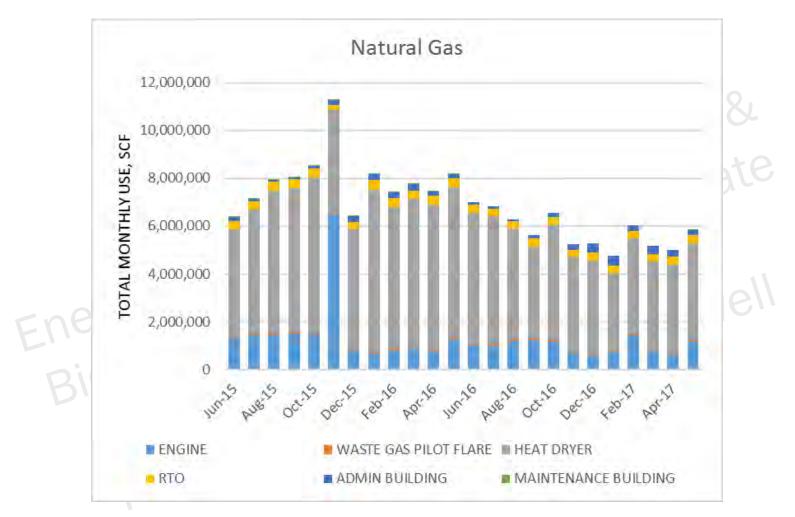
Digester Gas Usage Summary – Last 2 years



1) What happened November 2015? DG outage?

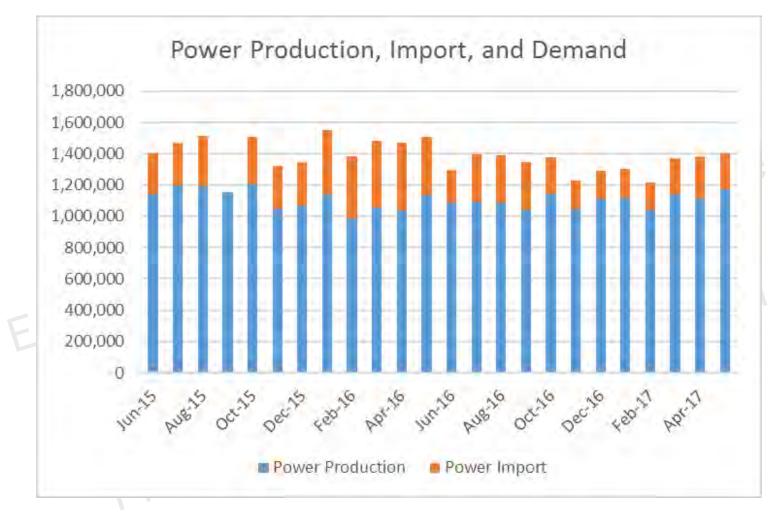
- 2) Divergence of "total gas production" from sum of other meters
- 3) When DG is sent to the heat dryer, what contributes to flaring?
- 4) Flared gas, over the course of the last year, represents 179 kW of "potential" power production

Natural Gas Usage Summary – Last 2 years



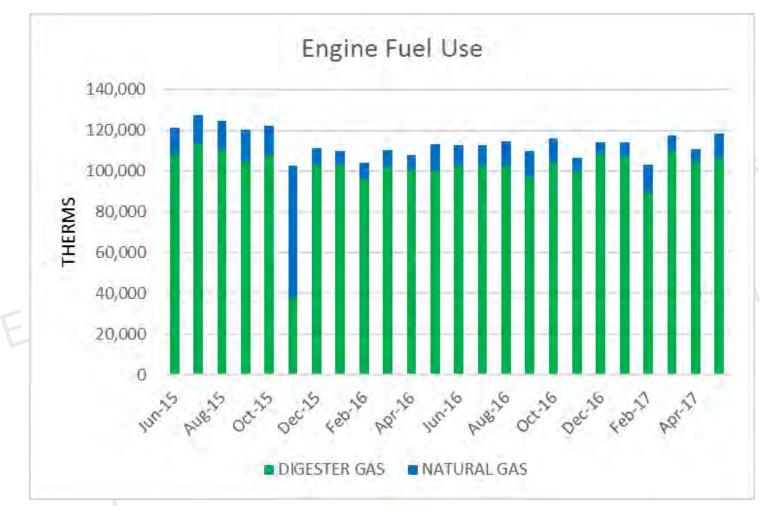
1) What is the NG control strategy to cogen? Why is there NG contribution to cogen in months where DG is being sent to dryer or flare?

Power Production and Import – Last 2 years



- 1) Consistently operating at 2-engine output
- 2) Operating a third engine at full output (if DG production increases and/or permit is modified) would result in power export

Engine Fuel Use – Last 2 years



- 1) Consistent operation
- 2) What is NG blending strategy?



Screening of Technologies



Fatal Flaw Filter

- Applied uniformly across all technologies
- Four criteria:
 - At least one successful North American installation of technology
 - At least one successful installation in a facility of similar size
 - Available space
 - Compatibility with plant size and any existing equipment
 Bio
 Bio

Evaluation Criteria

Criterion	Criterion Description	Scoring Description
End Use Market Compatibility	 Onsite technology directly produces one of the recommended product alternatives. Alternately, onsite technology product is compatible with product alternatives. 	 Low score indicates technology product that has not been identified as part of the product list nor compatible with the product list. High score indicates technology product that is compatible with Class B cake, Class A cake, Class A THP cake, and dried Class A pellet.
Proven Technology Performance	 Proven and reliable technology with same configuration intended at Encina. Long successful operating track record. 	 Low score indicates no successful large scale operating installations in North America or Europe, no successful demonstration scale installations in North America or Europe, and unknown safety or reliability record. High score indicates more than one successful operating installation in North America or Europe, more than one operating installation at a WWTP of at least 40 mgd in North America or Europe, track record duration > 5 years, and vendors in Western USA.
Minimize Life Cycle Costs	 Qualitative metric of program cost. Capital and O&M costs based on existing Encina data or similar experience at other WWTPs. Potential revenues from sales. Product/market geographic proximity. 	 Low score indicates high capital cost to build onsite facilities, high 0&M costs, expensive end use market, and high transportation costs. High score indicates low capital cost to build onsite facilities, low 0&M costs, potential product revenue, and product destination within 100 miles.

Evaluation Criteria (cont.)

Criterion	Criterion Description	Scoring Description
Energy/Resource Recovery	 Increases biogas production through advanced digestion. Supports co-digestion of organic waste. Recovery of renewable energy. Beneficial use of biosolids product. 	 Low score indicates high energy requirement for onsite technology, no increase in biogas production, technology does not recover energy as biogas, no recovery of renewable energy in biosolids, and no biosolids resource recovery. High score indicates a higher biogas production, compatible with co-digestion of organic waste, and biosolids resource recovery.
O&M Impacts	 levels. Complexity of new technology O&M and control systems. Reliability of new technology (potential downtime). 	 Low score indicates more O&M time required, complex mechanical and control systems required compared with existing plant facilities, potential equipment downtime, and new chemicals or hazards. High score indicates reduction in O&M staff time required, new technology is simple to operate and maintain, reliable with minimal downtime, and no new chemicals or hazards.
	Minimal impacts to plant safety.	

Evaluation Criteria (cont.)

Criterion	Criterion Description	Scoring Description
Environmental Impacts	 Impacts to carbon footprint and air permitting. 	 Low score indicates high carbon footprint for technology, high travel distance to end use, difficult to treat side-streams or impacts to GWRS, and new permitting for environmental regulatory requirements. High score indicates low carbon footprint for technology, low travel distance to end use, minimal side-stream generation or impacts, no additional permitting for environmental regulatory requirements.
Community & Stakeholder Impacts	 Minimize nuisance impacts such as dust, odors, vectors, aesthetics, noise and traffic. Assess impacts to partner agency issues/values as well as local planning codes and requirements. 	 Low score indicates nuisance factors for onsite technology are difficult to mitigate. High score indicates nuisance factors can be mitigated at plant site.
Project Site Compatibility	 Assess compatibility of technology with available plant footprint. Incorporation into existing treatment process. Ability to accept co-digestion substrates. 	 Low score indicates lack of site space for new facilities, requires abandonment of existing facilities, and difficult integration with existing plant. High score indicates available footprint for new facilities and maintains space for future facilities, easy of integration with existing processes and facilities.

Evaluation Criteria Weighting

Criterion	Weight Stabilization	Weight Dewatering	Weight Biogas Use and Waste Heat
End Use Market Compatibility	15%	15%	NA
Proven Technology Performance	15%	25%	20%
Minimize Life Cycle Costs	10%	20%	10%
Energy/Resource Recovery	20%	NA	25%
O&M Impacts	10%	15%	10%
Environmental Impacts	10%	5%	15%
Community & Stakeholder Impacts	10%	5%	10%
Project Site Compatibility	10%	15%	10%

Thickening Technologies

- Primary Clarifier (Existing)

- Rotary Drum Thickener (RDT)
 Recommendation from prior planet status quo Brown and Calower Prepared by Brown evaluate RDTs compared to status quo

Starting with the End in Mind – Market Compatibility

- Class B Cake Land application (Arizona) or contract composting
- Class A Cake Land application in CA and AZ (soil blending and land reclamation possible)
- Class A THP Cake Land application and soil blending (land reclamation possible)
- Class A granules (high quality) Land application, horticulture, fertilizer blending, soil blending (land reclamation possible)
- Class A granules (low quality) Land application (land reclamation possible)
- Class A Lystegro Land application

Options to produce end-use product alternatives

Product Alternatives	Technology Options
Class B Cake	Class B digestion
Class A Cake	Class A digestion (thermophilic or TPAD)
Class A THP Cake	THP/digestion
Class A Dried Granule (high quality)	Class A or B digestion + two dryer trains
Class A Dried Granule (low quality)	Class A or B digestion + maximize existing dryer
Class A Lystegro	Class A or B digestion + Lystek
Class A Lystegro Prepared by Bro	

Stabilization Technologies

- Mesophilic Digestion

- Brown and Caldwell

 - Chemical Hydrolysis
 - Lystek
 - Thermal Hydrolysis Process (THP) Traditional CAMBI
 - THP Digestion-Lysis-Digestion (DLD)
 - THP Solid Stream CAMBI

Stabilization Technologies – Fatal Flaw

	Technology Maturity	Successful Operation of Comparable Size	Available Space	Compatibility
Mesophilic Digestion	Pass	Pass	Pass	Pass
Mesophilic with High Solids	Pass	Pass	Pass	Pass
Staged Digestion	Pass	Pass	Fail	Pass
Acid/Gas Phased Digestion	Pass	Pass	Fail	Pass
Thermophilic Digestion	Pass	Pass	Pass	Pass
Temperature Phased Anaerobic Digestion	Pass	Pass	Fail	Pass
Enzymatic Hydrolysis	Fail	Fail	Pass	Pass
Chemical Hydrolysis	Pass	Fail	Pass	Pass
Lystek	Pass	Pass	Pass	Pass
Traditional CAMBI	Pass	Pass	Pass	Pass
THP - DLD	Fail	Fail	Fail	Pass
Solid Stream CAMBI	Fail	Fail	Pass	Pass

Stabilization Technologies - Screening

	Mesophilic Digestion	Mesophilic Digestion with High Solids	Thermophilic Digestion	Lystek	Traditional CAMBI
End Use Market Compatibility	3	3	3	2	5
Proven Technology Performance	5	2	5	2	4
Minimize Life Cycle Costs	3	3	4	2	2
Energy/Resource Recovery	3	4	5	3	4
O&M Impacts	4	3	4	3	3
Environmental Impacts	4	4	4	3	4
Community & Stakeholder Impacts	4	4	4	2	4
Project Site Compatibility	5	3	5	3	2
Weighted Score	3.80	3.25	4.30	2.50	3.65

Dewatering Technologies

- Centrifuge

- volute press Bucher press
 - Prepared by Brown and Caldwell

Dewatering Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility	
Centrifuges	Pass	Pass	Pass	Pass	
Belt Press	Pass	Pass	Pass	Pass	
Screw Press	Pass	Pass	Pass	Pass	
Rotary Press	Pass	Pass	Pass	Pass	
Volute Press	Pass	Pass	Pass	Pass	
Bucher Press	Fail	Fail	Pass	Pass	
Volute PressPassPassPassBucher PressFailPassPass					

Dewatering Technologies - Screening

	Centrifuges	Belt Press	Screw Press	Rotary Press	Volute Press
End Use Market Compatibility	3	5	4	3	3
Proven Technology Performance	5	5	3	2	2
Minimize Life Cycle Costs	4	4	3	3	3
0&M Impacts	5	5	2	2	2
Environmental Impacts	3	2	3	3	3
Community & Stakeholder Impacts	4	4	4	4	4
Project Site Compatibility	5	4	2	3	3
Weighted Score	4.35	4.45	2.90	2.65	2.65
Prepared by prepared by					

Post-Dewatering Technologies

- Thermal drying high quality granules
- Thermal drying low quality granules (indirect dryer) nt Plan Update

- Junyons
 Partial solar drying
 Deep well injection
 Dehydration
 Incineration Julon Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell

 - Incineration

Post-Dewatering Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility
Thermal Drying: Low Quality (Indirect Dryer)	Pass	Pass	Pass	Fail
Thermal Drying: High Quality (Drum Dryer)	Pass	Pass	Pass	Pass
Gasification	Fail	Fail	Pass	Pass
Pyrolysis	Fail	Fail	Pass	Pass
	ids Main Wo epared b		Pass Pass	

Alternative Power Production Technologies

- Internal Combustion Engines
- Digester gas upgrading
 - For pipeline injection
 - For vehicle fueling (CNG)
- Microturbines
- Biosolids Drying direct use of biogas and Caldwell
- Energy Storage (Batteries)
- Fuel Cells
- Large Scale Solar Photovoltaics (PV)
- Small Scale/Rooftop Solar Photovoltaics
- Wind Turbines
- Direct sale to adjacent power plant

Alternative Power Production – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility
Internal Combustion Engines	Pass	Pass	Pass	Pass
Digester Upgrading: Pipeline Injection	Pass	Pass	Pass	Pass
Digester Upgrading: Vehicle Fueling (CNG)	Pass	Pass	Pass	Pass
Microturbines	Pass	Pass	Pass	Pass
Biosolids Drying - Direct Use Of Biogas	Pass	Pass	Pass	Pass
Energy Storage	Pass	Pass	Pass	Pass
Fuel Cells	Fail	Fail	Pass	Pass
Large Scale Solar Photovoltaics	Pass	Pass	Pass	Pass
Small Scale/Rooftop Solar Photovoltaics	Pass	Pass	Pass	Pass
Wind Turbines	Pass	Pass	Fail	Fail

Alternative Power Production – Screening

	Internal Combustio n Engines - Status Quo	Engines - With Gas	Engines - With Exhaust	Digester Upgrading: Pipeline Injection	Digester Upgrading: Vehicle Fueling (CNG)	Micro- turbines	Biosolids Drying - Direct Use Of Biogas	Energy Storage (Batteries)	Small Scale Rooftop PV	Large Scale Photovoltaics
Proven Technology Performance	5	5	4	2	3	4	5	3	5	5
Minimize Life Cycle Costs	3	3	4	4	4	3	3	3	4	4
Energy/Resourc e Recovery	4	4	5	4	4	4	2	1	5	5
O&M Impacts	3	4	3	4	4	4	3	4	5	5
Environmental Impacts	3	3	4	5	5	5	3	3	5	4
Community & Stakeholder Impacts	4	4	5	5	5	4	3	3	5	5
Project Site Compatibility	5	5	4	4	4	4	5	3	2	2
Weighted Score	3.95	4.05	4.25	3.85	4.05	4.05	3.35	2.60	4.60	4.45

Waste Heat Technologies

- Small Scale Steam Turbines
- Absorption and Adsorption Chillers
 Organic Rankine Cycle (ORC)
 Gasification of Biosolids
- Workshop #2 Workshop #2 Prepared by Brown and Caldwell
- Biosolids

Waste Heat Technologies – Fatal Flaw

	Technology Maturity	Successful Operation	Available Space	Compatibility			
Small Scale Steam Turbines	Pass	Pass	Pass	Pass			
Use For Thermo/THP	Pass	Pass	Pass	Pass			
Absorption And Adsorption Chillers	Pass	Pass	Pass	Fail			
Organic Rankine Cycle	Fail	Fail	Pass	Pass			
Gasification Of Biosolids	Fail	Fail	Pass	Pass			
Gasification Of BiosolidsFailPass							

Waste Heat Technologies – Screening

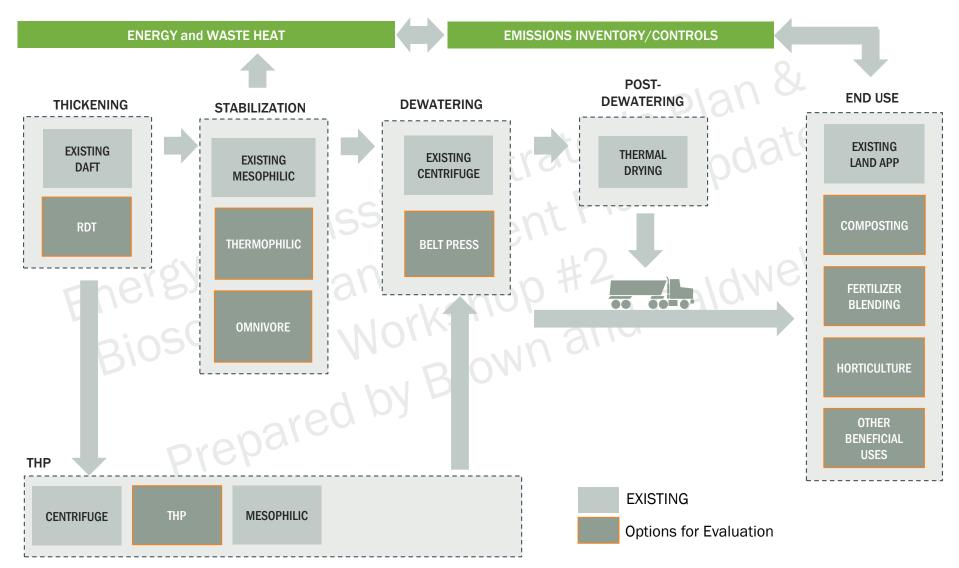
	Small-Scale Steam Turbines	Thermo/THP	
Proven Technology Performance	2	5	
Minimize Life Cycle Costs	3	5	
Energy/Resource Recovery	4	4	
O&M Impacts	3	3	
Environmental Impacts	3	4	
Community & Stakeholder Impacts	3	4	
Project Site Compatibility	3	4	
Weighted Score	3.05	4.2	
Weighted Score Prepare			



Creation of End to End Alternatives



Evaluating Technologies and Markets Together



Brown and Caldwel

Initial Alternatives

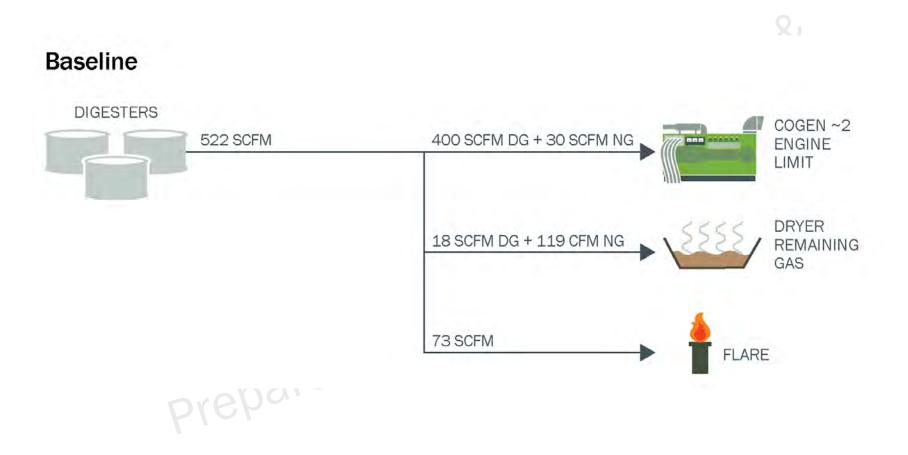
- Meso plus second dryer
- Meso plus Class B hauling
- Thermophilic
 - Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell With and without second dryer
- Cambi (traditional)
 - With and without second dryer

- Additional Layers
 - Thickening
 - Dewatering
 - Energy alternatives
 - End use markets

Alternatives: Power Production

- Baseline: Existing cogen + drying
- Baseline + gas conditioning
 - Gas conditioning serves to reduce O&M costs associated with engines and dryer
- Existing cogen + vehicle fuel (via pipeline injection or tube trailer)
 - No permit modification to cogen / no DG to dryer
 - Continue to operate two engines
 - Additional gas routed to vehicle fuel
- Existing cogen + microturbines
 - Includes gas conditioning
 - No permit modification to cogen / no DG to dryer
- Existing cogen + steam boiler/turbine
 - No permit modification to cogen / no DG to dryer
 - Additional gas routed to steam boiler; steam used in small turbine
- New cogen permit, CO catalyst and SCR, gas conditioning
 - Need to consider plant demand as a limit on power production
- Vehicle Fuel (primary use of DG) + existing cogen (natural gas + tail gas)
 - "All in" on vehicle fuel

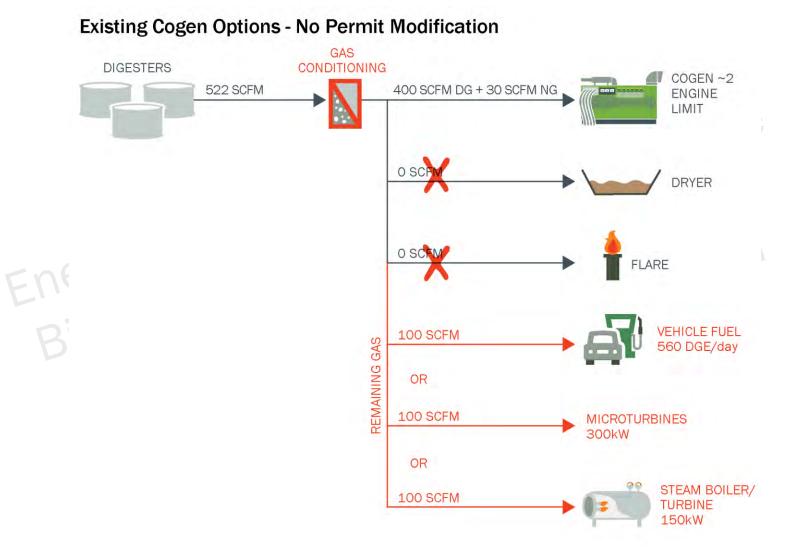
Baseline includes cogeneration (permit limited), dryer and some flaring



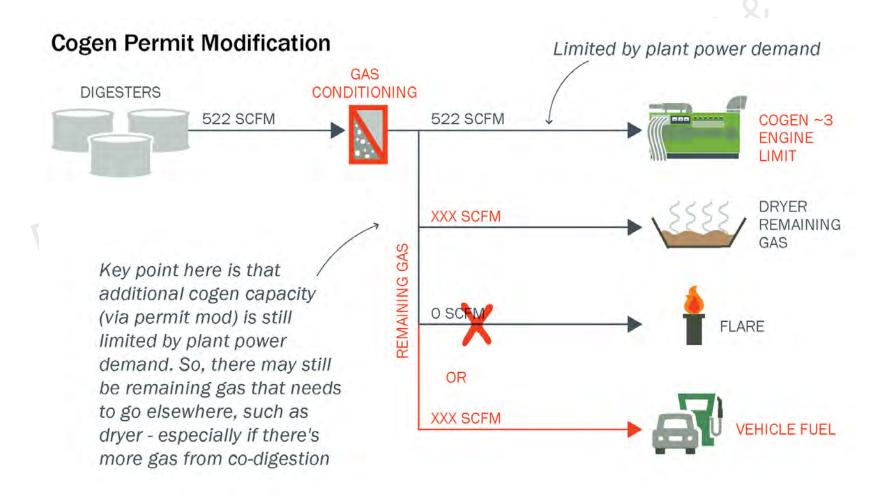
Gas conditioning could reduce engine and dryer O&M costs associated with siloxanes

Baseline with Gas Conditioning GAS DIGESTERS CONDITIONING COGEN~2 522 SCFM 400 SCFM DG + 30 SCFM NG 000 -ENGINE LIMIT DRYER 18 SCFM DG + 119 CFM NG REMAINING GAS 73 SCFM FLARE

With the existing permit in place, where else can we send digester gas to get highest value?

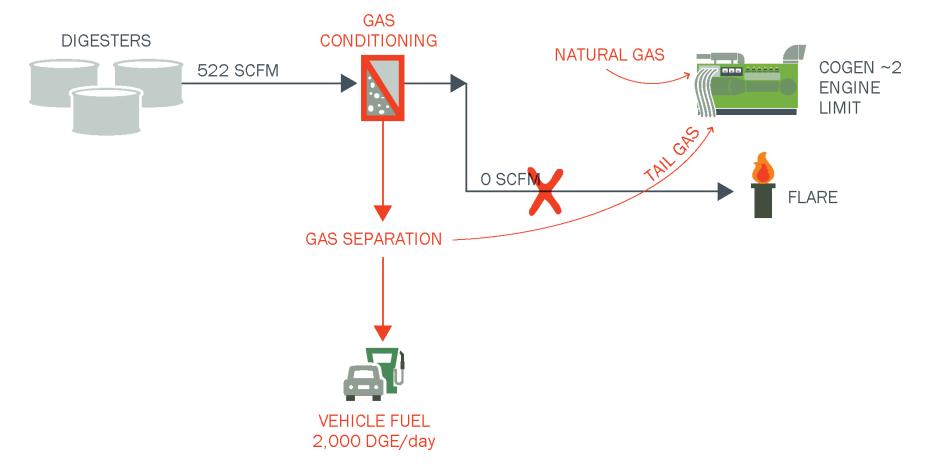


A permit modification allows EWA to meet plant electricity demand, but any additional gas would need to go to a non-generating use



An all-vehicle-fuel option may deliver the best economics

Vehicle Fuel



Alternatives to be presented at next workshop

- Process schematic
- sprint Potential locations solons for plan agend to the plan

 - Workshop #2 Workshop and Caldwell Prepared by Brown and Caldwell



Grant Updates



Self Generation Incentive Program

Program	Self-Generation Incentive Program (SGIP)
Agency	California Energy Commission / administered by SDG&E
Eligible Projects	Self-generation projects such as new engines, microturbines, or steam turbines – increased incentives for renewable/biogas projects; Energy storage / batteries
Funding	Incentives based on anticipated power output – based on fuel availability, not nameplate capacity; 50% paid upfront / 50% paid over 5 years based on performance
Schedule	Funding available each year / first-come, first-served Battery funding decreases as tiers fill up Projects must be operational within 18 months of award
How much are we talking?	~\$500k - \$1M depending on project size
Recommendation for SWEET Analysis	Don't count on funding to justify project economics
Next steps	Continue to track / pursue if selected alternatives meet criteria

Low-Carbon Fuel Standard

Program	Low-Carbon Fuel Standard (LCFS)
Agency	California Air Resources Board
Eligible Projects	Part of AB 32 scoping plan – projects that reduce the carbon intensity of California's vehicle fuel – i.e. renewable compressed natural gas (CNG vehicle fuel)
Funding	Incentives based on fuel production, market-based values; Paid on a per-gallon basis as the project performs
Schedule	Ongoing program, recently extended through 2030
How much are we talking?	Varies could equate to ~\$0.50/DGE - \$1.00/DGE depending on market factors
Recommendation for SWEET Analysis	Include in SWEET analysis for vehicle fuel projects; Assume funding only through 2030, use conservative values
Next steps	Continue to track / pursue if vehicle fuel is recommended

Renewable Fuel Standard

Program	Renewable Fuel Standard
Agency	US Environmental Protection Agency
Eligible Projects	Renewable fuel projects - i.e. renewable compressed natural gas (CNG vehicle fuel)
Funding	Incentives based on fuel production, market-based values; Paid on a per-gallon basis as the project performs
Schedule	Ongoing program, not guaranteed beyond 2022
How much are we talking?	A lot of uncertainty: Wastewater digester gas is eligible for highest value of RINs – D3 EPA has recently stated that DG from food waste is a lower value – D5 EPA has the ability to set RIN quotas, which drive supply-and-demand, market-based pricing
Recommendation for SWEET Analysis	Include in SWEET analysis for vehicle fuel projects; Assume funding only through 2022, use conservative values
Next steps	Continue to track / pursue if vehicle fuel is recommended

Organics Grant Program

Program	Organics Grant Program
Agency	Department of Resource Recovery and Recycling (CalRecycle)
Eligible Projects	Projects that serve to divert organics (food waste) from landfill – toward anaerobic digestion or composting; recently issued with a food rescue requirement
Funding	Incentives based on project size and potential tons diverted
Schedule	Recently awarded, not expected to reissue for ~18 months
How much are we talking?	Up to \$4M per project
Recommendation for SWEET Analysis	Do not include – too competitive to count on
Next steps	Continue to track / pursue if food waste receiving is recommended

Organics Grant Program - Recent Award

Recommendation:

Staff recommends approval of 10 grant awards, as listed in Table 1 below, for \$24,000,000.

Applicant	County	Total Award
Anaerobic Digestion Projects		
County Sanitation Districts of Los Angeles County	Los Angeles	\$4,000,000
HZIU Kompogas SLO, Inc.	San Luis Obispo	\$4,000,000
Rialto Bioenergy Facility, LLC	San Bernardino	\$4,000,000
	Subtotal	\$12,000,000
Compost Projects		
City of San Diego	San Diego	\$3,000,000
Mid Valley Recycling, LLC	Fresno	\$1,875,000
Salinas Valley Solid Waste Authority	Monterey	\$1,341,865
Recology Yuba-Sutter (partially funded)	Yuba	\$2,783,135
	Subtotal	\$9,000,000
Rural Compost Projects		
Napa Recycling & Waste Services, LLC	Napa	\$541,700
South Lake Refuse Company, LLC	Lake	\$1,218,026
West Coast Waste (partially funded)	Madera	\$1,240,274
	Subtotal	\$3,000,000
	Grand Total	\$24,000,000

Table 1. Organics Grant Program Recommended Award – List A

Organics Grant Program - Recent Award

Applicant	County	Total Award Requested*
Anaerobic	Digestion Projects	
CR&R Incorporated	Riverside	\$4,000,000
Contra Costa Waste Services	Contra Costa	\$4,000,000
City of Manteca	San Joaquin	\$1,500,000
Santa Barbara County	Santa Barbara	\$4,000,000
Subtotal		\$13,500,000
Com	oost Projects	
Recology Yuba-Sutter (partially funded)	Yuba	\$216,865
Agromin OC, LLC	San Bernardino	\$600,000
Waste Management of Alameda County,	nc. Alameda	\$3,000,000
GreenWaste Recovery, Inc.	Santa Clara	\$1,700,000
Burrtec Waste Industries, Inc.	Riverside	\$3,000,000
Arakelian Enterprises Inc. DBA Athens Services	San Bernardino	\$3,000,000
Best Way Disposal Company, Inc. DBA Advance Disposal Co.	San Bernardino	\$2,481,250
Kern County	Kern	\$3,000,000
City of Oceanside	San Diego	\$1,178,351
Subtotal		\$18,176,466
Rural Co	ompost Projects	
West Coast Waste (partially funded)	Madera	\$161,326
Upper Valley Disposal Service	Napa	\$1,250,000
Subtotal		\$1,411,326
	Grand Total	\$33,087,792

Table 2. Organics Grant Program Recommended Award - List B

Heathy Soils Program

Program	Healthy Soils Program
Agency	California Department of Food and Agriculture
Eligible Projects	Demonstration projects that sequester carbon and reduce GHG emissions – groups within CASA
Funding	Incentives based on project size and potential GHG benefit
Schedule	Currently accepting applications through September 19 Annual funding program (AB 32 funds), amounts and criteria may vary
How much are we talking?	Up to \$3.75M total
Recommendation for SWEET Analysis	Do not include / ancillary benefit to support end use program
Next steps	Continue to track / connect with CASA Science and Research Group for potential partnerships

Green Project Reserve

Program	Green Project Reserve
Agency	California Water Resources Control Board
Eligible Projects	Projects that improve energy efficiency, renewable energy generation, or recycled water production
Funding	A component of Clean Water State Revolving Funding; Green Project Reserve is a "loan forgiveness" program CWSRF is generally oversubscribed, but GPR is underutilized
Schedule	Ongoing
How much are we talking?	Up to \$4M per project, or 50% of project value, whichever is higher
Recommendation for SWEET Analysis	Do not include
Next steps	Something for EWA to keep in mind – if a larger capital project requires funding, consider CWSRF and adding an eligible GPR component



Air Permitting Discussion



EWA is actively pursuing air permit modification

- EWA (with Don King) will submit a request for permit modification within ~1 week
- Goal is to adjust the CO emission rate from 530 ppm to ~400 ppm, and thereby adjust the fuel input limit aimed at keeping CO emissions below Title V synthetic minor threshold
- If successful, this effort would increase permitted cogen capacity by ~20%
- This increase would allow EWA to meet plant electricity demand with current digester gas flows and cogen system



Look Ahead & Wrap-Up



Project Schedule

- Workshop #3 in mid-September
- Draft Analysis and Reports to Begin

Combined Project Schedule	JUL '17	AUG '17	SEP '17	OCT '17	NOV '17	DEC '17	JAN '18	FEB '18	MAR '18
TASK 1 - Baseline Energy									
TASK 2 - Biosolids Tech									
TASK 3 - Power Tech									
TASK 4 - Biogas Tech									
TASK 5 - Waste Heat Tech									1
TASK 6 - Air Emissions Evaluation									1
TASK 7 - Alternatives and Evaluation									
TASK 8 - Grants/Incentives									
TASK 9 - Management/QC									
Workshops	◆W1	🔶 W2	🔶 W3	3		◆ W4	♦ W5	1	W6
	COLOR KEY	Y:	Evaluation	Analyz	e/Report	Client R	leview	Final Repo	*

Look Ahead – September Workshop

- Consensus on mass balance/baseline
- Conceptual layouts/details of alternatives for consensus/feedback (example numbers to support including biogas production, food waste that can be imported)
- Air permitting impacts on power production alternatives
- Informational meeting with waste haulers
- Debrief on Anaergia meeting
- Grants update

Wrap-Up

QUESTIONS?



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Brown AND Caldwell

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Technical Memorandum

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FINAL

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- Prepared for: Encina Wastewater Authority
- Project Title: Biosolids, Energy and Emissions
- Project No.: 150871.006

Technical Memorandum No. 6

- Subject: Air Emissions
- Date: February 13, 2018
- To: Scott McClelland, Assistant General Manager
- From: Scott Lacy, Project Manager



Prepared by:

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Limitations:

This document was prepared solely for Encina Wastewater Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between Encina Wastewater Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by Encina Wastewater Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Encina Wastewater Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List of Figures	. iii
List of Tables	. iii
Executive Summary	. 1
Section 1: Introduction 1.1 Existing SDAPCD Permit 1.2 Synthetic Minor Facility	. 2
 Section 2: Future Alternatives	. 4 . 6 . 6 . 7 . 8
Section 3: Future Regulations	
3.1 California Assembly Bill 617 3.2 SCR for All Digester Gas Fueled IC Engines	. 8
Section 4: Greenhouse Gas Inventory	. 9
4.1 Introduction to GHG Scope Emission Categories	
 4.2 Current Baseline GHG Emissions	
References1	13
Attachment A: Revised Air Permit	-1



ii

List of Figures

Figure 2-1. A post-combustion exhaust treatment system, including an oxidation catalyst, urea dosing, ar an SCR unit	
Figure 2-2. Flue gas recirculation in a natural gas boiler	7
Figure 2-1. Scope 1, 2 and 3 emission categories that contribute to a typical GHG Inventory. Only Scopes and 2 are included in this TM.	
Figure 3-2. Fraction of Scope 1 GHG emissions estimates from each source	11
Figure 3-3. Fraction of GHG Emissions from biomass fueled combustion devices	12

List of Tables

Table 1-1. Previous and Existing Air Permit Requirements for the IC Engines	2
Table 1-2. Title V Major Source Emissions Thresholds	3
Table 2-1. Relevant Federal Emissions Regulations for IC Engines	5
Table 2-2. Relevant Federal Regulations for Boilers	7
Table 3-1. Scope 1 GHG Emissions Estimates	11
Table 3-2. Biogas Combustion Biogenic GHG Emissions	12



Executive Summary

The Encina Water Pollution Control Facility (EWPCF) currently has four 750-kilowatt (kW) internal combustion (IC) engines, a biosolids dryer, a waste gas flare, and a wet scrubber and regenerative thermal oxidizer. Operation of and air emissions from these technologies are currently regulated by the San Diego Air Pollution Control District. Changes to biosolids processing, energy production and utilization, and waste heat recovery that are covered in Technical Memoranda (TMs) 2, 3, 4, and 5 may require modifications to the existing air permits or new air permits. Specific regulatory requirements for alternatives that produce emissions and pass fatal-flaw filters in TMs 2, 3, 4, and 5 are discussed in this TM 6. Alternatives that may require permitting changes include:

- Changes to thermal drying operation
- Changes to internal combustion engine operation
- Addition of microturbines for power generation
- Addition of boilers to provide steam for a Cambi™ thermal hydrolysis process
- · Changes to odor control equipment associated with new odor sources
- Addition of digester gas conditioning
- Addition of digester gas upgrading for pipeline injection or vehicle fuel
- Addition of digester gas storage

New regulations and regulatory trends that may impact future air permitting for EWPCF were also assessed as part of this TM.

Last, a greenhouse gas (GHG) inventory was performed for the existing gas utilization technologies, including the engines, thermal biosolids dryer, RTO, and flare. Potential GHG reductions associated with future energy production alternatives are included in the discussion of the GHG inventory.

Section 1: Introduction

EWA has undertaken a Biosolids Energy and Emissions Plan (BEE Plan) which will be used to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan. The BEE Plan has several goals:

- 1. Provide a comprehensive analysis of all project elements including biosolids treatment, gas use, energy generation, and waste heat;
- 2. Address capacity limitations in the solids handling process at the EWPCF;
- 3. Assess which alternative is likely to be the most cost effective and sustainable solution for EWA;
- 4. Move the EWPCF toward greater energy independence; and
- 5. Reduce greenhouse gas emissions.

The purpose of TM 6 is to review permit requirements related to air emissions associated with the cogeneration operation. This TM explores opportunities to remove the air permit constraints to optimize the use of the existing IC engines, presents pathways to meet Best Available Control Technology (BACT) and other air emission requirements for potential alternatives in TMs 3, 4 and 5, and presents the greenhouse gas inventory (GHG) for the existing operation that future alternatives can be measured against.



1.1 Existing SDAPCD Permit

The EWPCF is regulated under the San Diego County Air Pollution Control District (SDAPCD). SDAPCD permits establish operating limits based on maximum estimated emissions levels that must be confirmed by regular source testing. Regulated processes at the plant include stationary sources and abatement devices. Emissions requirements differ between stationary sources and abatement devices. Major stationary sources at the plant are:

- One Andritz DDS40 biosolids dryer
- Four Caterpillar G3516 750-kW lean-burn internal combustion (IC) engines

Abatement devices at the plant are:

- One Varec Biogas 244 Series enclosed flare
- One wet scrubber and one CECO Systems regenerative thermal oxidizer (RTO), which are coupled with the biosolids dryer

The air permits for the four IC engines limit fuel consumption and emission of criteria air pollutants. EWA pursued air permit modifications for the IC engines to increase the permitted fuel consumption. An updated IC engine air permit was received on November 8, 2017 (Attachment A). Fuel consumption and emission limits for the IC engines from the previous permit and the new permit are summarized in Table 1-1. The IC engine air permits also delineate source testing, maintenance, record-keeping, and site accessibility requirements.

Table 1-1. Previous and Existing Air Permit Requirements for the IC Engines					
Requirement	Previous Permit Limit	New Permit Limit	Units		
Nitrogen oxides (NO _x) emissions limit, digester gas	47	47	Parts per million by volume (ppmv)		
NO _x emissions limit, natural gas	54	54	ppmv		
Carbon monoxide (CO) emissions limit, digester gas	569	400	ppmv		
CO emissions limit, natural gas	390	390	ppmv		
Annual fuel consumption, total	224,000,000	280,000,000	Standard cubic feet (scf)		
Annual fuel consumption, natural gas	22,400,000	28,000,000	scf		
Daily fuel consumption, digester gas	1,000,000	1,000,000	scf		
Daily fuel consumption, natural gas	550,000	550,000	scf		

Note: Fuel consumption limits include all four engines.

No modifications to the air permits for the biosolids dryer, flare, and wet scrubber and RTO have been requested, but EWA may need to pursue an updated flare permit to meet projected digester gas production. The potential for a new flare permit is discussed further in Section 2.5. The current flare permit allows digester gas usage of 300 million scf/year, which equates to approximately 570 scf/minute. Flare operation, maintenance, and monitoring requirements are also defined in the permit.



1.2 Synthetic Minor Facility

EWPCF currently operates as a Synthetic Minor Facility, meaning the facility's stationary emissions sources have the potential to exceed at least one of the Title V Major Source thresholds. For reference, the Major Source thresholds are provided in Table 1-2. Stationary emission sources at EWPCF are operated to keep the facility within the Synthetic Minor Facility confines. Historically, CO has been the limiting air pollutant (i.e. CO emissions have been closest to the applicable Major Source threshold). IC engine operation produces most of the CO emissions.

Table 1-2. Title V Major Source Emissions Thresholds				
Pollutant	Emissions Threshold (tons/year)			
Volatile organic compounds (VOCs)	100			
Inhalable particulates (PM10)	100			
Sulfur dioxide (SO ₂)	100			
NO _x	100			
CO	100			
Ozone depleting compounds	100			
Lead compounds	10			
Single Hazardous Air Pollutant	10			
Combination of Hazardous Air Pollutants	25			

Section 2: Future Alternatives

All alternatives that involve future modifications or additions of equipment that may produce air emissions must be compliant with current SDAPCD, California Air Resources Board (CARB), and federal regulations.

First, considerations for EWPCF's Synthetic Minor status must be made when evaluating alternatives. Some alternatives, such as expanding IC engine operation or adding a second biosolids dryer, may cause annual emissions of one or more regulated pollutants to exceed the respective Major Source threshold. Because CO emissions at EWPCF have historically been close to this limit, additional CO emissions from future alternatives and CO emissions controls must be weighed when evaluating these alternatives. Exceeding any Major Source threshold would change EWPCF's status from a Synthetic Minor facility to a Title Major Source Facility. Obtaining a Title V permit involves significant costs and reporting requirements, and EWA has expressed a desire to maintain EWPCF's Synthetic Minor Source status.

Under SDAPCD rules, BACT must be applied to "any new, modified, relocated, or replacement emission unit which is required to obtain an Authority to Construct and/or Permit to Operate pursuant to Rule 10, which will result in an increased potential to emit, and which has a post-project potential to emit 10 or more pounds per day of the pollutant being increased" (SDAPCD, 2011). BACT is determined on a pollutant by pollutant basis, and pollutants included in this rule are inhalable particulates (PM₁₀), NO_x, volatile organic compounds (VOCs), and sulfur oxides (SO_x). In addition to the BACT determinations presented in the SDACPD BACT Guidance Document, BACT determinations from CARB and the federal Environmental Protection Agency (EPA) may be applied at the discretion of SDAPCD. It is important to note that BACT is a continuously



changing standard, and BACT determinations presented in this document may not be considered BACT when a new or modified permit is pursued.

Relevant federal regulations include the New Source Performances Standards (40 CFR Part 60) and the National Emission Standards for Hazardous Air Pollutants (40 CFR Part 63). While BACT only applies at the time of permitting, performance standards are always applicable. These standards are specified for different types of equipment, and specific applicable emissions restrictions are presented in the following subsections.

When evaluating alternatives presented in TMs 3, 4, and 5, compliance with BACT and any other relevant air pollution regulations has been included in the analyses. Compliance with these air regulations will be considered in all future analyses, as well. Specific BACT and regulatory requirements for alternatives that produce emissions and pass fatal-flaw filters in TMs 3, 4, and 5 are discussed in this section.

2.1 Biosolids Drying – Thermal Dryer

EWPCF has one existing Andritz DDS40 biosolids dryer that is fueled by a mix of digester gas and natural gas. The fuel mixture is approximately 80 percent natural gas and 20 percent digester gas, and approximately 9 MMBtu/hr of fuel is consumed. The current fuel consumption was calculated assuming the dryer opperates 11 days every two weeks. The dryer is capable of utilizing a fuel mix with up to 80 percent digester gas; however, this fuel mixture has not been tested. Exhaust from the dryer furnace is treated by a wet scrubber and a RTO that is fueled by natural gas.

As discussed in TM 2, drying capacity may be increased. A second biosolids dryer may be installed, which will require a new air permit application. Additionally, the digester gas composition of the dryer fuel may be increased. EWA is in ongoing discussions with Andritz on how to modify the Solids Building to accommodate dryer modifications, but do not anticipate these changes will impact the air permit. Since plans to modify the building are not finalized, the permit should be revisited once the size of the dryer and RTO are selcted.

Biosolids dryers are not covered in SDAPCD's BACT Guidance Document, but the CARB BACT Clearinghouse contains BACT determinations for large industrial ovens and dryers. BACT determinations are available for units with capacities between 1.9 MMBtu/hr and 96 MMBtu/hr. For all units within this range, low-NO_x burners are considered BACT.

2.2 Internal Combustion Engines

Increasing the fuel input to the existing IC engines at EWPCF has been presented as an alternative power production strategy in TM 3. As stated in Section 1.1, EWA received a modification to the existing IC engine permits that allows expanded digester gas and natural gas use. Increasing fuel use beyond these new permit regulations will trigger BACT.

Lean-burn IC cogeneration engines fueled by digester gas and natural gas are not covered in SDAPCD's BACT Guidance Document; however, BACT information for these engines is contained within the CARB BACT Clearinghouse. According to the BACT Clearinghouse, BACT for NO_x, CO, and VOC control is selective catalytic reduction (SCR) combined with an oxidation catalyst. However, installing and maintaining a SCR system is typically cost prohibitive, and SDAPCD has historically not required SCR for digester gas fueled IC engines.

Expanding IC engine operation under the new air permit may cause EWPCF's CO emissions to increase beyond the Major Source threshold. In this case, EWA may reduce engine operation to limit CO emissions, or oxidation catalysts can be added to reduce CO emissions while maximizing engine output. If oxidation catalysts are installed, an upstream gas conditioning system must also be installed to reduce harmful contaminants that can poison catalysts. Oxidation catalysts are relatively inexpensive compared to full SCR systems and can be economical options for controlling CO emissions.



SCR and oxidation catalysts both operate via catalysis, which is a process that significantly increases the rate of a chemical reaction. SCR systems are active abatement devices in which ammonia (NH_3) is injected as urea and reacts with NO_x molecules in the IC engine exhaust to produce nitrogen and water vapor. Oxidation catalysts are passive abatement devices that reduce CO and VOCs to CO_2 and water vapor; no additional reactants must be supplied for the oxidation process. An exhaust treatment process flow diagram is provided in Figure 2-1.

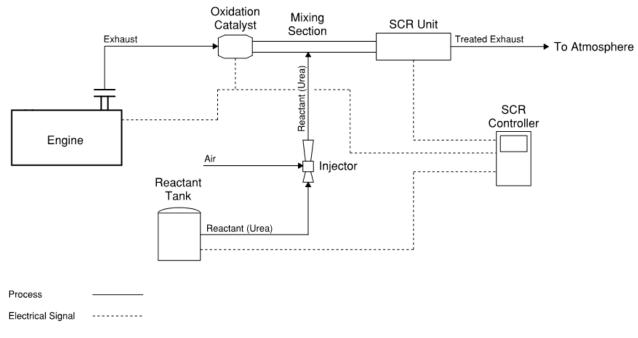


Figure 2-1. A post-combustion exhaust treatment system, including an oxidation catalyst, urea dosing, and an SCR unit

In addition to BACT, state and federal performance standards apply to operation of natural gas and digester gas fueled IC engines. Relevant standards are presented in Table 2-2. These standards are preliminary determinations, and specific limits are applied when an emissions source is permitted.

Table 2-1. Relevant Federal Emissions Regulations for IC Engines					
Requirement	Limit	Units	Regulation		
Formaldehyde, reduction	76 or greater	%	40 CFR Part 63 Subpart ZZZ		
Formaldehyde, emissions limit	350	ppbv	40 CFR Part 63 Subpart ZZZ		
NO _x emissions limit, digester gas	150	ppmv	40 CFR Part 60 Subpart JJJJ		
NOx emissions limit, natural gas	82	ppmv	40 CFR Part 60 Subpart JJJJ		
CO emissions limit, digester gas	610	ppmv	40 CFR Part 60 Subpart JJJJ		
CO emissions limit, natural gas	270	ppmv	40 CFR Part 60 Subpart JJJJ		
VOC emission limit, digester gas	80	ppmv	40 CFR Part 60 Subpart JJJJ		
VOC emissions limit, natural gas	560	ppmv	40 CFR Part 60 Subpart JJJJ		



2.3 Microturbines

Microturbines are small combustion turbines that cogenerate heat and electricity and are included in TM 3 as a power production alternative. Digester gas, natural gas, or a combination can be used to fuel microturbines.

As stated in the Section 2 Introduction, BACT must be applied when an emission unit has a potential to emit 10 or more pounds per day of PM₁₀, NO_x, VOCs, or SO_x. Microturbines are low-emission combustion units, and most available models from Capstone and FlexEnergy do not trigger BACT because full load emissions of each pollutant of concern are below the 10 pounds per day threshold. Of all the Capstone 65 kW AND 200 kW units, only the CR 200 Digester Gas model exceeds one of the BACT thresholds. The CR200 Digester Gas model produces 3.6 lb/MW-hr of CO at full load, which is equivalent to 17.3 lb/day of CO. Even if two 200-kW units are installed, the only BACT exceedance is the CO limit. In this case, an oxidation catalyst would be required. Refer to Section 2.2 for information on using oxidation catalysts to control CO.

2.4 Boilers

In TM 4, the Cambi[™] thermal hydrolysis process (THP) is presented as an alternative to increase biogas production. Refer to Section 2.5 for additional air emissions impacts of Cambi[™] THP. This process uses medium-pressure steam, which must be produced in boilers. Conventional or composite boilers may be installed as part of this alternative, and boilers may be fueled by digester gas, natural gas, or a combination of the two.

Under SDAPCD rules, new boilers must meet BACT standards. For natural gas boilers with a heat input of less than 50 MMBtu/hr, BACT is a low NO_x burner, flue gas recirculation, and oxygen controller. According to the SDAPCD BACT Guidance Document, in lieu of meeting the BACT requirement, EWA may choose to limit the potential to emit from the boilers to less than 10 pounds per day. However, CARB and EPA BACT databases contain more stringent for natural gas fueled boilers including EMx, also known as SCONOx[™], and SCR. Refer to Section 2.2 for a description of SCR. EMx has been shown to achieve lower NO_x emissions than SCR under some conditions.

EMx operates via a catalysis/absorption cycle to remove NO_x and CO. The system employs a platinum catalyst impregnated with potassium carbonate. Both NO_x and CO are oxidized by the platinum catalyst, and the oxidized NO_x reacts with the potassium carbonate and is absorbed within the catalyst surface. Potassium carbonate must be regenerated with hydrogen when saturated with NO_x. The regeneration process must take place in an oxygen-free environment, which is achieved via valves and louvers. Elemental nitrogen and water vapor are released during regeneration. Various sections of catalysts alternate between oxidation/absorption and regeneration. There are several critical issues associated with EMx that should be considered, including sensitivity to sulfur, safety issues with use of hydrogen, and a high capital cost.

Flue gas recirculation diverts flue gases from the boiler exhaust stream to the combustion chamber, which reduces the peak flame temperatures, decreases the oxygen content in the combustion air, and slows the combustion process. This process controls thermal NO_x formation, which occurs at higher combustion temperatures and oxygen contents. A flue gas recirculation system for a boiler is shown in Figure 2-2. Oxygen controllers reduce NO_x by limiting the amount of excess air provided for the combustion process, which controls the oxygen to fuel ratio.



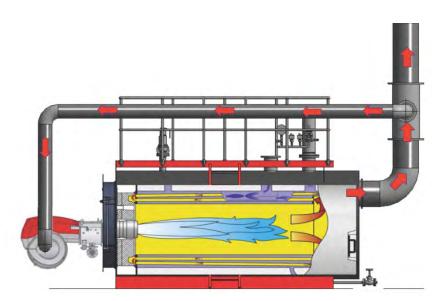


Figure 2-2. Flue gas recirculation in a natural gas boiler. Source: Bosch.

In addition to BACT, state and federal performance standards apply to operation of natural gas and digester gas fueled boilers. Relevant standards are presented in Table 2-2. These standards are preliminary determinations, and specific limits are applied when an emissions source is permitted.

Table 2-2. Relevant Federal Regulations for Boilers					
Requirement	Limit	Units	Notes	Regulation	
CO emissions limit, gaseous fuel	130	ppmv	Dry basis, corrected to 3 % oxygen	40 CFR Part 63 Subpart DDDDD	
Hydrogen chloride, gaseous fuel	1.7 x 10 ⁻³	lb/MMBtu of heat input	N/A	40 CFR Part 63 Subpart DDDDD	
Mercury, gaseous fuel	7.9 x 10⁻ ⁶	lb/MMBtu of heat input	N/A	40 CFR Part 63 Subpart DDDDD	
Filterable PM, gaseous fuel	6.7 x 10 ⁻³	lb/MMBtu of heat input	N/A	40 CFR Part 63 Subpart DDDDD	

2.5 Flare

As stated in Section 1.1, the current flare permit allows digester gas usage of 300 million scf/year. Current digester gas production at EWPCF is below this limit, but, according to TM 1, digester gas production is projected to exceed 300 million scf/year between 2020 and 2030. These projections assume that high strenth waste (HSW) codigestion remains constant. If EWPCF starts accepting additional HSW deliveries, digester gas production may exceed the flare permit limit earlier than 2020. At current conditions, codigesting an additional 7,000 lb of HSW will cause digester gas production to exceed the flare permit limit.

Installation of a higher capacity flare will be required when digester gas production exceeds the current permit's limit, and a modified flare permit must be obtained. The new flare should be sized with digester gas production projections in mind.



2.6 Odor Control

EWPCF currently has three odor reduction facilities (ORF1, ORF 2, and ORF3). ORF 1 and ORF 3 are covered under a single air permit, and ORF 2 is covered under the permit for the biosolids processing facility. Cambi™ THP and increased codigestion, which are discussed in TMs 2 and 4, may produce additional odors that are subject to regulation. If impacts to the existing odor reduction facilities exceed the current air permit limitations, a modified air permit for odor reduction must be developed. Odor mitigation measures and possible air permitting requirements are included in current analyses and will be considered in future analyses.

2.7 Other Alternatives

There are several other alternatives that have passed the fatal-flaw filters in TMs 3, 4, and 5 that may or may not require air permitting.

CambiTM THP, which is mentioned in Section 2.4, usually increases the NH₃ content in digester gas, which results in greater NO_x formation during combustion in an engine, flare or dryer, and can cause exceedances of emissions limits. To avoid potential NO_x issues, NH₃ removal can be added to a gas conditioning system.

Gas conditioning systems can be considered permittable abatement devices because these systems reduce the concentrations of regulated air pollutants in digester gas, including SO_x and NO_x. An air permit is required for a gas conditioning system if employed in conjunction with a combustion process (e.g. an IC engine, microturbine, and/or a flare). An air permit is not required if the gas conditioning system is associated with a permit-exempt emission source.

A digester gas upgrading system for either pipeline injection or direct vehicle fueling may also require an air permit. Upgrading systems separate the methane and carbon dioxide in digester gas, which produces a methane-rich product gas and a tail gas that is mostly carbon dioxide. The tail gas may or may not contain a significant quantity of methane, depending on the separation efficiency of the digester gas upgrading process. Separation efficiencies typically vary between 90 percent and 99+ percent. If the tail gas contains a significant quantity of methane, air permitting and emissions control will most likely be required. Even if tail gas has a negligible methane concentration, an air permit may still be required.

Although digester gas storage does not produce or affect emissions, adding digester gas storage changes the currently permitted process, which requires a permit modification.

Small-scale and large-scale solar photovoltaics do not require an air permit.

Section 3: Future Regulations

New regulations and regulatory trends that may impact future air permitting for EWPCF were assessed as part of this TM. Two relevant regulatory developments were identified, California Assembly Bill 617 and forthcoming SCR requirements. Brief descriptions of these regulatory developments are provided in this section.

3.1 California Assembly Bill 617

The State of California recently passed Assembly Bill (AB) 617 Nonvehicular Air Pollution: Criteria Air Pollutants and Toxic Air Contaminants, which has a wide range of impacts on air regulations. The most relevant change of AB 617 is that it requires air districts to adopt an implementation schedule for best available retrofit technology (BARCT) that applies to all emissions producing equipment that received new or revised air permits prior to 2007. Eligible equipment must be upgraded by December 31, 2023. In other



words, even if no major modifications are made to a piece of equipment, that equipment must comply with the appropriate air district's new BARCT regulations if it was permitted prior to 2007.

3.2 SCR for All Digester Gas Fueled IC Engines

Air districts in the state of California may move to require SCR emissions control as BACT for all digester gas fueled IC engines in California. The Bay Area Air Quality Management and South Coast Air Pollution Control Districts have been the first districts to implement this requirement for SCR, and California's other air districts may follow this lead. It is uncertain when California's other air districts may adopt these stricter SCR requirements, but it is important for facilities with digester gas fueled IC engines to be aware of this trend.

Section 4: Greenhouse Gas Inventory

A GHG inventory was performed for the existing gas utilization technologies, including the engines, thermal biosolids dryer, RTO, and flare. This section also includes a discussion on the potential GHG reductions associated with future energy production alternatives.

4.1 Introduction to GHG Scope Emission Categories

GHG emissions estimates are categorized as Scope 1, Scope 2, or Scope 3. Scope 1 emissions are direct GHG emissions from within a given boundary; the boundary for EWPCF's Scope 1 GHG emissions estimates developed in this TM include combustion emissions from the 1) engines, 2) thermal dryer, 3) flare, and 4) RTO. Combustion of anthropogenic fuels such as natural gas contributes to GHG emissions as well as byproducts such as CH_4 and N_2O from incomplete combustion of biogenic fuels such as biogas. GHG emissions from biogas combustion are considered biogenic and do not count towards the total emissions, but are still reported.

Scope 2 GHG emissions are associated with energy purchased through SDG&E and use the published 2014 V2 eGRID CO₂ emissions factor for the CAMX – WECC California subregion.

(https://www.epa.gov/sites/production/files/2017-02/documents/egrid2014_summarytables_v2.pdf). Scope 2 GHG emissions estimates are included as part of this analysis and include EWPCF's entire operational boundary, including headworks, solids treatment, liquids treatment, building, and lighting. All energy purchased through SDG&E that is recorded on EWPCF's meter contributes to Scope 2 estimates in this TM.

Scope 3 GHG emissions are indirect emissions that are not covered under Scope 1 or 2, such as emissions from biosolids hauling. Scope 3 sources are not included in the GHG emissions estimates reported in this TM. Figure 2-1 provides a graphical representation of the three Scopes that contribute to the GHG emissions inventory. Scope 3 sources are shown in Figure 2-1 only for informational purposes.

GHG emissions estimates in this analysis are based on fuel consumption during the baseline period (June 2016 to May 2017) presented in TM 1.



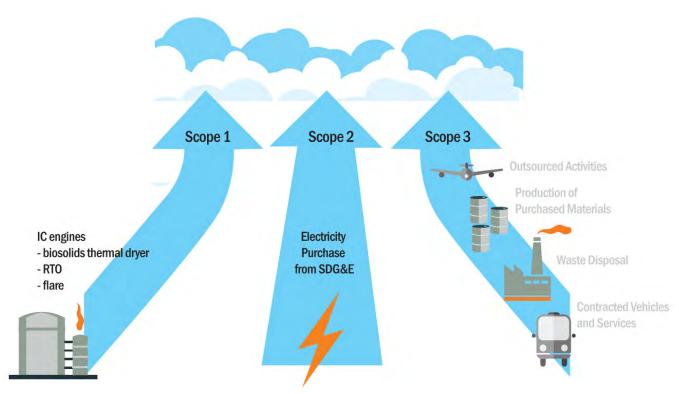


Figure 2-1. Scope 1, 2 and 3 emission categories that contribute to a typical GHG Inventory. Only Scopes 1 and 2 are included in this TM.

4.2 Current Baseline GHG Emissions

To determine the GHG inventory for the engines, biosolids thermal dryer, RTO, and flare, The Climate Registry (TCR) General Reporting Protocol (GRP) version 2.1, January 2016, methodology was applied. Equations from Chapter 12: Direct Emissions from Stationary Combustion of the GRP were used in the calculations. Additionally, the following tables from the March 2017 version of the Default Emissions Factors were used:

- Table 12.1 U.S. Default Factors for Calculating CO2 Emissions from Fossil Fuel
- Table 12.9.1 Default CH₄ and N₂O Emission Factors by Fuel Type Industrial and Energy Sectors
- Subregion Emissions Greenhouse Gasses (eGRID2014v2), CAMX WECC California eGRID subregion

The estimated total GHG emissions within the established Scope 1 and 2 boundaries are 4,312 metric tons of carbon dioxide equivalents (CO₂e). This estimate does not include combustion emissions from digester gas, which are reported separately; however, emissions from incomplete combustion of digester gas is considered Scope 1. Figure 3-2 shows the fraction of GHG emissions that each Scope 1 source contributes and Table 3-1 summarizes these values.



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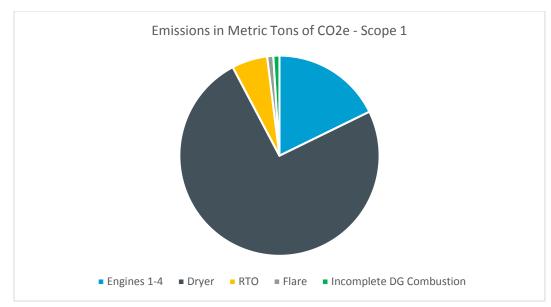


Figure 3-2. Fraction of Scope 1 GHG emissions estimates from each source

Table 3-1. Scope 1 GHG Emissions Estimates							
Combustion Device	Annual NG Combustion (SCF)	Annual DG Combustion (MMBtu)	Direct CO2e (metric tons)	CH₄ as CO₂e (metric tons)	N ₂ O as CO ₂ e (metric tons)	Incomplete Biogas Combustion (metric tons CO ₂ e)	Total CO2e (metric tons)
Engines 1-4	11,563,000	11,563	614	0	0	30	644
Dryer	50,789,368	50,789	2,695	1	1	2	2,700
RT0	3,929,441	3,929	208	0	0	0	209
Flare	598,643	599	32	0	0	4	36
Total	3.588 Metric Tons						

1. Emission factors for CO₂, CH₄, and N₂O are 53.06 kg/MMBtu, 0.001 kg/MMBtu, and 0.0001 kg/MMBtu, respectively.

2. Global Warming Potential for CO_2 , CH_4 , and N_2O is 1, 28, and 265, respectively.

The intergovernmental Panel on Climate Change (IPCC) *Guidelines for National Greenhouse Gas Inventories* requires that CO₂ emissions from biomass combustion be reported separately from Scope 1 direct emissions. The CO₂ emissions from biogas combustion total 7,257 metric tons of CO2e. Figure 3-3 shows the fraction of GHG emissions that each combustion source contributes and Table 3-2 summarizes these values.



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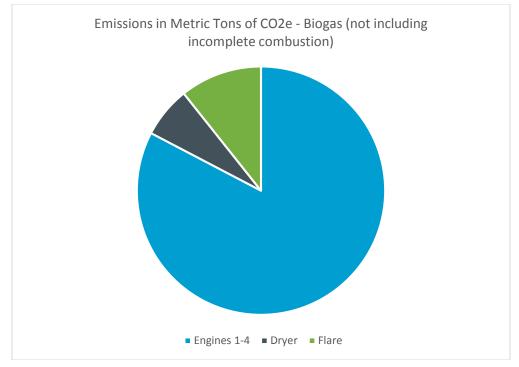


Figure 3-3. Fraction of GHG Emissions from biomass fueled combustion devices

Table 3-2. Biogas Combustion Biogenic GHG Emissions					
Combustion Device	Annual Biogas Combus- tion (SCF)	Annual Biogas Combustion (MMBtu)	CO2e (metric tons)		
Engines 1-4	205,734,000	115,211	5,999		
Dryer	16,526,871	9,255	482		
Flare	26,600,529	14,896	776		
Total	7,257 Metric Tons				

1. Emission factors for CO₂ is 52.07 kg/MMBtu.

2. Global Warming Potential for CO2 is 1.

4.3 GHG Emissions Related to Energy Production Alternatives

GHG emissions estimates will vary depending on the alternative energy production technology selected under Task 3 and the HSW quantities reviewed in TM 4. The alternatives that are being considered in the Solids Water Energy and Emissions Tracking (SWEET) model that would impact the GHG emissions compared to the current baseline include the following:

- Increasing the quantity of HSW to increase biogas production
- Gas conditioning and selective catalytic reduction (SCR) engine exhaust treatment to increase engine power output
- Upgrading biogas to renewable natural gas (RNG) and purchasing power from SDG&E
- Adding solar photovoltaics to the current engine operation



The GHG impact of each technology is discussed below.

- Increased HSW for codigestion will increase biogas production, which decreases anthropogenic GHG emissions but increases biogenic GHG emissions. Since biogas combustion does not count towards anthropogenic Scope 1 GHG emissions, producing additional biogas to offset natural gas consumption will lower EWPCF's anthropogenic GHG emissions.
- Sending more biogas to the engines instead of the thermal dryer will not have an impact on GHG emissions.
- Upgrading biogas to RNG for pipeline injection will increase Scope 1 and Scope 2 anthropogenic GHG emissions. EWPCF currently runs two 750-kW IC engines at full load, primarily on biogas. Sending all biogas to the pipeline will result in increasing natural gas fired combustion (Scope 1 anthropogenic) in the engines or purchasing electricity directly from SDG&E (Scope 2). Carbon dioxide in the tail gas from the biogas separation process also adds to Scope 1 GHG emissions. Transferring the product to the pipeline would not credit EWPCF with replacing an anthropogenic fuel with a biogenic fuel.
- Large-scale and small-scale solar photovoltaics will decrease Scope 2 GHG emissions. Solar PV panels
 do not emit GHGs and reduce the amount of energy that EWPCF would need to purchase from SDG&E or
 produce from the engines.

References

- San Diego County Air Pollution Control District. New Source Review Requirements for Best Available Control Technology Guidance Document. June 2011.
- The Climate Registry General Reporting Protocol for the Voluntary Reporting Program. Version 2.1, January 2016. http://www.theclimateregistry.org/wp-content/uploads/2014/11/General-Reporting-Protocol-Version-2.1.pdf
- The Climate Registry Default Emission Factors. March 2017. <u>http://www.theclimateregistry.org/wp-content/up-loads/2017/05/2017-Climate-Registry-Default-Emission-Factors.pdf</u>
- Subregion Emissions Greenhouse Gasses (eGRID2014v2), CAMX WECC California eGRID subregion. https://www.epa.gov/sites/production/files/2017-02/documents/egrid2014_summarytables_v2.pdf



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Attachment A: Revised Air Permit

November 2017



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B-1



COUNTY OF SAN DIEGO, AIR POLLUTION CONTROL DISTRICT 10124 OLD GROVE ROAD, SAN DIEGO, CA 92131 PHONE (858) 586-2600 FAX (858) 586-2601 www.sdapcd.org

Sectors:2, ESite Record ID:APCD1984-SITE-03370Application Record ID:APCD2017-APP-004926

Startup Authorization Expires: May 8, 2018

Encina Wastewater Authority General Manager 6200 Avenida Encinas Carlsbad CA 92011 EQUIPMENT ADDRESS Encina Wastewater Authority Douglas Campbell 6200 Avenida Encinas Carlsbad CA 92011

STARTUP AUTHORIZATION

After examination of your Application APCD2017-APP-004926 for an Air Pollution Control District (hereinafter referred to as "the District") Authority to Construct and Permit to Operate for equipment located at 6200 Avenida Encinas Carlsbad CA 92011 in San Diego County, the District has decided on the following actions:

This Startup Authorization is granted pursuant to Rule 21 of the Air Pollution Control District Rules and Regulations for equipment to consist of:

Modification to conditions of Permits 000542, 000543, 000544, 000545 for four identical cogeneration engines: Caterpillar lean burn engine, model G3516, S/Ns 4EK05160, 4EK05161, 4EK05168, 4EK05175, fueled with digester gas and supplemented with natural gas, rated at 1306 bhp when fueled with digester gas and 1085 bhp when fueled with natural gas, each engine drives a 750 KW generator.

This Startup Authorization is issued with the following conditions:

- 1. When fueled with digester gas, the emissions of oxides of nitrogen (NOx) shall not exceed 47 parts per million by volume (ppmv), calculated as nitrogen dioxide at 15 percent oxygen on a dry basis.
- 2. When fueled with digester gas, the emissions of carbon monoxide (CO), shall not exceed 400 ppmv, calculated at 15 percent oxygen on a dry basis.
- 3. When fueled with natural gas, the emissions of oxides of nitrogen (NOx) shall not exceed 54 ppmv, calculated as nitrogen dioxide at 15 percent oxygen on a dry basis.
- 4. When fueled with natural gas, the emissions of carbon monoxide (CO), shall not exceed 390 ppmv, calculated at 15 percent oxygen on a dry basis.
- 5. Total digester gas and natural gas consumption for the four engines of Permit Nos. APCD2010-PTO-000542, APCD2010-PTO-000543, APCD2010-PTO-000544 and APCD2010-PTO-000545 shall not exceed 280 million standard cubic feet per year. Total natural gas consumption for all four engines shall not exceed 28 million standard cubic feet per year. Records demonstrating compliance with these limits shall be maintained on site and made available for inspection upon request. (NSR)
- Total digester gas consumption for the four engines of Permit Nos. APCD2010-PTO-000542, APCD2010-PTO-000543, APCD2010-PTO-000544 and APCD2010-PTO-000545 shall not exceed 1 million standard cubic feet per day. Total natural gas consumption for all four engines shall not exceed 0.55 million standard cubic feet per day. Records demonstrating compliance with these limits shall be maintained on site and made available for inspection upon request. (NSR)
- 7. The owner or operator of each engine shall conduct periodic inspections of each engine and add-on control equipment to ensure that each engine is operated in compliance. Inspections shall be conducted at least once every 4,000 hours of operation or every six months, whichever occurs first. [R69.4.1]
- 8. The owner or operator of this engine shall conduct periodic maintenance of the engine and add-on control equipment, if any, as recommended by the engine and control equipment manufacturers or as specified by the engine servicing company's maintenance procedures. The periodic maintenance shall be conducted at least once each calendar year. (Rule 12, Rule 69.4.1)



COUNTY OF SAN DIEGO, AIR POLLUTION CONTROL DISTRICT 10124 OLD GROVE ROAD, SAN DIEGO, CA 92131 PHONE (858) 586-2600 FAX (858) 586-2601 www.sdapcd.org

Sectors:2, ESite Record ID:APCD1984-SITE-03370Application Record ID:APCD2017-APP-004926

Startup Authorization Expires: May 8, 2018

- 9. This equipment shall be source tested once each permit year (annual source test) to demonstrate compliance with the emission standards contained in this permit. For the purposes of this permit, a permit year is the 12-month period ending on the last day of the permit expiration month. It is the responsibility of the permittee to schedule the source test with the District. The source test shall be performed or witnessed by the District. Each annual source test shall be separated by at least 90 days from any annual source test performed in a different permit year.
- 10. The engine shall be source tested annually to demonstrate compliance with the emission standards contained in this permit. Source testing shall be performed using the fuel with higher annual fuel consumption (in standard cubic feet) during the previous calendar year.
- 11. The owner or operator of the engine shall maintain records containing, at a minimum, the following: total daily and annual fuel consumptions of all four engines of Permit Nos. APCD2010-PTO-000542, APCD2010-PTO-000543, APCD2010-PTO-000544 and APCD2010-PTO-000545; records of periodic inspection and maintenance for the engines and control equipment, including dates inspection and maintenance were performed and copies of manuals of recommended maintenance procedures provided by the manufacturer.
- 12. All records shall be retained on site for at least three (3) years and made readily available to the District upon request.
- 13. Access, facilities, utilities and any necessary safety equipment for source testing and inspection shall be provided upon request of the Air Pollution Control District.
- 14. This Air Pollution Control District Permit does not relieve the holder from obtaining permits or authorizations required by other governmental agencies.
- 15. The permittee shall, upon determination of applicability and written notification by the District, comply with all applicable requirements of the Air Toxics "Hot Spots" Information and Assessment Act (California Health and Safety Code Section 44300 et seq.)



COUNTY OF SAN DIEGO, AIR POLLUTION CONTROL DISTRICT 10124 OLD GROVE ROAD, SAN DIEGO, CA 92131 PHONE (858) 586-2600 FAX (858) 586-2601 www.sdapcd.org

Sectors:2, ESite Record ID:APCD1984-SITE-03370Application Record ID:APCD2017-APP-004926

Startup Authorization Expires: May 8, 2018

This authorization is for temporary operation of the above-specified equipment. This temporary Permit to Operate will remain in effect, unless withdrawn or modified by the District or a Permit to Operate is granted or denied.

This Startup Authorization shall be posted on or within 25 feet of the described equipment or maintained readily available at all times on the operating premises.

This Startup Authorization does not relieve the holder from obtaining permits or authorizations, which may be required by other governmental agencies. This Startup Authorization is not an authorization to exceed any applicable emission standard established by this District or any other governmental agency. This authorization is subject to cancellation if any emission standard or condition is violated.

Within 30 days after receipt of this Startup Authorization, the applicant may petition the Hearing Board for a hearing on any conditions imposed herein in accordance with Rule 25.

This Startup Authorization will expire on May 8, 2018, unless an extension is granted in writing.

If you have any questions regarding this action, please contact me at (858) 586 2747 or via email at <u>camqui.nguyen@sdcounty.ca.gov</u>.

Camqui hyuyu Camqui Nguyeh

Associate Engineer

CC: Compliance Division



Technical Memorandum

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FINAL

T: 858.514.8822 F: 858.514.8833

- Prepared for: Encina Wastewater Authority
- Project title: Biosolids, Energy, and Emissions

Project no.: 150871.007

Technical Memorandum 7

- Subject: Alternatives Development, Evaluation, and Selection
- Date: May 17, 2018
- To: Scott McClelland, Assistant General Manager
- From: Scott Lacy, Project Manager



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Limitations:

This document was prepared solely for Encina Wastewater Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between Encina Wastewater Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by Encina Wastewater Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Encina Wastewater Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List c	of Figure	S	v
List c	of Tables	5	vi
Exec	utive Su	mmary	iii
Secti	on 1: Int	troduction	1
1.1	Purpose	9	1
1.2	SWEET	Model	1
Secti	on 2: De	evelopment of SWEET Model	2
2.1	Process	Assumptions	2
	2.1.1	Baseline Solids Model	2
	2.1.2	Feedstock Assumptions	2
	2.1.3	Thickening Process Assumptions	3
	2.1.4	Thermal Hydrolysis Process Assumptions	3
	2.1.5	Digestion Process Assumptions	4
	2.1.6	Dewatering Process Assumptions (Digested Biosolids)	5
	2.1.7	Thermal Drying Assumptions	5
	2.1.8	Baseline Energy Model	6
	2.1.9	Air Permit Restrictions	6
	2.1.10	Internal-Combustion Engine Assumptions	7
	2.1.11	Gas Conditioning Assumptions	8
	2.1.12	Microturbine Assumptions	8
	2.1.13	Biogas Upgrading and Pipeline Injection	9
	2.1.14	Solar	10
	2.1.15	Net Electric Metering	10
	2.1.16	Carbon Monoxide Catalyst	10
2.2	Cost As	sumptions	11
	2.2.1	Capital Costs	11
	2.2.2	Operating Costs	12
	2.2.3	Repair and Replacement Costs	14
Secti	on 3: SV	VEET Model Results - Round 1A	14
3.1	SWEET	Round 1A Biosolids Alternatives	14
	3.1.1	Solids Stream Comparison Themes	14
	3.1.2	Economic Evaluation of Solids Stream Alternatives	16
	3.1.3	Alternative Selection for Combined SWEET Model (Round 1B)	22
3.2	SWEET	Round 1A Energy Alternatives	23
	3.2.1	Engine Alternatives	26
	3.2.2	Pipeline Injection Alternatives	26
	3.2.3	High-Strength Waste Addition	27
	3.2.4	Alternative Selection for Combined SWEET Model (Round 1B)	28

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Secti	on 4: Co	ombined Solids and Energy SWEET Model Results - Round 1B	
4.1	Round	1B Alternatives	
4.2	Econor	nic Evaluation of Solids and Energy Alternatives	
	4.2.1	Dryer Evaluation	
	4.2.2	Final Product Evaluation	
	4.2.3	Source-Separated-Organics Evaluation	
	4.2.4	Thickening Evaluation	
	4.2.5	Energy Evaluation	
4.3	Alterna	ative Selection for Combined SWEET Model (Round 2)	
Sect	ion 5: C	ombined Solids and Energy SWEET Model Results - Round 2	
5.1	Round	2 Alternatives	
5.2	Econo	mic Evaluation of Top Five Alternatives	
5.3	Impler	nentation Schedule	
	5.3.1	Digester Excess Capacity Evaluation	
	5.3.2	Implementation Schedules for Top Five Alternatives	
Sect	ion 6: N	lon-Economic Evaluation of Top Five Alternatives	
	6.1.1	Mesophilic versus Thermophilic Comparison on Non-Cost Criteria	
	6.1.2	One-Dryer versus Two-Dryer Comparison on Non-Cost Criteria	
	6.1.3	Engines versus Engines/Pipeline	
	6.1.4	Non-Cost Ranking Recommendations	
Sect	ion 7: F	inal Phasing Considerations for the Recommended Alternative (Alternative 2)	
Sect	ion 8: S	ummary	
8.1	Solids	Next Steps and Recommendations	
8.2	Energy	Next Steps and Recommendations	



iv

List of Figures

Figure ES-1. Overall NPV for top five alternatives	iv
Figure ES-2. Implementation schedule for preferred alternative	v
Figure 2-1. Several engine output lines are plotted for combinations of biogas and NG usage	7
Figure 3-1. Overall 20-year NPV for solids alternatives	17
Figure 3-2. Comparison of thickening systems (assuming two dryers)	18
Figure 3-3. Comparison of stabilization options (assuming RDTs and 1 dryer)	19
Figure 3-4. Comparison of THP options	20
Figure 3-5. Comparison of Class A options (assuming RDTs)	21
Figure 3-6. Comparison of one dryer versus two dryers	22
Figure 3-7. Comparison of alternatives	25
Figure 4-1. Overall NPV for all alternatives	30
Figure 4-2. Overall NPV for all alternatives without THP	31
Figure 4-3. One dryer versus two dryers	32
Figure 4-4. Class A pellets versus pellets and Class B cake hauling	33
Figure 4-5. SSO versus no SSO	34
Figure 4-6. DAF versus RDT	35
Figure 4-7. DG production as a function of HSW co-digestion with key operating points	36
Figure 4-8. BCE results with HSW and RINs until 2022 (full value) with standby charges removed for all alternatives except base case	37
Figure 4-9. BCE results with HSW and RINs to 2030 (full value) with standby charges removed for all alternatives except base case	37
Figure 4-10. BCE results with HSW and RINs to 2030 (half value) with standby charges removed for all alternatives except base case	38
Figure 5-1. Overall NPV for top five alternatives	41
Figure 5-2. Excess digester capacity available for importing 12 percent HSW with DAF	42
Figure 5-3. Excess digester capacity available for importing 12 percent HSW with RDTs	43
Figure 5-4. Implementation schedule for Alternative 1	44
Figure 5-5. Implementation schedule for Alternative 2	45
Figure 5-6. Implementation schedule for Alternative 3	46
Figure 5-7. Implementation schedule for Alternative 4	47
Figure 5-8. Implementation schedule for Alternative 5	48
Figure 6-1. Relative value of DG energy based on alternative	51
Figure 7-1. Implementation schedule for Alternative 2	52

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List of Tables

Table 2-1. Summary of Feedstocks	3
Table 2-2. DAF Thickening Process Assumptions	3
Table 2-3. THP Process Assumptions	4
Table 2-4. Digestion Process Assumptions	5
Table 2-5. Dewatering Process Assumptions	5
Table 2-6. Thermal Drying Process Assumptions	6
Table 2-7. IC Engine Process Assumptions	8
Table 2-8. Gas Conditioning Cost Assumptions	8
Table 2-9. Microturbine Process Assumptions	9
Table 2-10. Biogas Upgrading System Process Assumptions	9
Table 2-11. Pipeline Injection Cost Assumptions	10
Table 2-12. Solar Process Assumptions	10
Table 2-13. Capital Costs Assumptions for Biosolids Alternatives	11
Table 2-14. Capital Costs Assumptions for Energy Alternatives	12
Table 2-15. Assumptions on Operations and Maintenance Costs	12
Table 3-1. Overview of Solids Alternatives Evaluated (Round 1A)	15
Table 3-2. Cost Summary for Solids Alternatives	16
Table 3-3. Overview of Energy Alternatives Evaluated	23
Table 3-4. Economic Summary for Energy 1A Alternatives	24
Table 4-1. Overview of Alternatives Evaluated (Round 1B) ^a	29
Table 5-1. Overview of Solids Alternatives Evaluated (Round 2)	40
Table 5-2. Cost Summary for Top Alternatives	41
Table 6-1. Digestion Process Non-Cost Ranking Matrix	49
Table 6-2. Dryer Non-Cost Ranking Matrix	50
Table 6-3. Engine Utilization Non-Cost Ranking Matrix	51



vi

List of Abbreviations

°F	degree(s) Fahrenheit	RDT	rotary-drum thickener
AACE	American Association of Cost Engineering	RFS	Renewable Fuel Standard
BC	Brown and Caldwell	RIN	renewable identification number
BCE	business case evaluation	RNG	renewable natural gas
BEE	Biosolids Energy and Emissions	scfm	standard cubic foot/feet per minute
Btu	British thermal unit(s)	SCR	selective catalytic reduction
BUS	biogas upgrading system	SDG&E	San Diego Gas & Electric
CH ₄	methane	SGIP	Self-Generation Incentive Program
CNG	compressed natural gas	SS0	source-separated organics
CO	carbon monoxide	SWEET	Solids Water Energy Evaluation Tool
CO ₂	carbon dioxide	THP	thermal hydrolysis process
d	day(s)	TM	technical memorandum
DAF	dissolved air flotation	TS	total solids
DG	digester gas	VS	volatile solids
DGE	diesel gallon equivalent	VSR	volatile solids reduction
dtpd	dry ton(s) per day	WAS	waste activated sludge
EWA	Encina Wastewater Authority		
EWPCF	Encina Water Pollution Control Facility		
FOG	fats, oils, and grease		
ft ³	cubic foot/feet		
gal	gallon(s)		
GCS	gas conditioning system		
hp	horsepower		
hr	hour(s)		
HSW	high-strength waste		
IC	internal combustion		
kW	kilowatt(s)		
kWh	kilowatt-hour(s)		
lb	pound(s)		
LCFS	Low Carbon Fuel Standard		
MMscf	million standard cubic feet		
MW	megawatt(s)		
NEM	net electric metering		
NG	natural gas		
NPV	net present value		
0&M	operations and maintenance		
PS	primary sludge		
psig	pound(s) per square inch gauge		

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Executive Summary

The Encina Wastewater Authority (EWA) has undertaken a Biosolids Energy and Emissions (BEE) Plan that will be used to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan. The BEE Plan provides a comprehensive analysis of all project elements including biosolids treatment, gas use, energy generation, and waste heat; addresses capacity limitations in the solids handling process at the Encina Water Pollution Control Facility (EWPCF); assesses which alternative is likely to be the most cost-effective and sustainable solution for EWA, and develops plans to move EWPCF toward lower energy costs, rate stability, greater overall sustainability, and reduced greenhouse gas emissions.

The approach of this work is to allow for consideration of all feasible alternatives, evaluation of all economic impacts, and consideration of non-cost risks in the development of defensible recommendations for future capital projects. This Technical Memorandum (TM) 7 presents the results of the end-to-end alternatives development, the evaluation process, and selection of a recommended alternative. Project alternatives were first screened in TMs 2 through 5, and shortlisted, via a fatal-flaw filter and an initial evaluation scoring for all solids processes, energy utilization alternatives, and waste heat recovery options. Alternatives that passed the screening criteria were then further analyzed using Brown and Caldwell's (BC's) Solids Water Energy Evaluation Tool (SWEET). TM 7 includes results from SWEET evaluation work, recommendation of a preferred alternative, and considerations for implementation of the recommended alternative.

The SWEET model is an Excel based computational spreadsheet developed over years from numerous designs for the quick and efficient analysis of numerous combinations of alternatives for solids processes, biosolids management and end use, co-digestion, and energy recovery. The tool evaluates process and energy demands and compares alternatives on an economic basis using capital and operating costs. The screened recommendations from the work described in TMs 2 through 6 were combined, evaluated with SWEET, and presented to EWA staff through multiple workshops. All alternatives were ranked based on the 20-year net present value (NPV). The key findings of the analysis are listed below:

- All alternatives benefited from increased digester gas (DG) production from co-digestion of organic highstrength waste (HSW). HSW is a general term that encompasses all imported waste streams that are typically highly digestible and contain high quantities of organics such as fats, oils and grease (FOG), liquid waste (i.e., brewery waste), and source separated organics or food waste.
- Improved thickening with rotary drum thickeners (RDT) provides multiple benefits, including increasing the capacity of the existing digesters, and reduced lifecycle costs compared to the existing thickening scheme.
- Installation of RDTs increases digester capacity and allows for implementation of a food-waste program.
- Upgraded DG for use as vehicle fuel, via pipeline injection, provides the greatest apparent return on investment compared to cogeneration systems or DG use in the solids dryer.

Through a comparison of NPV and site-specific constraints, five preferred alternatives were identified for detailed consideration in this TM. These alternatives include:

- Alternative 1: RDT-Mesophilic Digestion-Centrifuge Dewatering-One dryer-(Engines+Pipeline Injection)
- Alternative 2: RDT-Mesophilic Digestion-Centrifuge Dewatering-Two dryers-(Engines+Pipeline Injection)
- Alternative 3: RDT-Thermophilic 15-day Digestion-Centrifuge Dewatering-One dryer-(Engines+Pipeline Injection)
- Alternative 4: RDT-Thermophilic 15-day Digestion-Centrifuge Dewatering-Two dryers-(Engines only)
- Alternative 5: RDT-Thermophilic 10-day Digestion-Centrifuge Dewatering-Two dryers-(Engines+Pipeline)

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iii

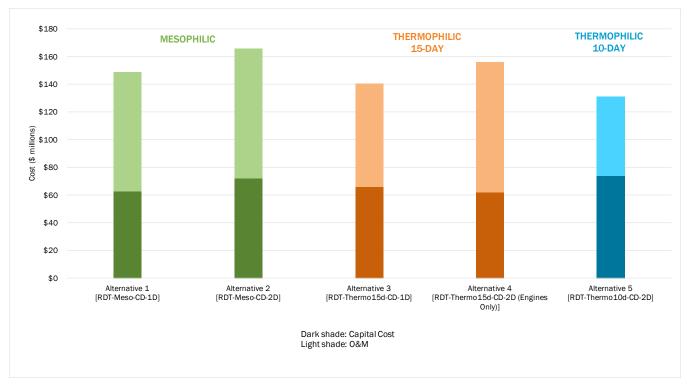


Figure ES-1. Overall NPV for top five alternatives

The economic evaluation of the top 5 alternatives indicated that the NPV results of these alternatives were similar and within the anticipated margin of accuracy for this level of analysis. Therefore, a consideration of non-cost criteria and risks was warranted in selection of a preferred alternative for implementation. Based on a non-cost criteria comparison, the Alternative 2 was identified as the preferred alternative for implementation. Mesophilic digestion was chosen as the preferred digestion process as it is well known and understood by plant staff. It provides enough digester gas to meet EWA's energy recovery goals and can be converted to a thermophilic digestion process any time in the future. Continued operation of the dryer and installation of a second dryer in the future would greatly reduce truck traffic and odors within the plant. It provides end-use resiliency through a Class A pelletized product. Energy recovery was identified as a critical component of the project implementation, and pursuit of multiple energy recovery options is recommended to adopt the best approach for EWA. DG upgrading for pipeline injection and increased cogeneration output are both contingent upon approval from outside agencies. For pipeline injection, the EWA must work toward an interconnection agreement with the natural gas (NG) utility. San Diego Gas & Electric (SDG&E). This process can take up to 2 years and may uncover unforeseen costs or project requirements. For increased cogeneration output, EWA must first work toward another air permit revision with the San Diego Air Pollution Control District, which requires gas conditioning and exhaust treatment. In addition, EWA must develop a net electric metering (NEM) tariff with SDG&E. This will likely require a new interconnection agreement.

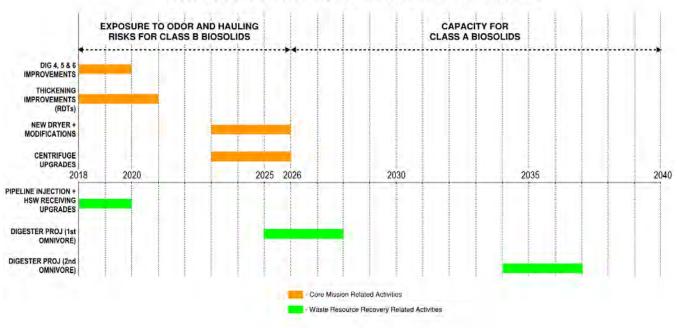
Because both primary alternatives (pipeline injection and increased cogeneration output) require work with outside agencies (and associated risks), BC recommends that EWA pursue both options in parallel. EWA should pursue a revised air permit while initiating conversations with SDG&E to perform initial steps for NG pipeline interconnection as well as NEM. These discussions are the first step in determining whether an alternative remains viable. Total project costs for these DG alternatives range from \$3 million to \$22 million, with grant opportunities available for pipeline injection.



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Solids process upgrades were also considered in this evaluation. Installation of the RDTs will increase capacity in the existing mesophilic digesters, deferring the need for future digester capacity until 2038 (with the second dryer in operation by 2026). Other processes, such as the thermal hydrolysis process (THP), were considered to identify economic benefits related to the solids dryer capacity and the need for a second dryer; however, these processes were found to have higher economic cost relative to other options. With increased capacity for HSW and the desire to develop a reliable HSW program, it is recommended that the existing high-strength waste receiving equipment be upgraded or a new receiving station installed to improve waste receiving and process control in the future. These expansions should include improvements to facilitate safe and dependable truck traffic through the plant for HSW deliveries.

Digester improvements in terms of upgrading existing mixing systems on Digesters 4, 5, and 6 along with structural modifications will need to be addressed immediately for continued operation. Until the installation of a second dryer, it is recommended that improvements to the Class B loadout are provided to improve reliability of the operation and reduce odor impacts from the plant. This includes upgrades to the existing centrifuges and mechanical piping modifications to allow for simultaneous operation of dryer and loadout of Class B biosolids.



ALTERNATIVE 2: RDT-MESOPHILIC-CENTRIFUGE-2 DRYER

Figure ES-2. Implementation schedule for preferred alternative

BC recommends the following based on economic and non-economic evaluation:

- Implement common project elements such as thickening improvements (RDTs), digester improvements, HSW receiving, and Class B truck loadout improvements. Continue operation of mesophilic digestion until capacity or energy recovery needs change.
- Plan for implementation of a second dryer.

Brown AND Caldwell

- Consider construction of gas upgrading to pipeline to capitalize on market opportunities and offset costs for needed gas conditioning equipment. First, a capacity analysis should be performed with SDG&E to determine the location of the nearest pipeline and the feasibility of accepting biomethane. If the capacity analysis indicates SDG&E can accept biomethane, EWA may pursue a private-public partnership arrangement to deliver the project (including a HSW receiving facility) without requiring a capital outlay from EWA.
- Pursue a new air permit with carbon monoxide (CO) catalyst to increase engine output. If a new air permit can be obtained to allow additional fuel usage in the engine, EWA should initiate discussions with SDG&E for NEM electrical rate schedule to potentially lower power bills and export power.
- Continued use and operation of the cogeneration system is recommended. Any measures that increase permitted cogeneration energy production or reduce the cost of electricity should be pursued. An NEM tariff would reduce electric utility costs by eliminating the standby charge—it would also allow for power export and simplify (or eliminate) the EWPCF's current grid isolation practice. Any air permit revisions to allow for greater DG utilization and energy output are recommended. The addition of upstream DG conditioning and exhaust treatment using a CO catalyst appears to be the best pathway. Any changes that trigger more stringent exhaust treatment measures, such as selective catalytic reduction or continuous emissions monitoring systems, should be avoided.
- Installation of a second dryer was identified as the preferred alternative for continued solids processing. This alternative had a comparable economic impact relative to the other top-rated alternatives and allowed for the best non-cost considerations, including reduced risk management related to biosolids management, reduced truck traffic, reduced plant odors, and maximized use of existing infrastructure. However, the installation of a second dryer can be deferred by operating a Class B truck loadout until other necessary improvements are made to the process (until 2026).
- While the second dryer train does not perform as well on an NPV basis in nearly all alternatives, there are non-cost and practical reasons to implement a second train. The timing of bringing this second train on line to realize the most cost savings will be a very important decision for EWA.



Section 1: Introduction

The Encina Wastewater Authority (EWA) has undertaken a Biosolids Energy and Emissions (BEE) Plan that will be used to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan. The BEE Plan has several goals:

- Provide a comprehensive analysis of all project elements including biosolids treatment, gas use, energy generation, and waste heat.
- Address capacity limitations in the solids handling process at the Encina Water Pollution Control Facility (EWPCF).
- Assess which alternative is likely to be the most cost-effective and sustainable solution for EWA.
- Move EWPCF toward lower energy costs, rate stability, and greater overall sustainability.
- Reduce greenhouse gas emissions.

1.1 Purpose

This Technical Memorandum (TM) 7 presents the results of the end-to-end alternatives development, the evaluation process, and selection of a recommended alternative. Project alternatives were first screened in TMs 2 through 5, and shortlisted, via a fatal-flaw filter and an initial evaluation scoring. Alternatives that passed the screening criteria were then further analyzed using Brown and Caldwell's (BC's) Solids Water Energy Evaluation Tool (SWEET). TM 7 includes results from SWEET evaluation work. TM 7 is preceded by the following TMs as part of the BEE project:

- TM 1: Baseline Energy Profiles and Projections
- TM 2: Technology Evaluations for Biosolids Handling
- TM 3: Technology Evaluations for Alternative Power Production
- TM 4: Technology Evaluations for Biogas Production
- TM 5: Technology Evaluations for Waste Heat
- TM 6: Air Emissions

1.2 SWEET Model

The alternatives analysis uses BC's SWEET model, which tracks volatile solids (VS), inert solids, and water through potential process alternatives and considers energy required to power/heat those processes and forecast energy production and material recovery. It also allows energy balances to be compared with integration of multiple feedstocks, and it allows the carbon footprint of each alternative to be determined. Two notable advantages of SWEET are its ability to evaluate alternatives in real time during workshops and its transparency on all of the factors used.

The SWEET model provides the ability to develop a life-cycle economic analysis for end-to-end alternatives over a specific planning period. A business case evaluation (BCE) consisting of capital costs, operations and maintenance costs, repair and replacement associated with each alternative, and environmental attributes can be generated by running the SWEET model.

BC's approach to developing the SWEET model started with two separate models, one for energy alternatives and one for the solids alternatives. These two models were evaluated separately to determine trends and patterns that would then facilitate screening and/or adding appropriate alternatives into a combined SWEET model. The results from the individual SWEET models for energy and solids are referred to as Round 1A



results; the results from the first comparison of the combined SWEET model are referred to as Round 1B results.

The results from Round 1A were discussed with EWA in two weekly progress conference calls and input from that call provided a basis for developing the end-to-end alternatives for the combined Round 1B model. Results from the combined Round 1B model were presented at Workshop 4 held in December 2017. Discussions from that workshop provided basis for screening out many of the alternatives evaluated in Round 1B and ultimately led to evaluating five top alternatives for Round 2 of the SWEET model.

Section 2: Development of SWEET Model

The SWEET model is an Excel based computational spreadsheet based on numerous designs for the quick and efficient analysis of numerous combinations of alternatives for solids processes, biosolids management and end use, co-digestion, and energy recovery. The tool develops process and energy models and compares alternatives on an economic basis using capital and operating costs. This section describes the process used to develop solids stream alternatives for this BCE, including process assumptions applied, Round 1A end-to-end alternatives, cost assumptions, and solids stream comparison themes.

2.1 Process Assumptions

The technologies and options evaluated for each major unit process, along with corresponding process assumptions, are described in this section. Each end-to-end alternative used one or more of the options listed here.

2.1.1 Baseline Solids Model

The baseline model describing the solids process at EWPCF based on plant data from 2015 to 2017 was built using the calibrated mass balance detailed in TM 1. The results of the mass balance were captured in SWEET in a baseline model, which served as a basis for comparison to all end-to-end alternatives.

Each input stream and process is captured in SWEET using a module, where process and energy inputs are provided, and the model performs cumulative solids and power calculations. A single SWEET model constitutes a linear stream of several input and process modules, with all calculations occurring cumulatively. The baseline model was built using 2-year average waste activated sludge (WAS); primary sludge (PS); and fats, oils, and grease (FOG) loads as feedstock inputs, with WAS undergoing thickening using dissolved air flotation (DAF). These three loads were applied as inputs to a mesophilic digestion module, where volatile solids reduction (VSR) was determined by applying a load-weighted composite of assumed VSR for each of the three feedstocks. The digested sludge was fed to a centrifuge module for dewatering, followed by either the production of Class B dewatered cake, or thermal drying to produce Class A pellets.

2.1.2 Feedstock Assumptions

The feedstocks assumed as initial conditions for the evaluation of all alternatives are shown in Table 2-1. These values, based on the mass balance detailed in TM 1, were applied to 2017 loads. The projection of loads for future years through 2040 was based on the growth rate determined in the 2015 *Process Master Plan*. The high-strength waste (HSW) loads in terms of FOG were determined based on historical data from EWA and kept static regardless of the alternative under evaluation. Additional HSW loads applied were based on maximizing digester capacity for each digestion alternative under consideration. The excess gas can be utilized for pipeline injection, power generation, the existing solids dryer, or a combination of each.



Table 2-1. Summary of Feedstocks						
Feedstock	Input Flow (gpd)	Input Load, 2018 (lb/d)	TS (percent)	VS (percent)		
PS (thickened)	138,900	47,500	4.1	87		
WAS (thickened)	705,000	29,400	0.5	80		
FOG (as received)	8,720	4,000	5.5	80		
Future HSW Options						
SSO, mesophilic digestion	30,000b	30,000	12	85		
SSO, 10-day thermophilic digestion	80,000 ^b	30,000	12	85		
SSO, 15-day thermophilic digestion	50,000 ^b	50,000	12	85		
Conventional THP	80,000ª	80,000	12	85		
Conventional THP, Cambi B2-4 reactors	50,000ª	80,000	12	85		
WAS-only THP	30,000ª	30,000	12	85		

a. Year implemented would depend on phasing of digester projects over 20-year planning period.

2.1.3 Thickening Process Assumptions

The thickening technologies considered in all alternatives were either the existing dissolved air flotation thickeners (DAFTs) or new rotary-drum thickener (RDT) units. All DAFTs were assumed to thicken the WAS stream only, as occurs with current thickening operation. Table 2-2 summarizes the major process assumptions made for DAFTs in the SWEET model. RDT thickening was evaluated as a potential upgrade technology, owing to its higher energy efficiency and its smaller unit footprint compared to DAF thickening. If RDT thickening is implemented, it is assumed to be used to co-thicken WAS and PS streams. Table 2-2 summarizes the major assumptions made for thickening processes in the SWEET model.

Table 2-2. DAF Thickening Process Assumptions						
Parameter	Unit	DAF	RDT			
Stream thickened	-	WAS	WAS and PS			
Solids capture	-	95%	95%			
Thickened sludge TS	-	5.6%	6.0%			
Unit loading	lb/d	45,000	25,200			
Process energy consumption	hp	Variable ^a	8			

a. Process energy consumption is calculated using input stream loading in a linear relationship with power, based on historical data.

2.1.4 Thermal Hydrolysis Process Assumptions

The thermal hydrolysis process (THP) was evaluated as a potential technology to enhance existing facility capacity and cake quality, obviating the need for subsequent thermal drying. The THP process involves the use of pre-dewatering, followed by dilution, to bring solids content to a target of about 16.5 percent for reactor feed. Pre-dewatering for THP alternatives assumed the use of existing dewatering centrifuges, while final dewatering would be accomplished using other dewatering technology options. The thermal hydrolysis reactors may be sized on solids loading, and several THP alternatives were based on differences in size and



service number of THP reactors. The THP process is followed by standard mesophilic digestion, where the hydrolyzed sludge is diluted to ensure stable digestion operation.

THP was applied to two process streams, spanning several alternatives: conventional, or Class A THP, where all feed streams are fed to THP reactors, and WAS-only THP, where only the WAS stream undergoes THP, and is fed to the digesters along with the other feed streams. Table 2-3 summarizes the major assumptions made for digestion processes in the SWEET model. The Cambi THP system was used as the assumed THP system for evaluation purposes in this project.

Table 2-3. THP Process Assumptions						
Parameter	Unit	Conventional THP	WAS-only THP			
Streams processed	-	WAS, PS, SSO, FOG	WAS			
Pre-dewatering solids capture	-	95%	95%			
Pre-dewatered sludge TS	-	20%	18%			
Pre-dewatering energy consumption	hp	225	125			
THP feed solids content	-	16.5% (avg.)	16.5% (avg.)			
THP steam demand	lb/lb TS	0.9	0.9			
Heat requirement for steam generation	Btu/lb steam	1,197	1,197			
THP boiler efficiency	-	85%	85%			
THP operation temperature	°F	302	302			
THP reactor process energy consumption	hp	100	50			

2.1.5 Digestion Process Assumptions

Two major digestion processes were assumed in all alternatives: mesophilic digestion, which is the current process, and thermophilic digestion. Thermophilic digestion was evaluated at 10- and 15-day retention times. VSR in each alternative was calculated as a load-weighted composite of VSR assumptions for each feed stream, as detailed in Table 2-4. To summarize, VSRs for mesophilic digestion were assumed based on historical plant data received from EWA. VSRs for thermophilic digestion at 10-day retention time were assumed to be similar to those for mesophilic digestion. VSRs for 15-day thermophilic digestion were assumed to be higher for WAS and PS streams. Finally, in cases where THP is applied, VSRs are assumed to increase in downstream mesophilic digestion for those feed streams that are hydrolyzed.

Additionally, digestion enhancements to increase capacity or improve cake quality were evaluated in some alternatives, like recuperative thickening with mesophilic digesters, and the use of Class A batch tanks with thermophilic digesters at 10-day retention times. Table 2-4 summarizes the major assumptions made for digestion processes in the SWEET model.



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Table 2-4. Digestion Process Assumptions							
Parameter	Unit	Mesophilic	Thermophilic, 10-day	Thermophilic, 15-day	Post-THP Mesophilic Digestion		
Operation temperature	°F	97	131	131	97		
PS VSR	-	65%	68%	68%	68%		
WAS VSR	-	47%	47%	52%	55%		
FOG VSR	-	90%	90%	90%	90%		
SSO VSR	-	80%	80%	80%	80%		
Gas production	ft ³ /lb VS removed	18	18	18	18		
Energy consumption	hp	Variable ^a	Variable ^a	Variable ^a	Variable ^a		
Shell heat loss	-	5%	10%	10%	5%		

a. Energy consumption is calculated using input stream loading in a linear relationship with power, based on historical data.

2.1.6 Dewatering Process Assumptions (Digested Biosolids)

Three major technologies were evaluated for dewatering, including the existing centrifuges, belt filter presses, and screw presses. Each of these technologies was assumed to dewater all digested sludge. It should be noted that peak day loads that may have been applied for the sizing of processes upstream of digestion may not apply to dewatering, because some equalization is provided by digestion and digested sludge storage, using an existing smaller digester tank. Table 2-5 summarizes the major assumptions made for dewatering processes in the SWEET model.

Table 2-5. Dewatering Process Assumptions							
Parameter	Centrifuge	Belt Filter Press	Belt Filter Press (THP) ª	Screw Press			
Unit loading	lb/d	72,000	48,000	48,000	48,000		
Solids capture	-	95%	90%	95%	90%		
Dewatered cake TS	-	22%	25%	30%	25%		
Energy consumption	hp	Variable ^b	Variable ^c	Variable ^c	35		

a. Belt filter presses are assumed to perform final dewatering on all THP alternatives.

b. Centrifuge energy consumption is calculated using input stream loading in a linear relationship with power, based on historical data.

c. Belt filter press energy consumption is calculated as 50% of corresponding centrifuge energy consumption.

2.1.7 Thermal Drying Assumptions

EWPCF currently operates a single thermal dryer to produce dried pellets from dewatered cake. The dryer is operated on a 14-day cycle, where it runs for 11 days and is shut down for routine maintenance during the 3 remaining days. A review of historical data (TM 1) showed some periods of extended dryer outage, when dewatered cake was hauled off site as a Class B product. Of total annual end use production, about 3.6 percent was hauled as cake.



Among the options considered in all alternatives in connection with solids end use were (1) adding a second dryer to add capacity; (2) continuing to use a single dryer; or (3) using no dryer. In the case of using two dryers, it was assumed that cake would not typically be hauled off site, because of the unlikeliness of both dryers being out of service at the same time. When a single dryer is used, the assumption was made that about 3.6 percent of solids produced continued to be hauled off site as cake on an annual average basis. Alternatives that removed thermal drying completely used THP upstream. The combination of THP/digestion plus thermal drying was deemed to produce a less desirable final product, and the assumption was made that all dewatered cake from THP sludge would be hauled off site as a Class A Cake product. Table 2-6 summarizes the major assumptions made for thermal drying in the SWEET model.

Table 2-6. Thermal Drying Process Assumptions							
Parameter	Unit	Two Dryers	One Dryer	No Dryer			
Unit loading	dtpd	28.5 ª	18 ^b	-			
Dried pellet TS	-	94%	94%	-			
Heat requirement	BTU/Ib	1,450	1,450	-			
Energy consumption	hp	Variable ^c	Variable °	0			

a. Capacity downrated by 5%.

b. Based on 14-day dryer operation cycle.

c. Dryer energy consumption is calculated using input stream loading in a linear relationship with power based on historical data.

2.1.8 Baseline Energy Model

The baseline model describing the energy process was first built upon the solids baseline alternative using existing dissolved air flotation thickening, thermal drying, and centrifugal dewatering. Unlike the solids baseline, the energy baseline assumes a thermophilic digestion process, which allows for a higher organic loading rate (i.e., addition of HSW) and the associated increase in biogas production in comparison to mesophilic digestion for a relatively low capital investment. Assuming a greater biogas production provided better financial differentiation between the biogas utilization alternatives. An additional set of baseline scenarios using mesophilic digestion were also investigated.

Each input stream and process is captured in SWEET in a similar process as described in Section 2.1.

2.1.9 Air Permit Restrictions

In November 2017, EWA received a modified air permit for the four existing 750-kilowatt (kW) internalcombustion (IC) engines. The previous permit allowed for a total annual consumption of biogas and natural gas up to 224 million standard cubic feet (MMscf), with a maximum of 24 MMscf of natural gas; the revised permit allows up to 280 MMscf of biogas and natural gas, with a maximum of 28 MMscf of natural gas. Modifying the air permit allows EWA to operate approximately one additional 750 kW engine on a 50 percent load, bringing the total permitted power production up to the current EWPCF demand estimated in TM 1.

Figure 2-1 illustrates the various achievable power outputs for a given biogas and natural gas (NG) volume input within permit restrictions. Lines indicating the permit maximum NG annual usage (y-axis) and total gas usage (x-axis) outline the allowable ranges of biogas and NG usage. There exists a unique combination of each one's annual average flow rates that maximizes engine power output. This point is indicated by the star on Figure 2-1 and it corresponds to a value of 1.92 megawatts (MW), assuming a 34.5 percent engine electrical efficiency. For the scenario in which EWPCF electricity demand is below 1.92 MW, the range of flow rate combinations would yield an engine output equal to EWPCF demand. Depending on whether biogas or NG use is prioritized, the gas use profile can be preferentially adjusted along the desired power output line.





Figure 2-1. Several engine output lines are plotted for combinations of biogas and NG usage The permitted values of 28 MMscf/year of natural gas and 280 MMscf/year of combined biogas and natural gas are plotted and outline the limits of engine power production. The green area represents possible combinations of DG and NG use.

These gas use restrictions and optimization strategies were applied to the energy alternatives to maximize electricity generation, pipeline injection of upgraded biogas, or both.

2.1.10 Internal-Combustion Engine Assumptions

IC engines produce power to offset purchased energy and reduce peak demand and non-coincident demand charges. IC engines, however, are subject to standby charges based on installed nameplate capacity. IC engines can operate on biogas, natural gas, or both up to the amount permitted by the San Diego Air Pollution Control District. The production capacity and ultimate power generation of each IC engine module in SWEET was dictated by the air permit and the end-to-end alternative goal (maximize electricity generation or pipeline injection). Table 2-7 summarizes the major process assumptions used for the IC engine units in the SWEET model. Although the installed engine capacity is 2.25 MW, the permit limit of 1.92 MW calculated in Section 2.1.9 was the maximum power output used in the SWEET model. One alternative explores the case where EWA pursues a new air permit, which would likely require engine exhaust treatment, so that EWPCF can run a large-scale cogeneration operation up to 5 MW and export power to its member agencies.



Table 2-7. IC Engine Process Assumptions					
Parameter	Unit	Value			
Engine electrical efficiency: existing engines	-	34.5%			
Engine electrical efficiency: new engines Alternative 12S	-	39%			
Thermal efficiency	-	40%			
Installed capacity	MW	2.25			
NG lower heating value	Btu/ft ³	909			
DG lower heating value	Btu/ft ³	560			
Process energy consumption	hp	Variable ^a			

a. IC engine energy consumption is calculated using input stream loading in a linear relationship with power, based on historical data.

Selective catalytic reduction (SCR) is an IC engine exhaust treatment technology that greatly reduces nitrogen oxides emissions and is discussed in TM 4. SCR was originally considered as an alternative for the existing engines to unlock additional engine capacity, but the revised permit achieved the same goal without capital investment. However, SCR is explored in several alternatives in addition to other process changes where engines operate on natural gas.

2.1.11 Gas Conditioning Assumptions

Several alternatives include the addition of a gas conditioning system (GCS) that removes moisture, hydrogen sulfide, siloxanes, and potentially ammonia from digester gas (DG) prior to utilization. While the GCS requires upfront capital costs, the IC engines, solids dryer, and potential microturbines (described below) benefit from cleaner gas being delivered to the equipment. Table 2-8 lists capital and project cost assumptions related to gas conditioning that were used in developing the net present value (NPV).

Table 2-8. Gas Conditioning Cost Assumptions				
Cost Element	Capital Cost	Project Cost		
GCS: 650 scfm	\$3.3M	\$4.3M		
GCS: 800 scfm	\$3.7M	\$4.8M		
GCS: 1,200 scfm	\$4.8M	\$6.2M		

2.1.12 Microturbine Assumptions

The installation and use of microturbines increase onsite power production while working around the existing air permit. Microturbines can utilize any digester gas beyond what the current air permit allows the engines to use and are a low-emission technology. Gas conditioning and compression up to 80 pounds per square inch gauge (psig) is required upstream of the microturbines. Table 2-9 lists the process assumptions for microturbine modules in the SWEET model.



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Table 2-9. Microturbine Process Assumptions						
Parameter	Unit	Value				
Microturbine electrical efficiency	-	31%				
Thermal efficiency	-	21%				
Installed capacity	MW	0.40				
Microturbine uptime	-	90%				
Process energy consumption	hp	Variable ^a				
Capital cost	\$	4.0M				
Project cost	\$	5.2M				

a. IC engine energy consumption is calculated using input stream loading in a linear relationship with power, based on historical data.

2.1.13 Biogas Upgrading and Pipeline Injection

A biogas upgrading system (BUS) includes the same gas conditioning as conventional treatment, in addition to carbon dioxide (CO₂) and methane (CH₄) separation to produce renewable natural gas (RNG) suitable for sale via utility pipeline injection. This system achieves the highest value of biogas if environmental attributes such as renewable identification numbers (RINs) and Low Carbon Fuel Standard (LCFS) credits are in place. The Renewable Fuel Standard (RFS) RINs and LCFS programs are previously discussed in TMs 4 and 8. The pipeline injection alternatives can be standalone or coupled with engine and solar options to offset the amount of power that EWA purchases. BUSs in SWEET were either 800 or 1,400-standard-cubic-foot per minute (scfm) capacity systems. When all biogas is sent to the pipeline, it is assumed that a boiler will provide heat for the digesters. It is more economical to fuel the hot water boiler with natural gas than digester gas because digester gas is significantly more valuable as a renewable fuel. Table 2-10 lists the process assumptions for the biogas upgrading and pipeline injection processes and Table 2-11 summarizes the cost assumptions for the various alternative sizes.

Table 2-10. Biogas Upgrading System Process Assumptions					
Parameter	Unit	Value			
System uptime	-	95%			
CH ₄ recovery	-	99.5%			
Installed capacity	scfm	Varies depending on HSW quantity and alternative			
Ethanol LHV	Btu/gal	76,330			



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Table 2-11. Pipeline Injection Cost Assumptions						
Cost Element Capital Cost Project Cost						
BUS: 1,400 scfm	\$16.9M	\$22.0M				
BUS: 1,200 scfm	\$16.3M	\$21.2M				
BUS: 800 scfm	\$13.0M	\$16.9M				
BUS: 650 scfm	\$11.7M	\$15.3M				
BUS: 200 scfm	\$7.8M	\$10.2M				

Note: These costs assume interconnection fees are included.

2.1.14 Solar

Solar panels installed over the existing equalization basins or aeration basins, or in a 5-acre lot, can provide supplemental power for EWPCF when the IC engines reach permitted capacity or when digester gas is being utilized for pipeline injection instead of onsite power generation. Several SWEET alternatives incorporate solar power in one of these three areas using power generation and cost assumptions listed in Table 2-12. The "capacity factor" listed below refers to the ratio of the expected actual average power output to the installed nameplate capacity of the solar panels.

Table 2-12. Solar Process Assumptions					
Parameter	Unit	Value			
Equalization basin installed capacity	MW	0.13			
Aeration basin installed capacity	MW	0.40			
5-acre lot installed capacity	MW	0.80			
Capacity factor	-	18.3%			

2.1.15 Net Electric Metering

Several SWEET alternatives result in EWPCF electricity production that exceeds EWPCF demand. This excess electricity can be sold to the utility for revenue via net electric metering (NEM). Economic assumptions of this process are described in Section 2.2.1. An assumed project cost of \$2 million is assumed for NEM upgrades at EWPCF.

Switching to an NEM tariff would eliminate the current standby charge. This is a significant portion of EWA's electric bill.

2.1.16 Carbon Monoxide Catalyst

Installing a carbon monoxide (CO) catalyst would provide an opportunity for EWA to pursue a revised air permit. The current permit limits the quantity of gas that can be combusted in the engine based on a CO emissions requirement. By installing a CO catalyst on the engine exhaust, CO emissions can be reduced to a level at which a revised air permit allows for additional gas to be combusted. A robust gas conditioning system is required upstream of the engine to remove siloxanes to non-detect levels and prevent catalyst fouling.



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2.2 Cost Assumptions

The following section describes the various assumptions made on capital costs, operating costs and repair and replacement for SWEET life-cycle cost analysis.

2.2.1 Capital Costs

Capital costs were estimated using several sources. Detailed cost estimating was not performed, but in many cases available costs from other appropriate biosolids projects in neighboring areas of Southern California were used. Capital cost estimates in this analysis are considered less reliable than a Class V estimate as defined by the American Association of Cost Engineering (AACE) (minus 50 percent, plus 100 percent). As such, capital cost estimates in this document should be used for comparison only, and not be used for capital budgeting.

Capital costs for each solids/energy option were tabulated based on the following sub-categories:

- 1. Civil and Structural Costs
- 2. Demolition Costs
- 3. Mechanical Costs (Included allowances for mechanical piping and installation)
- 4. Electrical, Instrumentation & Control Costs (Assumed to be 25 percent of mechanical equipment costs)

Project costs were then calculated by applying the following mark ups on the capital costs:

- 1. Contingency= 30 percent
- 2. Engineering and Administration= 20 percent

The following Table 2-13 represents the capital costs for the biosolids alternatives.

Table 2-13. Capital Costs Assumptions for Biosolids Alternatives					
Cost Element	Capital Cost	Project Cost			
Systems					
DAF Rehabilitation (Alts assuming DAFs)	\$3.6M	\$5.6			
RDT (WAS only)	\$4.6M	\$7.2M			
RDT (Co-thickening)	\$5.96M	\$9.3M			
Digester Improvements (Dig 4, 5 & 6)	\$2.39M	\$3.72M			
HSW Receiving Upgrades	\$0.5M	\$0.78M			
New HSW Receiving Station	\$3M	\$4.68M			
Digester (Omnivore I)	\$3.7M	\$5.77M			
Digester (Omnivore II)	\$3.7M	\$5.77M			
Thermophilic 15-day Upgrades	\$2.5M	\$3.9M			
Thermophilic 10-day Upgrades	\$3.69M	\$5.76M			
Centrifuge Upgrades	\$3M	\$4.68M			
Existing Dryer Modifications	\$2M	\$3.12M			
New Second Dryer (Includes dryer modifications)	\$14.52M	\$22.65M			
Class B Truck Loadout and Odor Control	\$10M	\$15.6M			
Truck Traffic Improvements	\$1.5M	\$2.34M			

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Table 2-14. Capital Costs Assumptions for Energy Alternatives					
Cost Element	Capital Cost	Project Cost			
Systems					
GCS - 650 scfm	\$3.3M	\$4.3M			
GCS - 800 scfm	\$3.7M	\$4.8M			
GCS - 1200 scfm	\$4.8M	\$6.2M			
SCR	\$3.0M	\$3.9M			
CO Catalyst	\$0.7M	\$1.0M			
Microturbines w/ Compression	\$4.0M	\$5.2M			
BUS - 1400 SCFM	\$17.0M	\$22.0M			
BUS - 1200 SCFM	\$16.3M	\$21.2M			
BUS - 800 SCFM	\$13.0M	\$16.9M			
BUS - 650 SCFM	\$11.7M	\$15.3M			
BUS - 200 SCFM	\$7.8M	\$10.2M			
Solar Installation - 130 kW	\$0.4M	\$0.5M			
Solar Installation - 400 kW	\$0.8M	\$1.0M			
Solar Installation - 800 kW	\$1.5M	\$2.0M			
Net Metering	\$1.5M	\$2.0M			

The following Table 2-14 represents the capital costs for the energy alternatives.

2.2.2 Operating Costs

The life-cycle cost evaluation of alternatives includes estimates of both operating costs and capital costs. To the best degree possible, operating cost estimates reflect the actual operating parameters and unit costs at EWPCF. Information was requested and received from EWA operations staff for labor; materials-chemicals; utilities such as water, natural gas (NG), and electricity; and biosolids trucking/disposition costs. Table 2-15 summarizes the basis of operations and maintenance (O&M) costs used. In some cases, future estimates are made for these products or situations.

Table 2-15. Assumptions on Operations and Maintenance Costs				
Cost Element	Value in Model			
Electricity used, \$/kWh	\$0.09			
Exported electricity produced, \$/kWh	\$0.04 (future estimate)			
NG unit cost, \$/therm	\$0.31			
Potable water, \$/gal	\$0.013			
Pellets disposition, \$/wet ton	\$16.00			
Class B cake hauling, \$/wet ton	\$48.00			
Class A cake hauling, \$/wet ton	\$41.00 (future option estimate)			

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Class A cake composting, \$/wet ton\$60.00 (future option estimate)Polymer, \$/Ib\$1.20.abor: maintenance, \$/hr\$69.63.abor: operations, \$/hr\$69.79CG tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.04Storted electricity cost, \$/kWh\$0.09Exported electricity price (\$/kWh)\$0.04IG unit cost (\$/therm)\$0.31Standby power charge, annual\$391,068Current standby power charge, annual\$255,923Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, \$/kW\$24.51Peak demand, \$/kW\$1.20SGIP, \$/watt\$1.20Soiler O&M: annual (without SSO)\$11.20Soiler O&M: no gas conditioning, \$/kWh\$0.03Cogen O&M: no gas conditioning, \$/kWh\$0.015Sas conditioning O&M, \$/kWh\$0.015	Table 2-15. Assumptions on Operations and Maintenance Costs				
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abor: maintenance, \$/hr\$69.63abor: operations, \$/hr\$69.63.abor: operations, \$/hr\$69.79COG tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.04Sector cost, \$/kWh\$0.09Sector cost, \$/kWh\$0.04Guint cost (\$/therm)\$0.31Standby power charge, \$/kW\$14.20Current standby power charge, annual\$391,068Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, \$/kW\$24.51Peak demand, \$/kW\$7.56Renewable Fuel Standard RINS, D3, \$/RIN\$2.00CFS: DG \$/DGE\$0.70SGIP, \$/watt\$1.20Boiler O&M: annual (without SSO)\$12,000Boiler O&M: annual (with HSW)\$15,000Cogen O&M: no gas conditioning, \$/kWh\$0.015Sas conditioning O&M, \$/kWh\$0.005SCR O&M, \$/kWh\$0.015	Class A cake composting, \$/wet ton	\$60.00 (future option estimate)			
abor: operations, \$/hr\$69.79:OG tipping fee, \$/gal\$0.04:SO tipping fee, \$/gal\$0.04:SO tipping fee, \$/gal\$0.04:Electricity cost, \$/kWh\$0.09:Exported electricity price (\$/kWh)\$0.04IG unit cost (\$/therm)\$0.31:Standby power charge, \$/kW\$14.20:Current standby power charge, annual\$391,068:Current standby power charge, annual\$255,923:Current non-coincident demand charge, annual\$24.51:Peak demand, \$/kW\$7.56:Renewable Fuel Standard RINs, D3, \$/RIN\$2.00:CFS: DG \$/DGE\$0.70:GGIP, \$/watt\$11.20:Boiler 0&M: annual (with HSW)\$15,000:Sogen 0&M: no gas conditioning, \$/kWh\$0.015:Sogen 0&M with gas conditioning, \$/kWh\$0.015:Soc 0&M, \$/kWh\$0.015	Polymer, \$/lb	\$1.20			
OG tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.09Exported electricity price (\$/kWh)\$0.04IG unit cost (\$/therm)\$0.31Standby power charge, \$/kW\$14.20Current standby power charge, annual\$391,068Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, \$/kW\$24.51Peak demand, \$/kW\$7.56Renewable Fuel Standard RINs, D3, \$/RIN\$2.00CFS: DG \$/DGE\$0.70SGIP, \$/watt\$1.20Boiler O&M: annual (with HSW)\$15,000Soler O&M: annual (with HSW)\$0.03Cogen O&M with gas conditioning, \$/kWh\$0.015Sas conditioning 0&M, \$/kWh\$0.005SCR 0&M, \$/kWh\$0.015	Labor: maintenance, \$/hr	\$69.63			
SSO tipping fee, \$/gal\$0.04SSO tipping fee, \$/gal\$0.09Electricity cost, \$/kWh\$0.09Exported electricity price (\$/kWh)\$0.04IG unit cost (\$/therm)\$0.31Standby power charge, \$/kW\$14.20Current standby power charge, annual\$391,068Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, \$/kW\$24.51Peak demand, \$/kW\$7.56Renewable Fuel Standard RINs, D3, \$/RIN\$2.00.CFS: DG \$/DGE\$0.70SGIP, \$/watt\$1.20Boiler O&M: annual (without SSO)\$12,000Boiler O&M: annual (with HSW)\$0.03Cogen O&M: no gas conditioning, \$/kWh\$0.015Sas conditioning O&M, \$/kWh\$0.015Sar Co &M, \$/kWh\$0.015	Labor: operations, \$/hr	\$69.79			
Clear Hold of HoldStandardClear Hold of Hold\$0.09Exported electricity price (\$/kWh)\$0.04IG unit cost (\$/therm)\$0.31Standby power charge, \$/kW\$14.20Current standby power charge, annual\$391,068Current standby power charge, annual\$255,923Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, \$/kW\$24.51Peak demand, \$/kW\$7.56Renewable Fuel Standard RINs, D3, \$/RIN\$2.00.CFS: DG \$/DGE\$0.70SGIP, \$/watt\$1.20Boiler O&M: annual (without SSO)\$12,000Boiler O&M: annual (with HSW)\$0.03Cogen O&M: no gas conditioning, \$/kWh\$0.015Scas conditioning 0&M, \$/kWh\$0.015Scas conditioning 0&M, \$/kWh\$0.015	FOG tipping fee, \$/gal	\$0.04			
Exported electricity price (\$/kWh)\$0.04IG unit cost (\$/therm)\$0.31Standby power charge, \$/kW\$14.20Current standby power charge, annual\$391,068Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, annual\$24.51Peak demand, \$/kW\$7.56Renewable Fuel Standard RINs, D3, \$/RIN\$2.00CFS: DG \$/DGE\$0.70SGIP, \$/watt\$1.20Boiler O&M: annual (without SSO)\$12,000Boiler O&M: annual (with HSW)\$15,000Cogen O&M: no gas conditioning, \$/kWh\$0.015Sca conditioning 0&M, \$/kWh\$0.005SGR 0&M, \$/kWh\$0.015	SSO tipping fee, \$/gal	\$0.04			
IG unit cost (\$/therm) \$0.31 Standby power charge, \$/kW \$14.20 Current standby power charge, annual \$391,068 Current non-coincident demand charge, annual \$255,923 Current non-coincident demand charge, annual \$24.51 Peak demand, \$/kW \$7.56 Renewable Fuel Standard RINs, D3, \$/RIN \$2.00 CFS: DG \$/DGE \$0.70 SGIP, \$/watt \$1.20 Boiler 0&M: annual (without SSO) \$12,000 Boiler 0&M: annual (with HSW) \$15,000 Cogen 0&M: no gas conditioning, \$/kWh \$0.015 Sas conditioning 0&M, \$/kWh \$0.005 ScR 0&M, \$/kWh \$0.015	Electricity cost, \$/kWh	\$0.09			
Standby power charge, \$/kW\$14.20Current standby power charge, annual\$391,068Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, \$/kW\$24.51Peak demand, \$/kW\$7.56Renewable Fuel Standard RINs, D3, \$/RIN\$2.00.CFS: DG \$/DGE\$0.70SGIP, \$/watt\$1.20Boiler O&M: annual (without SSO)\$12,000Boiler O&M: annual (with HSW)\$15,000Cogen O&M: no gas conditioning, \$/kWh\$0.015Sas conditioning O&M, \$/kWh\$0.005SCR O&M, \$/kWh\$0.015	Exported electricity price (\$/kWh)	\$0.04			
Current standby power charge, annual\$391,068Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, \$/kW\$24.51Peak demand, \$/kW\$7.56Renewable Fuel Standard RINs, D3, \$/RIN\$2.00.CFS: DG \$/DGE\$0.70SGIP, \$/watt\$1.20Boiler O&M: annual (without SSO)\$12,000Boiler O&M: annual (with HSW)\$15,000Cogen O&M: no gas conditioning, \$/kWh\$0.03Cogen O&M with gas conditioning, \$/kWh\$0.005SGR O&M, \$/kWh\$0.005	NG unit cost (\$/therm)	\$0.31			
Current non-coincident demand charge, annual\$255,923Current non-coincident demand charge, \$/kW\$24.51Ceak demand, \$/kW\$7.56Renewable Fuel Standard RINs, D3, \$/RIN\$2.00CFS: DG \$/DGE\$0.70GGIP, \$/watt\$1.20Boiler 0&M: annual (without SSO)\$12,000Boiler 0&M: annual (with HSW)\$15,000Cogen 0&M: no gas conditioning, \$/kWh\$0.03Cogen 0&M with gas conditioning, \$/kWh\$0.015Casa conditioning 0&M, \$/kWh\$0.015Core 0&M, \$/kWh\$0.015	Standby power charge, \$/kW	\$14.20			
Current non-coincident demand charge, \$/kW\$24.51Peak demand, \$/kW\$7.56Renewable Fuel Standard RINs, D3, \$/RIN\$2.00CFS: DG \$/DGE\$0.70GGIP, \$/watt\$1.20Boiler 0&M: annual (without SSO)\$12,000Boiler 0&M: annual (with HSW)\$15,000Cogen 0&M: no gas conditioning, \$/kWh\$0.03Cogen 0&M with gas conditioning, \$/kWh\$0.015Cogen 0&M, \$/kWh\$0.005Cogen 0&M, \$/kWh\$0.015	Current standby power charge, annual	\$391,068			
Peak demand, \$/kW \$7.56 Renewable Fuel Standard RINs, D3, \$/RIN \$2.00 CCFS: DG \$/DGE \$0.70 GGIP, \$/watt \$1.20 Boiler O&M: annual (without SSO) \$12,000 Boiler O&M: annual (with HSW) \$15,000 Cogen O&M: no gas conditioning, \$/kWh \$0.03 Cogen O&M with gas conditioning, \$/kWh \$0.015 Gas conditioning O&M, \$/kWh \$0.005	Current non-coincident demand charge, annual	\$255,923			
Renewable Fuel Standard RINs, D3, \$/RIN \$2.00 CFS: DG \$/DGE \$0.70 SGIP, \$/watt \$1.20 Boiler 0&M: annual (without SSO) \$12,000 Boiler 0&M: annual (with HSW) \$15,000 Cogen 0&M: no gas conditioning, \$/kWh \$0.03 Cogen 0&M with gas conditioning, \$/kWh \$0.015 Gas conditioning 0&M, \$/kWh \$0.005 SGR 0&M, \$/kWh \$0.015	Current non-coincident demand charge, \$/kW	\$24.51			
CFS: DG \$/DGE \$0.70 GGIP, \$/watt \$1.20 Boiler O&M: annual (without SSO) \$12,000 Boiler O&M: annual (with HSW) \$15,000 Cogen O&M: no gas conditioning, \$/kWh \$0.03 Cogen O&M with gas conditioning, \$/kWh \$0.015 Gas conditioning O&M, \$/kWh \$0.005 GCR O&M, \$/kWh \$0.015	Peak demand, \$/kW	\$7.56			
GGIP, \$/watt \$1.20 Boiler O&M: annual (without SSO) \$12,000 Boiler O&M: annual (with HSW) \$15,000 Cogen O&M: no gas conditioning, \$/kWh \$0.03 Cogen O&M with gas conditioning, \$/kWh \$0.015 Gas conditioning O&M, \$/kWh \$0.005 Gas Conditioning O&M, \$/kWh \$0.015	Renewable Fuel Standard RINs, D3, \$/RIN	\$2.00			
Boiler O&M: annual (without SSO) \$12,000 Boiler O&M: annual (with HSW) \$15,000 Cogen O&M: no gas conditioning, \$/kWh \$0.03 Cogen O&M with gas conditioning, \$/kWh \$0.015 Gas conditioning O&M, \$/kWh \$0.005 SCR O&M, \$/kWh \$0.015	LCFS: DG \$/DGE	\$0.70			
Boiler O&M: annual (with HSW)\$15,000Cogen O&M: no gas conditioning, \$/kWh\$0.03Cogen O&M with gas conditioning, \$/kWh\$0.015Gas conditioning O&M, \$/kWh\$0.005GCR O&M, \$/kWh\$0.015	SGIP, \$/watt	\$1.20			
Cogen 0&M: no gas conditioning, \$/kWh\$0.03Cogen 0&M with gas conditioning, \$/kWh\$0.015Gas conditioning 0&M, \$/kWh\$0.005GCR 0&M, \$/kWh\$0.015	Boiler O&M: annual (without SSO)	\$12,000			
Cogen 0&M with gas conditioning, \$/kWh\$0.015Gas conditioning 0&M, \$/kWh\$0.005GCR 0&M, \$/kWh\$0.015	Boiler O&M: annual (with HSW)	\$15,000			
Gas conditioning 0&M, \$/kWh \$0.005 SCR 0&M, \$/kWh \$0.015	Cogen O&M: no gas conditioning, \$/kWh	\$0.03			
SCR 0&M, \$/kWh \$0.015	Cogen O&M with gas conditioning, \$/kWh	\$0.015			
	Gas conditioning O&M, \$/kWh	\$0.005			
CNG 0&M, \$/MMscf \$540	SCR O&M, \$/kWh	\$0.015			
	CNG O&M, \$/MMscf	\$540			

Additionally, incentivized credits for producing RNG are based on current trading values as of November 2017. Broker fees for bundling and selling the RINs and LCFS credits typically range from 15 to 20 percent of the sale. To account for broker fees, the RINs were assigned a lower trading value in the D5 advanced biofuels category; D3 cellulosic RINs currently trade for up to three times the value of D5 RINs, which are generated from HSW in comparison to the D3 RINs, which are generated from municipal wastewater. The RFS and LCFS programs are currently expected to last through 2022 and 2030, respectively. These programs are expected to continue after the published program dates, but are not guaranteed; therefore, the SWEET evaluation conservatively assumes the current program durations.

The life-cycle cost analysis (BCE) was performed over a 20-year period that included a 4.0 percent escalation rate and a 3.5 percent discount rate. No risks associated with equipment failure, operation, and maintenance were included; however, benefits associated for FOG tipping and source-separated organics (SSO) tipping were accounted for in the analysis.



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2.2.3 Repair and Replacement Costs

Costs associated with repair and replacement of mechanical equipment was assumed to occur once over the 20-year life-cycle analysis. Service life for all mechanical equipment was assumed to be 15 years.

Section 3: SWEET Model Results – Round 1A

For Round 1A of SWEET analysis two separate models were developed, one for biosolids evaluation and one for energy evaluation respectively. The following sections describe the evaluation of each of the models.

3.1 SWEET Round 1A Biosolids Alternatives

End-to-end alternatives were developed using combinations of the above options for thickening, digestion, dewatering, and drying, as deemed relevant. A summary of the solids alternatives considered for Round 1A is provided in Table 3-1.

3.1.1 Solids Stream Comparison Themes

To evaluate alternatives in a more definitive manner, alternatives were selected for comparison such that all but one process remain constant. The major comparison themes were thickening, stabilization (digestion), THP, Class A solids production, and thermal drying.

3.1.1.1 Thickening

The two major thickening technologies evaluated—WAS-only thickening using existing DAFTs, and cothickening using RDT units—were compared across varying digestion options: specifically, mesophilic, thermophilic with 10-day retention time, and thermophilic with 15-day retention time with two dryers for thermal drying.

3.1.1.2 Stabilization (Digestion)

As one of the major solids stream processes, digestion processes were also compared internally where variables in other processes were held constant. Alternatives where RDT is used for co-thickening, centrifuges for dewatering, with a single dryer, were used to compare the three digestion processes (mesophilic, thermophilic 10-day, and thermophilic 15-day). Thermophilic digestion with 10-day retention time was also evaluated with the use of batch tanks to produce a Class A Cake, amounting to four stabilization options that were compared within this theme. It is important to mention that Thermophilic 10-day digestion process offers more flexibility in terms of digester capacity by allowing the retention time to go down to 10 days; however, in reality, the thermophilic digesters would normally be operated closer to 15 days' retention time.

3.1.1.3 THP

Several alternatives were considered that use THP/digestion configurations. Two THP configurations were evaluated: one that receives all feed streams, and another that receives WAS only. Several THP reactor sizes were also evaluated within each of these streams, with the differing sizes contributing to varying capital cost. The THP alternatives were compared to corresponding alternatives with mesophilic digestion and thermophilic digestion at a 15-day retention time.

3.1.1.4 Class A Cake Production

Alternatives that produce Class A cake were also evaluated for comparison from an end-use perspective. These included all THP alternatives, and thermophilic digestion alternatives with Class A batch tanks.



Table 3-1. Overview of Solids Alternatives Evaluated (Round 1A)										
Alternative No.	Stream Thickened	Thickening Process	SSO Input	Thermal Hydrolysis ^a	Digestion Process	Digestion Enhancements	Dewatering Process	Cake	No. of Dryers	Pellets
1	WAS	DAF	Yes	None	Mesophilic	None	Centrifuge	Class B	1	Yes
2	WAS	DAF	Yes	None	Mesophilic	None	Centrifuge	None	2	Yes
3	WAS + PS	RDT	Yes	None	Mesophilic	None	Centrifuge	Class B	1	Yes
4	WAS + PS	RDT	Yes	None	Mesophilic	None	Centrifuge	None	2	Yes
5	WAS	DAF	Yes	None	Thermophilic, 10-day	None	Centrifuge	None	2	Yes
6	WAS + PS	RDT	Yes	None	Thermophilic, 10-day	None	Centrifuge	Sub Class B	1	Yes
7	WAS + PS	RDT	Yes	None	Thermophilic, 10-day	Class A batch tanks	Centrifuge	Class A	1	Yes
8	WAS + PS	RDT	Yes	None	Thermophilic, 10-day	None	Centrifuge	None	2	Yes
9	WAS	DAF	Yes	None	Thermophilic, 15-day	None	Centrifuge	Class B	1	Yes
10	WAS	DAF	Yes	None	Thermophilic, 15-day	None	Centrifuge	None	2	Yes
11	WAS + PS	RDT	Yes	None	Thermophilic, 15-day	None	Centrifuge	None	2	Yes
12	WAS + PS	RDT	Yes	None	Thermophilic, 15-day	None	Centrifuge	Class B	1	Yes
13	WAS + PS	RDT	Yes	Traditional Cambi, B6-4 reactors (1+1)	Mesophilic	None	Belt filter press	Class A	0	No
14	WAS + PS	RDT	Yes	Traditional Cambi, B6-3 reactors (2+1)	Mesophilic	None	Belt filter press	Class A	0	No
15	WAS + PS	RDT	Yes	Traditional Cambi, B6-4 reactors (1+0)	Mesophilic	None	Belt filter press	Class A	0	No
16	WAS	DAF	Yes	Traditional Cambi, B2-4 reactors (2+1)	Mesophilic	None	Belt filter press	Class A	0	No
17	WAS	RDT	Yes	WAS only Cambi, 2+1 B2-4 reactors (1+0)	Mesophilic	None	Belt filter press	None	2	Yes
18	WAS	RDT	Yes	WAS only Cambi, B6-3 reactors (1+0)	Mesophilic	None	Belt filter press	Class B	1	Yes
19	WAS	DAF	Yes	WAS only Cambi, B2-4 reactors (2+0)	Mesophilic	None	Belt filter press	Class B	1	Yes

a. Alternatives using THP assume Cambi reactors. Cambi reactor types are shown, with the number of service and standby units.



3.1.1.5 Thermal Drying

The major options in terms of drying were the continued operation of the single existing thermal dryer, or the operation of two dryers, with the purchase and installation of a new unit. One- and two-dryer alternatives were compared within each digestion option. This included mesophilic digestion, thermophilic at 10-day retention time, thermophilic at 15-day retention time, and WAS-only THP. Conventional THP alternatives were not considered here because they do not assume the need for a dryer.

3.1.2 Economic Evaluation of Solids Stream Alternatives

This section presents the results from the Round 1A SWEET life-cycle analysis for the solids alternatives described previously. The results are presented in the form of bar charts that show the stacking of capital costs and running costs as seen on Figure 3-1. The running costs include all O&M costs, repair and replacement costs, and any associated benefits from FOG and SSO tipping. The stacked bars add up to the NPV over the 20-year planning period for each alternative. The following Table 3-2 shows the breakdown of capital and O&M costs in terms of NPV for all alternatives under evaluation.

	Table 3-2. Cost Summary for Solids Alternatives							
Number	Description	Capital Cost (\$M)	0&M (\$M)	Total NPV (\$M)				
1	DAF-Meso-CD-1D	20.69	107.25	127.94				
2	DAF-Meso-CD-2D	45.13	131.97	177.10				
3	RDT-Meso-CD-1D	24.38	99.30	123.68				
4	RDT-Meso-CD-2D	48.83	124.94	173.77				
5	DAF-Thermo10d-CD-2D	43.10	126.11	169.21				
6	DAF-Thermo10d-CD-1D	22.35	99.77	122.12				
7	RDT-Thermo10d+BT-CD-1D	28.35	102.71	131.07				
8	RDT-Thermo10d-CD-2D	46.80	118.90	165.70				
9	DAF-Thermo15d-CD-1D	24.33	107.62	131.95				
10	DAF-Thermo15d-CD-2D	48.78	132.99	181.77				
11	RDT-Thermo15d-CD-2D	52.48	125.89	178.37				
12	RDT-Thermo15d-CD-1D	28.03	100.26	128.29				
13	RDT-CambiB6-4(1+1)-BFP-0D	88.90	132.17	221.07				
14	RDT-CambiB6-3(2+1)-BFP-0D	99.26	139.40	238.66				
15	RDT-CambiB6-4(1+0)-BFP-0D	74.77	122.42	197.19				
16	DAF-CambiB2-4(4+0)-BFP-0D	75.30	129.52	204.82				
17	RDT(WAS)-CambiB6-2-BFP-2D	100.29	153.55	253.84				
18	RDT(WAS)-CambiB6-2-BFP-1D	75.84	127.66	203.50				
19	DAF(WAS)-CambiB2-4(2+0)-BFP-1D	54.38	130.33	184.71				

a. (Duty + standby) unit configuration for THP reactors.



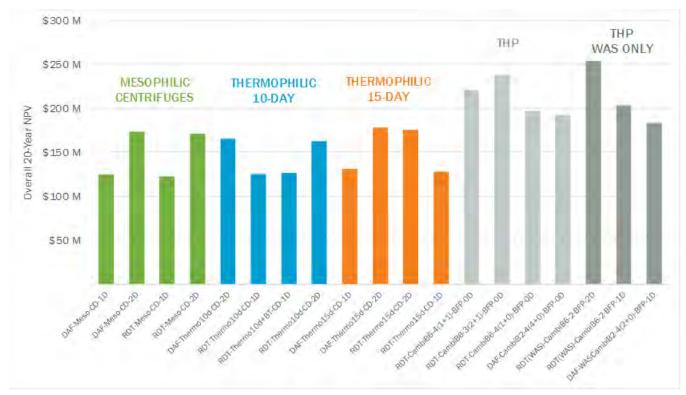


Figure 3-1. Overall 20-year NPV for solids alternatives

3.1.2.1 Thickening Comparison

Figure 3-2 extracts the comparable thickening alternatives from the broader group presented on Figure 3-1 to allow for easier comparison. Overall, the results displayed on Figure 3-2 suggest that the life-cycle costs of RDTs versus rehabilitation of the existing thickening system are comparable. The similarity in overall NPV for the RDT and DAF alternatives is due to the RDT alternative including a higher capital cost but lower operating costs when compared to the DAF alternative.

In addition, the life-cycle costs demonstrate a payback over the planning period with seven RDTs installed. Another option would be to install fewer units for a lower initial capital cost and expand to all seven units in the future, as solids loads to the EWPCF increase. Aiding the final selection of RDTs is the fact that switching thickening technologies opens valuable plant footprint for other processes.



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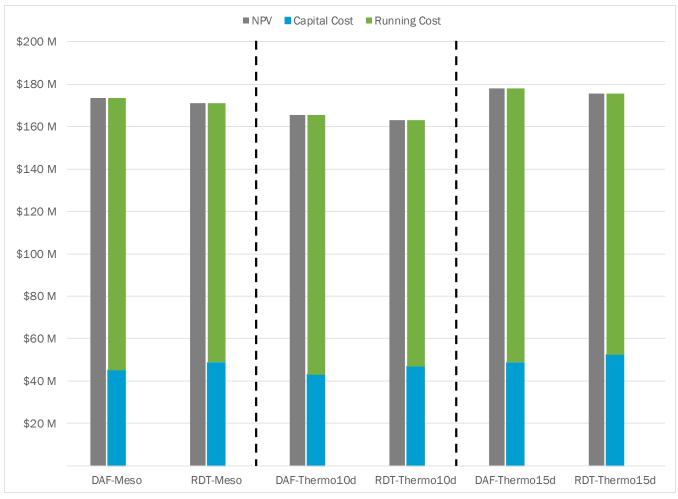


Figure 3-2. Comparison of thickening systems (assuming two dryers)

3.1.2.2 Stabilization Comparison

Figure 3-3 compares the stabilization options side by side. Note that these alternatives have energy implications that could not be fully analyzed until each alternative was combined with one or more energy alternatives. Items of note regarding the stabilization comparison that could be made from this analysis were:

- It is evident that 15-day thermophilic and mesophilic alternatives perform similarly (Figure 3-3).
- Better distinction between thermophilic 10-day and thermophilic 15-day alternatives can be made once these are evaluated together with energy alternatives.



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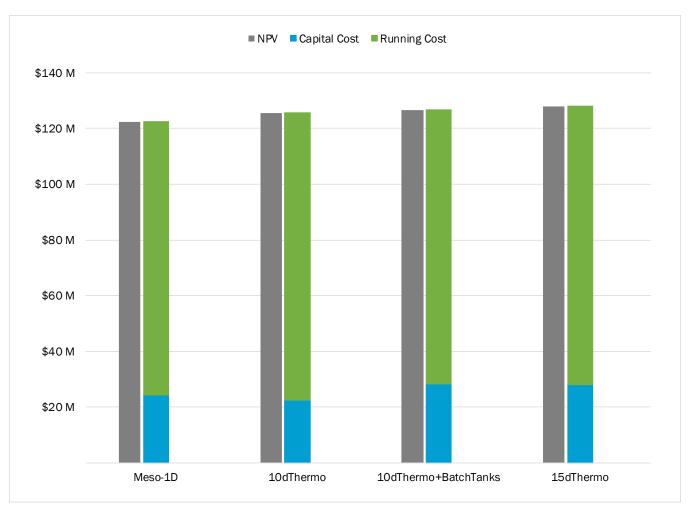


Figure 3-3. Comparison of stabilization options (assuming RDTs and 1 dryer)

3.1.2.3 THP Comparison

The primary purposes of comparing THP alternatives (Figure 3-4) was to identify the best performing configuration for THP at EWPCF. As with the digestion alternatives, a full comparison is not possible without including corresponding energy alternatives. Below are items of note regarding the THP comparison:

- WAS-only THP, designed as a lower capital alternative, does not confer any advantage in terms of eliminating a need for a second dryer or in providing a Class A alternative.
- THP/Digestion alternatives are not combined with thermal drying due to final product concerns.



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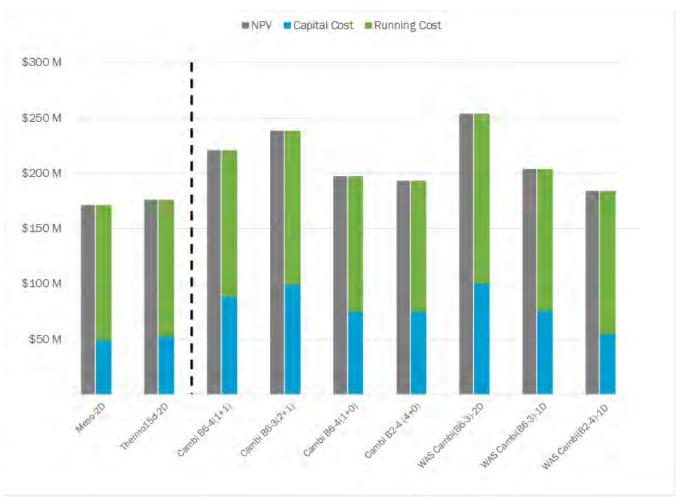


Figure 3-4. Comparison of THP options

3.1.2.4 Class A Comparison

All alternatives that consisted of two dryers, full THP, and 10-day thermophilic with batch tanks were considered to produce Class A out of EWPCF. The results from the evaluation are shown on Figure 3-5 below All Class A alternatives shall be carried forward to the next round of evaluation when combined with energy options to get a clearer picture of how end-use impacts overall life-cycle costs.



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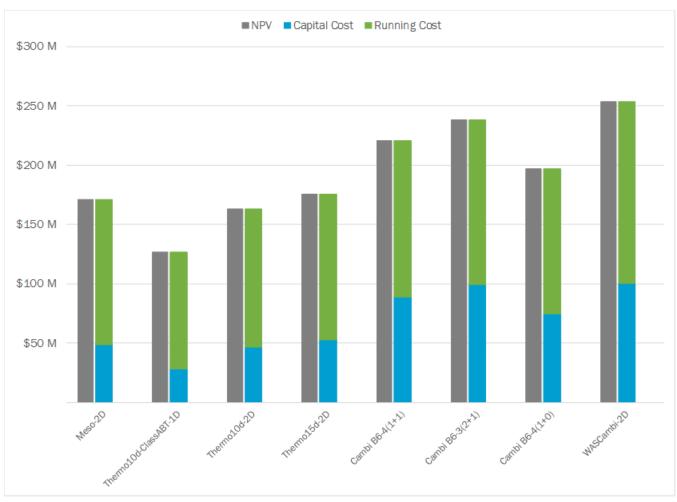


Figure 3-5. Comparison of Class A options (assuming RDTs)

3.1.2.5 Dryer Evaluation

The main purpose of the dryer comparison was to evaluate the overall performance of one dryer versus two dryers (see following Figure 3-6). The results of the evaluation show that the one dryer alternative (two different biosolids products out of EWPCF) is less costly over the life cycle. All dryer alternatives shall be carried forward to the next round of evaluation when combined with energy options. This would provide a clearer picture on energy utilization since different quantities of digester gas would be sent to the dryer based on type of digestion process under evaluation.



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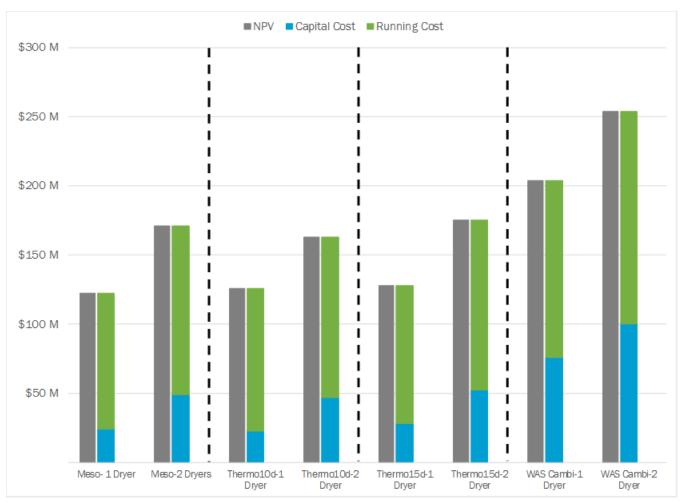


Figure 3-6. Comparison of one dryer versus two dryers

3.1.3 Alternative Selection for Combined SWEET Model (Round 1B)

In merging the solids model with the energy model, most of the solids alternatives were selected to be evaluated in the combined SWEET model. Excluding the baseline, alternatives with existing DAFs were screened out as they show a higher life-cycle cost when compared to RDTs, The DAFs are reaching the end of their useful life which implies a significant capital investment would be required to rehabilitate the system and continue operation. RDTs offer a more competitive life-cycle cost over the 20-year period due to its reduced energy demand and maintenance costs. They also have a much smaller footprint which frees up valuable real estate for EWA in the future.

This section reviews the various energy alternatives developed in the first round of the SWEET model and input assumptions used in the NPV evaluation.



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3.2 SWEET Round 1A Energy Alternatives

The initial list of alternatives based on decisions from Workshop 4 and TMs 3, 4, 5, and 6 is presented below. The following main alternatives were considered:

- 1. Engines (baseline)
- 2. Engines with gas conditioning
- 3. Engines with microturbines
- 4. Pipeline injection
- 5. Hybrid of engines and pipeline injection
- 6. Engines with solar (varying sizes and installation locations)
- 7. NG engines and SCR with all DG to pipeline injection
- 8. NG engines and SCR with all DG to pipeline injection and solar
- 9. Large-scale 5-megawatt (MW) cogeneration facility with NEM

Sub-alternatives are indicated with an S, which indicates HSW co-digestion and, therefore, increased DG production. Table 3-3 lists the SWEET Round 1A energy alternatives evaluated.

Table 3-3. Overview of Energy Alternatives Evaluated									
Alternative No.	SSO Input	Digestion Process	Gas Conditioning	IC Engine Capacity	Microturbine Capacity	Biogas Upgrading and Pipeline Injection Capacity	Solar	SCR	NEM
1	None	Thermophilic	None	1.92 MW	None	None	None	None	None
1S	Yes	Thermophilic	None	1.92 MW	None	None	None	None	None
2	None	Thermophilic	Yes	1.92 MW	None	None	None	None	None
25	Yes	Thermophilic	Yes	1.92 MW	None	None	None	None	None
3	None	Thermophilic	Yes	1.92 MW	0.40 MW	None	None	None	None
35	Yes	Thermophilic	Yes	1.92 MW	0.40 MW	None	None	None	Yes
4	None	Thermophilic	Yes	None	None	800 scfm: 3-year RIN	None	None	None
4S	Yes	Thermophilic	Yes	None	None	1,400 scfm: 3-year RIN	None	None	None
5S	Yes	Thermophilic	Yes	1.92 MW	None	800 scfm: 3-year RIN	None	None	None
6	None	Thermophilic	None	1.92 MW	None	None	Aeration basins (0.40 MW)	None	None
6S	Yes	Thermophilic	None	1.92 MW	None	None	Aeration basins (0.40 MW)	None	Yes
7	None	Thermophilic	None	1.92 MW	None	None	Equalization basins (0.13 MW)	None	None
7S	Yes	Thermophilic	None	1.92 MW	None	None	Equalization basins (0.13 MW)	None	Yes
8	None	Thermophilic	None	1.92 MW	None	None	5-acre field (0.80 MW)	None	None



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	Table 3-3. Overview of Energy Alternatives Evaluated								
Alternative No.	SSO Input	Digestion Process	Gas Conditioning	IC Engine Capacity	Microturbine Capacity	Biogas Upgrading and Pipeline Injection Capacity	Solar	SCR	NEM
8S	Yes	Thermophilic	None	1.92 MW	None	None	5-acre field (0.80 MW)	None	Yes
9	None	Thermophilic	Yes	2.25 MW (natural gas only)	None	1,400 scfm	None	Yes	None
9S	Yes	Thermophilic	Yes	2.25 MW (natural gas only)	None	1,400 scfm	None	Yes	None
10	None	Thermophilic	Yes	2.25 MW (natural gas only)	None	1,400 scfm	Aeration basins (0.40 MW)	Yes	None
10S	Yes	Thermophilic	Yes	2.25 MW (natural gas only)	None	1,400 scfm	Aeration basins (0.40 MW)	Yes	None
11	None	Mesophilic	None	1.92 MW	None	None	None	None	None
11S	Yes	Mesophilic	None	1.92 MW	None	None	None	None	None
12S	Yes	Thermophilic	Yes	5.00 MW a	None	None	None	None	Yes
14S	Yes	Thermophilic	Yes	1.92 MW	None	1,400 scfm: 10-year RIN	None	None	None

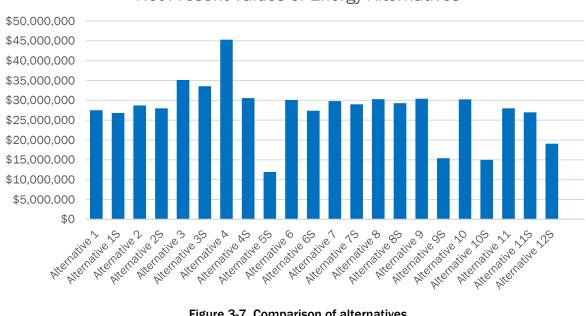
a. Assumes a modified air permit.

A 20-year evaluation was performed to determine the NPV of each alternative based on the assumed capital and O&M costs of Section 2.2. Table 3-4 lists the capital costs, annual O&M costs, and NPVs of each alternative based on the SWEET model inputs and assumptions described in Section 2. Note that the capital costs for additional infrastructure required for HSW receiving are assumed in the solids capital costs. The same methodology in determining costs for the solids model described in Section 2.2 was used for the energy model. Figure 3-7 provides a visual comparison of each alternative aside from Alternative 14S, which is the only one with a negative NPV.

	Table 3-4. Economic Summary for Energy 1A Alternatives							
Number	Description	Capital Cost (\$M)	NPV of O&M (\$M)	Total NPV (\$M)				
1	Base case: engines + DG to dryer		27.5	27.5				
1S	Base case: engines + DG to dryer + HSW	0.5	26.3	26.8				
2	Engines + gas conditioning	4.3	24.4	28.7				
2\$	Engines + gas conditioning + HSW	4.8	23.2	28.0				
3	Engines + gas conditioning + microturbines	9.5	25.6	35.1				
3S	Engines + gas conditioning + microturbines + HSW	10.0	23.5	33.5				
4	Pipeline injection	17.0	28.3	45.3				
4S	Pipeline injection + HSW	22.0	8.5	30.6				

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Table 3-4. Economic Summary for Energy 1A Alternatives							
Number	Description	Capital Cost (\$M)	NPV of O&M (\$M)	Total NPV (\$M)			
5S	Engines + pipeline injection + HSW	16.9	(5.0)	11.9			
6	Engines + solar on aeration basins	3.0	27.1	30.1			
6S	Engines + solar on aeration basins + HSW	1.5	25.8	27.4			
7	Engines + solar on equalization basins	2.5	27.4	29.8			
7S	Engines + solar on equalization basins + HSW	3.0	26.1	29.0			
8	Engines + solar on 5-acre field	3.9	26.4	30.3			
8S	Engines + solar on 5-acre field + HSW	4.4	24.8	29.3			
9	NG Engines + DG pipeline injection + SCR	20.9	9.6	30.4			
9s	NG Engines + DG pipeline injection + HSW + SCR	25.9	(10.5)	15.4			
10	NG Engines + DG pipeline injection + SCR + solar on aeration basins	21.4	8.9	30.2			
10S	NG Engines + DG pipeline injection + HSW + SCR + solar on aeration basins	26.4	(11.4)	15.0			
11	[Mesophilic] + engines	0	28.0	28.0			
11S	[Mesophilic] + engines + HSW	0.5	26.5	27.5			
12S	Big cogen (5 MW)	31.6	(12.5)	19.1			
14S	Pipeline injection: 10-year RIN	22.5	(62.7)	(40.2)			



Net Present Values of Energy Alternatives

Figure 3-7. Comparison of alternatives Alternative 14S not included.



25

Several engine output lines are plotted for combinations of biogas and NG usage. The permitted values of 28 MMscf/year of natural gas and 280 MMscf/year of combined biogas and natural gas are plotted and outline the limits of engine power production.

3.2.1 Engine Alternatives

This section presents an economic evaluation of the engine alternatives.

3.2.1.1 Gas Conditioning

Alternatives 2 and 2S build from Alternatives 1 and 1S, respectively, via the addition of gas conditioning. NPV results indicate that 0&M savings from employing gas conditioning over the 20-year period nearly offset the capital cost. Additionally, gas conditioning would also lower 0&M costs of the dryer that are not quantified in this analysis. Therefore, it is recommended that EWA install a gas conditioning system in the near future.

3.2.1.2 Solar

Solar alternatives were coupled with the existing IC engines in Alternatives 6 through 8S, ranging from an additional 130 to 800 kW of electrical output. The HSW addition in Alternatives 6S, 7S, and 8S allows for enough electricity production in the early years of the BCE to earn revenue via NEM. However, this revenue stream dissipates as the EWPCF electricity demand climbs past the generation capacity.

Solar power production capacity is cost-effective when digester gas is limited or prioritized for pipeline injection. When enough digester gas is available for the engines to use to meet EWPCF energy demand, solar power is not needed, which makes it not cost-effective under these circumstances. Conversely, when DG use in the engines is limited because of either short supply or diversion to pipeline injection, installing solar power becomes cost-effective by reducing the amount of electricity EWPCF purchases.

Based on the current energy demands at EWPCF and the results of the analysis indicating that solar alternatives do not provide much of a reduction in O&M costs, installation of solar panels is not a priority.

3.2.1.3 Microturbines

Despite providing excess power generation and electricity revenue in the early years of the BCE, the microturbine alternatives did not result in enough savings or revenue to offset capital costs, leaving them with NPVs higher than the baseline models. Microturbines are not recommended for installation at EWPCF.

3.2.1.4 Large-Scale Cogeneration

Alternative 12S explored the effect of large-scale cogeneration by assuming a revised air permit, which would allow for a total IC engine capacity of 5 MW. The increased capacity allows EWA to export power to its member agencies via NEM sale. This revenue stream makes Alternative 12S one of the more attractive scenarios tested, with an NPV lower than the baseline scenarios. The success of this alternative is due to the efficient utilization of excess biogas and is feasible only when co-digestion is maximized, and therefore is not a priority alternative.

3.2.2 Pipeline Injection Alternatives

This section presents an economic evaluation of the pipeline injection alternatives.

3.2.2.1 100 Percent Pipeline

Alternatives 4 and 4S demonstrate that using 100 percent of EWPCF biogas for pipeline injection does not generate enough revenue to pay back the capital costs and these options raise electricity costs over the 30-year BCE. However, the addition of HSW co-digestion and installation of a higher-capacity BUS allowed



Alternative 4S to collect significantly more revenue and reduce its NPV. This led to the exploration of a hybrid alternative that incorporated engines and pipeline injection, detailed in the following section.

3.2.2.2 Engines with Pipeline Injection

Alternative 5S is a hybrid engine and pipeline injection option that assumes maximizing IC engine output and pipeline injection of excess biogas, which yielded the lowest NPV aside from Alternative 14S. The success of this alternative is similar to that of Alternative 12S, the large-scale cogeneration alternative. Here, the capital improvements of a biogas upgrading and pipeline injection system pay off when co-digestion of HSW is incorporated. Like Alternative 12S, Alternative 5S creates a strong revenue stream using excess biogas from HSW co-digestion to attain environmental attributes and avoid peak and demand electrical charges. This alternative provides operational flexibility to handle peaks in biogas production by sending it to the pipeline while also meeting the EWA goal of power production. A hybrid engine and pipeline injection alternative is recommended for near-term implementation.

3.2.2.3 Pipeline Injection with NG Engines

Alternatives 9 through 10S all combine 100 percent biogas utilization for pipeline injection with SCRmediated cogeneration using only natural gas. Like Alternative 5S, this scenario allows for maximum IC engine output paired with revenue-generating pipeline injection. The main difference is that Alternatives 9 through 10S prioritize biogas for pipeline injection and use natural gas strictly for IC engine operation. Additionally, SCR allows the engines to produce beyond the permit limit and up to the EWPCF capacity (2.25 MW). While the overall alternative NPV is lower than that of the baseline scenarios, the high capital cost of SCR leaves this alternative with a higher NPV than Alternative 5S. Because these alternatives do not provide significant value and are higher risk than the hybrid engine and pipeline injection project, they are not recommended for implementation.

3.2.2.4 Effect of RINs

The current RFS (RFS2) for RINs does not end in 2022; however, the dictated escalation of required renewable volumes of fuel does stop on December 31, 2022. The rule requires that volume obligations of renewable fuel for years after 2022 be at least equal to, or larger than, the current volume. Because there is uncertainty with the value of future RINs after 2022, the alternatives incorporating pipeline injection assume that the program ends on that day. These alternatives have the potential to generate significantly more revenue while the RFS2 is in place.

Alternatives 13S and 14S were developed to examine how an increase in RIN lifetime affected NPV, assuming IC engines would utilize biogas once incentives ran out. An increase from 3 to 10 years in RIN lifetime between the two resulted in more than \$70 million of additional revenue. Unlike NEM of excess electricity, the sale of biogas through pipeline injection offers two revenue streams: the actual sale of upgraded biogas and the value of RINs. It is likely that RINs will continue to exist for more than 3 years, meaning that a continued financial payback like Alternative 14S can be a likely situation.

3.2.3 High-Strength Waste Addition

A major theme and general conclusion of the SWEET model is that the co-digestion of HSW universally lowered NPV. An assumed capital cost of \$500,000 for HSW receiving infrastructure is quickly paid back because of the revenue generation linked to the additional biogas production. Gas production that exceeds plant demand yields valuable returns with pipeline injection and also reduces purchase of supplemental natural gas. Alternatives 5S, 9S, 10S, and 12S all had lower NPVs than the baseline alternatives because the addition of HSW co-digestion allowed for higher production and utilization of biogas via extra engine capacity or pipeline injection or both.



It should also be noted that not a single alternative without HSW co-digestion resulted in a lower NPV than the baseline alternatives. This shows the resilience of the baseline scenario with a modified air permit as well as the significance of HSW co-digestion in lowering NPV. It is recommended that EWA pursue additional HSW contracts and increasing the size of the existing HSW facility to accommodate a larger co-digestion program.

3.2.4 Alternative Selection for Combined SWEET Model (Round 1B)

In merging the energy model with the solids model, the energy alternatives were narrowed to the baseline cogeneration alternative (status quo) and a hybrid engines and pipeline injection alternative. These two alternatives will be merged with the selected solids alternatives in a combined SWEET model. Both alternatives offered competitive NPVs and potential revenue without significant risks. The results of the initial SWEET analysis indicate that gas conditioning offers O&M benefits and is nearly break-even with the baseline alternative; for this reason, it is not carried forward into the combined SWEET analysis as a separate alternative, but may be considered as having nearly the same NPV as the baseline alternative.

Section 4: Combined Solids and Energy SWEET Model Results -Round 1B

Analysis of the solids model and the energy model individually provides a distinct picture of how the alternatives perform on their own over the life-cycle. The results from the previous round also provides information to screen out some of the apparent outliers in the solids and energy alternatives in terms of life-cycle costs. On combining the solids and the energy models, a more comprehensive analysis can be made with how the solids processes impact the energy utilization within the plant. The benefits derived from reduced energy requirement affect the overall life-cycle costs.

The combined SWEET model involved merging the solids model and the energy model into one. The combined model then generates the overall life-cycle costs for the end-to-end alternatives. The two primary energy alternatives selected were baseline cogeneration alternative and a hybrid engine and pipeline injection alternative. These two energy alternatives were evaluated with each individual biosolids alternative listed in the following Table 4-1.

4.1 Round 1B Alternatives

On analysis of results from Round 1A, a new set of alternatives were developed that combined the solids and energy alternatives into one SWEET model. These end-to-end alternatives were developed using combinations of the above options for thickening, digestion, dewatering, and drying, as deemed relevant.



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				Table 4-1. Overview of	of Alternatives Evaluated (Round	1B) ^a				
Alternative No.	Stream Thickened	Thickening Process	SSO Input	Thermal Hydrolysis ^b	Digestion Process	Digestion Enhancements	Dewatering Process	Cake	No. of Dryers	Pellets
1	WAS	DAF	Yes	None	Mesophilic	None	Centrifuges	Class B	1	Yes
2	WAS + PS	RDT	Yes	None	Mesophilic	None	Centrifuges	Class B	1	Yes
3	WAS + PS	RDT	Yes	None	Mesophilic	None	Centrifuges	None	2	Yes
4	WAS + PS	RDT	Yes	None	Mesophilic	Recuperative thickening	Centrifuges	Class B	1	Yes
5	WAS + PS	RDT	Yes	None	Mesophilic	Recuperative thickening	Centrifuges	None	2	Yes
6	WAS + PS	RDT	Yes	None	Thermophilic, 10-day	None	Centrifuges	Sub Class B	1	Yes
7	WAS + PS	RDT	Yes	None	Thermophilic, 10-day	Class A batch tanks	Centrifuges	Class A	1	Yes
8	WAS + PS	RDT	Yes	None	Thermophilic, 10-day	None	Centrifuges	None	2	Yes
9	WAS + PS	RDT	Yes	None	Thermophilic, 15-day	None	Centrifuges	None	2	Yes
10	WAS + PS	RDT	Yes	None	Thermophilic, 15-day	None	Centrifuges	Class B	1	Yes
11	WAS + PS	RDT	Yes	None	Thermophilic, 15-day	Class A batch tanks	Centrifuges	Class A	1	Yes
12	WAS + PS	RDT	Yes	Traditional Cambi, B6-4 reactors (1+1)	Mesophilic	None	Belt filter press	Class A	0	No
13	WAS + PS	RDT	Yes	Traditional Cambi, B6-3 reactors (2+1)	Mesophilic	None	Belt filter press	Class A	0	No
14	WAS	DAF	Yes	Traditional Cambi, B6-4 reactors (1+0)	Mesophilic	None	Belt filter press	Class A	0	No
15	WAS + PS	DAF	Yes	Traditional Cambi, B2-4 reactors (2+1)	Mesophilic	None	Belt filter press	Class A	0	No
16	WAS + PS	RDT	Yes	Traditional Cambi B4-4 reactors (2+1)	Mesophilic	None	Belt filter press	Class A	1	Yes
17	WAS + PS	RDT	Yes	Traditional Cambi, B4-4 reactors (2+0)	Mesophilic	None	Belt filter press	Class A	0	No
18	WAS	RDT	Yes	WAS only Cambi, B6-3 reactors (1+0)	Mesophilic	None	Belt filter press	None	2	Yes
19	WAS	RDT	Yes	WAS only Cambi, B2-4 reactors (1+0)	Mesophilic	None	Belt filter press	Class B	1	Yes
20	WAS	DAF	Yes	WAS only Cambi, B2-4 reactors (2+0)	Mesophilic	None	Belt filter press	Class B	1	Yes
21	WAS + PS	RDT	Yes	None	Mesophilic	None	Screw press	None	2	Yes
22	WAS	DAF	Yes	None	Mesophilic	None	Screw press	None	2	Yes
23	WAS + PS	RDT	Yes	None	Mesophilic	None	Belt filter press	None	2	Yes
24	WAS	DAF	Yes	None	Mesophilic	None	Belt filter press	None	2	Yes

a. Each alternative listed was evaluated with the two primary energy alternatives (Engines only and Engines+Pipeline Injection).

b. Alternatives using THP assume Cambi reactors. Cambi reactor types are shown, with the number of service and standby units.



The following are key items that were included in developing this round of alternatives:

- The two primary energy alternatives include engines only up to existing air permit and engines with pipeline injection.
- Alternatives that evaluated existing DAFs for thickening were screened out except for the one that represents the baseline.
- Additional Cambi reactor sizes were evaluated for THP/digestion alternatives.
- Omnivore technology (Recuperative thickening) was introduced as an option to provide more digester capacity and evaluated with mesophilic digestion. In this scenario, the existing small Digesters 1 and 2 would be repurposed to be used as Omnivore tanks with additional thickening equipment and a new mixing system within the tanks.
- Thermophilic digestion at 10-day and 15-day were evaluated with batch tanks to provide Class A Cake.
- Different dewatering technologies such as Belt Filter Press and Screw Press were added to alternatives with two dryers for evaluation.
- One and two dryer alternatives were evaluated due to the non-cost advantages provided by the second dryer.

Each alternative shown in the table is compared with two energy options, one with engines and one with a hybrid of engines and pipeline injection.

4.2 Economic Evaluation of Solids and Energy Alternatives

Results from Round 1B of the SWEET life-cycle analysis for all alternatives under consideration are presented on Figure 4-1 below.

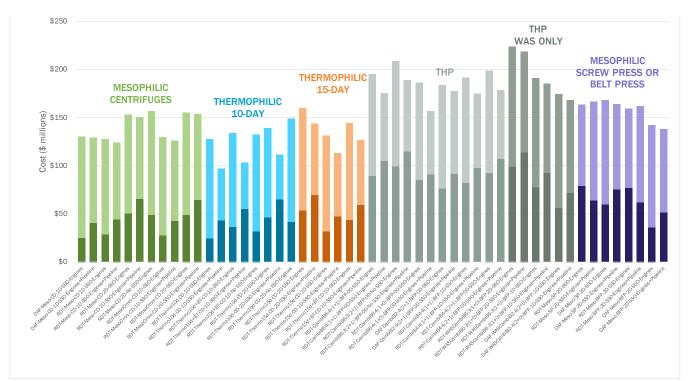


Figure 4-1. Overall NPV for all alternatives



From the figure above, it is evident that all the THP options represent a much higher NPV over 20 years compared to the other alternatives. These options were screened out from further consideration, particularly since they do not offer sufficient non-cost advantages to justify the higher cost.

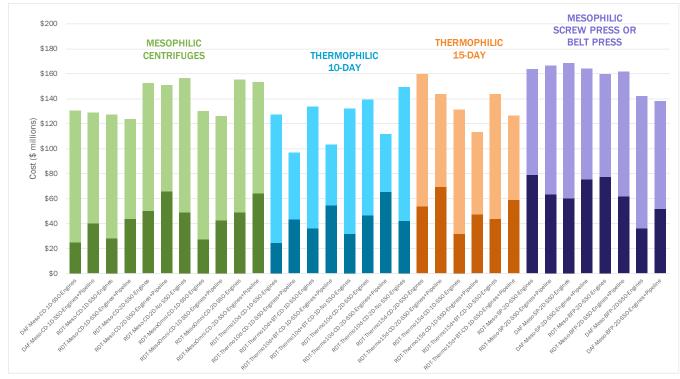
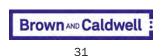


Figure 4-2 provides a closer look at the results without THP.

Figure 4-2. Overall NPV for all alternatives without THP

4.2.1 Dryer Evaluation

The following Figure 4-3 compares alternatives with one dryer and two dryers for different digestion scenarios such as mesophilic, thermophilic 10-day, and thermophilic 15-day. Overall, alternatives with two dryers have a higher NPV compared to those with one dryer because of the higher capital cost. The operating and running costs over time for the one- and two-dryer options are comparable. EWA staff felt there were important non-cost advantages to a second dryer, so the decision was made to preserve some two dryer alternatives for the best performing digestion alternatives.



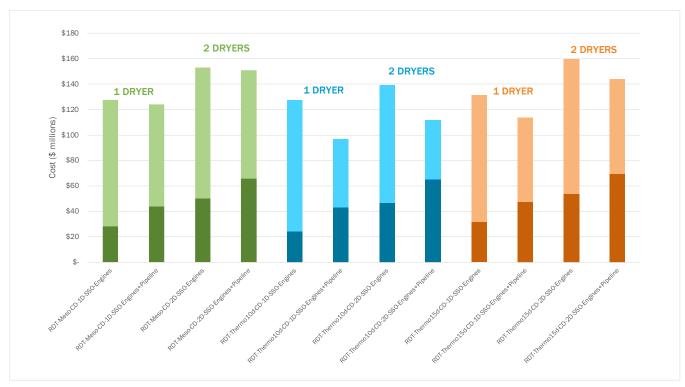


Figure 4-3. One dryer versus two dryers

4.2.2 Final Product Evaluation

The following Figure 4-4 compares alternatives that produce only one type of finished product (Class A pellets) versus producing two types of biosolids products (Class A pellets and Class B cake). The results from this evaluation suggest that the costs to produce only pellets (with two dryers) as the finished product out of EWA is higher than producing a portion of pellets and hauling the remaining Class B cake. The latter has a lower capital cost compared to any option with two dryers, as implied by the previous figure.



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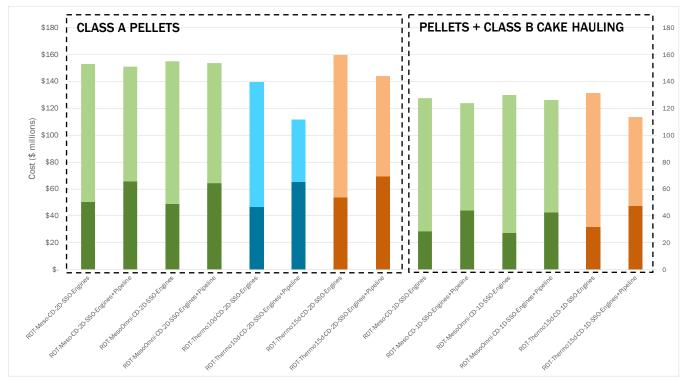


Figure 4-4. Class A pellets versus pellets and Class B cake hauling

4.2.3 Source-Separated-Organics Evaluation

The following Figure 4-5 compares options that were evaluated with and without importing SSO. SSO importing was considered additional over the already existing FOG and brewery waste quantities. The results suggest that the life-cycle costs for no SSO are higher than those that do import SSO. This is attributed to the benefits associated with SSO tipping fees and more effective energy utilization in the options that import SSO, and is consistent with the findings of the Round 1A energy evaluation.



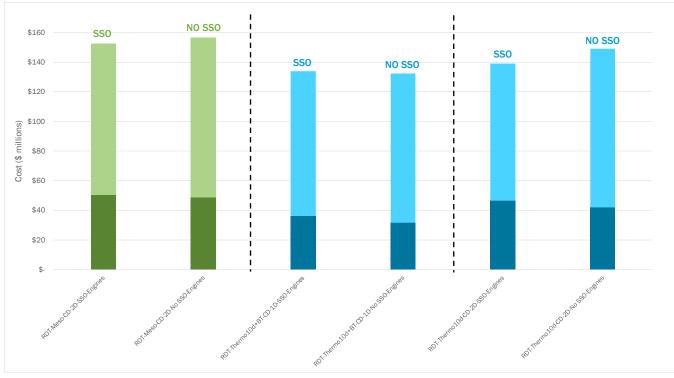


Figure 4-5. SSO versus no SSO

4.2.4 Thickening Evaluation

The following Figure 4-6 shows the results of evaluating existing DAFTs with mesophilic digestion versus RDTs with mesophilic digestion. The RDTs have a lower running cost, especially in terms of energy, but a higher initial capital investment. However, over the life cycle the NPV of RDTs is lower than that of DAFs. As mentioned previously, RDTs also provide an important advantage of freeing up valuable footprint on the EWA site.



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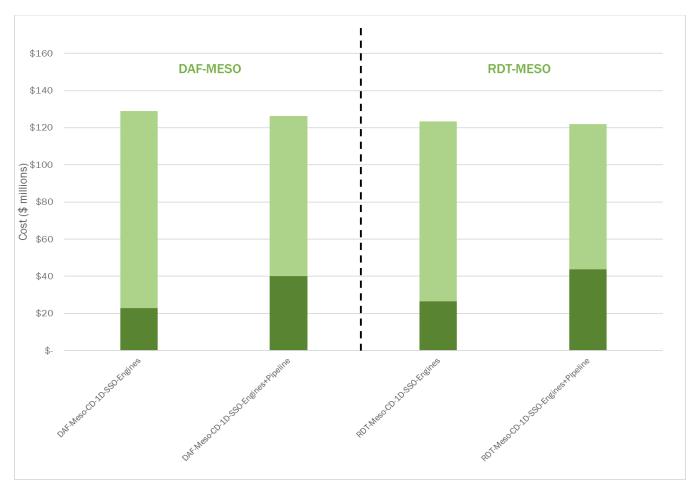


Figure 4-6. DAF versus RDT

4.2.5 Energy Evaluation

Because the revised engine permit allows for a maximum DG usage of 533 scfm, on average, any DG in excess of the permit limit can either be utilized in the dryer or sent to the pipeline. Or, with a revised air permit, gas conditioning, NEM, and a CO catalyst, additional gas can be utilized in the engines. Figure 4-7 shows the DG production as a function of HSW co-digestion assuming mesophilic digestion in addition to key operating points assuming a current baseline DG production of 500 scfm without any HSW addition.



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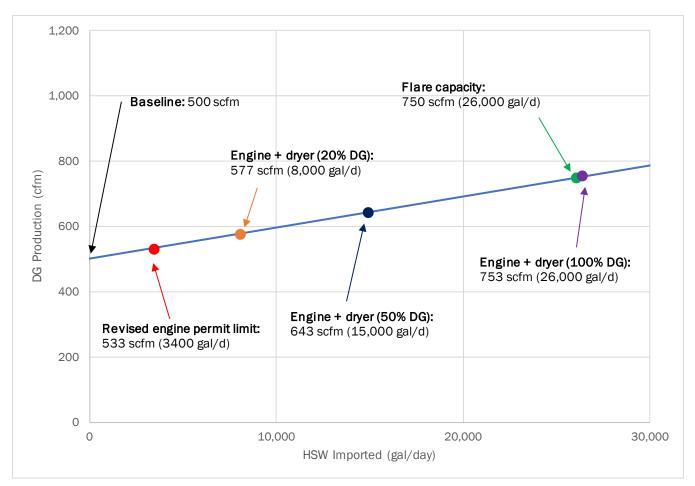


Figure 4-7. DG production as a function of HSW co-digestion with key operating points

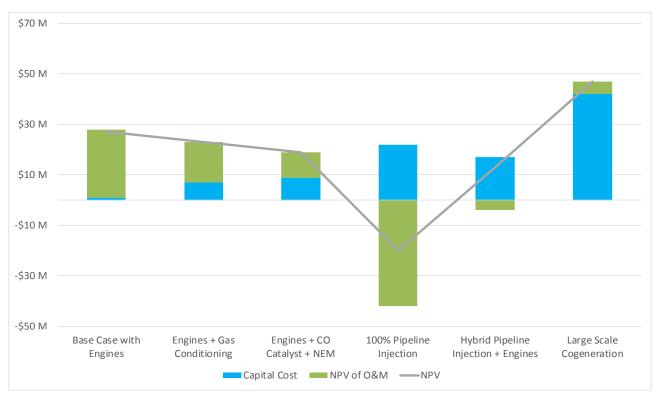
The results of the energy SWEET model were refined for a solids treatment process including RDTs, mesophilic digestion and one dryer based on the feedback from Workshop 4. While the engines only and engines with pipeline injection energy alternatives were carried forward into the Round 1B model, several alternatives were continued to be modeled in conjunction with the preferred solids treatment process. Figures 4-8 to 4-10 show the energy SWEET model results assuming the preferred solids process with varying levels of RINs durations and values. These figures assume 15,000 gallons per day of HSW for codigestion, or approximately 690 scfm of "day 1" DG production.

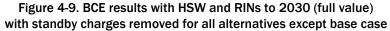


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Figure 4-8. BCE results with HSW and RINs until 2022 (full value) with standby charges removed for all alternatives except base case







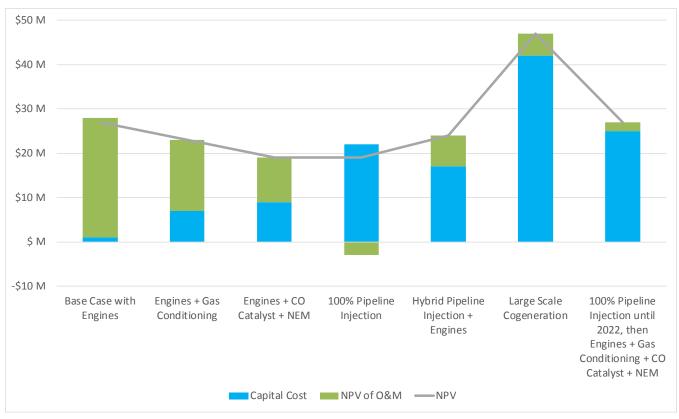


Figure 4-10. BCE results with HSW and RINs to 2030 (half value) with standby charges removed for all alternatives except base case

Based on the findings of the SWEET model, the alternatives EWA should pursue and consider for capital improvement include the following:

- Run engines up to the permit limit and send the remainder of the gas to the pipeline. Pursue an NEM schedule with San Diego Gas & Electric (SDG&E) to avoid standby charges (hybrid engines + pipeline injection).
- Provide gas conditioning upstream of engines followed by a CO catalyst on engine exhaust to unlock
 more engine capacity via air permit modification. Pursue an NEM schedule with SDG&E to avoid standby
 charges (engines + gas conditioning + CO catalyst).

When coupled with the solids alternatives, The SWEET model results indicate the following findings:

- Digester gas is more financially valuable when injected into the pipeline based on current NG prices, LCFS credit prices, and RINs credit prices that provide revenue to EWA. Revenue from LCFS and RINs credits, based on current market value, can provide significant financial value to EWA.
- Regardless of technology, the addition of HSW for co-digestion improves the overall economics, leading to a recommendation that EWA increase the size of its HSW receiving facility to accommodate a larger co-digestion program.
- EWA should produce as much gas as possible in early years to send as much gas as possible to the pipeline, assuming that RINs values continue to hold the same market value.
- A CO catalyst coupled with gas conditioning offers a viable project with NEM opportunities if a revised air permit can be obtained.



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Several of the gas upgrading systems on the market allow provisions for including a separate gas outlet prior to separating CO_2 from the CH_4 stream; this provides EWA with flexibility to route conditioned gas from the gas upgrading system to the engines or boilers if pipeline injection incentives are no longer in place. This conditioned gas would also meet the treatment requirements upstream of the engines if a CO catalyst is installed on the engine exhaust.

4.3 Alternative Selection for Combined SWEET Model (Round 2)

As previously stated, RDTs shall be carried over to the next round of evaluation due to its significant advantages over DAFs. Evaluating mesophilic digestion with Omnivore technology shows promise as a viable option due to its lower capital cost and ability to provide more digester capacity in the future. Thermophilic digestion provides some benefits such as increased HSW loading to the digesters and therefore shall be evaluated further. Centrifuges are the current technology used for sludge dewatering and shall be carried over to the next round provided the existing units are upgraded. Although operation of the dryer may not have shown a competitive NPV over the life-cycle, it offers significant non-economic advantages and therefore operation of one dryer and/or two dryers shall be evaluated further.

The results of the combined 1B model as related to the energy alternatives indicates that regardless of solids processes selected, with HSW co-digestion, a hybrid engine and pipeline injection project offers economic benefit over the engine only base case. For this analysis, it was assumed that RINs end in 2022, however, this is a highly conservative assumption. Greater economic upside can be observed as the RIN program continues beyond 2022 as demonstrated in the energy NPV results.

Section 5: Combined Solids and Energy SWEET Model Results -Round 2

Upon selecting the desired top five alternatives to be evaluated for Round 2, the combined SWEET model was customized in a way that would allow the capital and operating costs for the different projects elements to occur at different times over the life-cycle. The combined SWEET model would incorporate phasing different project elements based on capacity requirements, remaining useful life on equipment, and maximum derivable benefits with respect to RINS and LCFS. This is discussed in greater detail in Section 5.3.

Following are the assumptions made for the combined SWEET model Round 2.

- Capital costs for new projects would occur at the mid-point of construction based on when they are required to come on line during the planning period. For example, if RDTs were required to be in operation by 2021, and assuming it is a 3-year construction project, the capital cost would occur in year 2020.
- Operating costs for new projects would start at the end of construction and carry over all the way through planning period.
- Repair and replacement costs were assumed to occur once over the planning period. Service life of all mechanical equipment was assumed to be 15 years.
- Material disposition costs in terms of pellets and hauling Class B biosolids would be addressed based on operation of one dryer or two dryers. For example, if the second dryer were to be installed in 2026 material dispositions costs would be calculated for both pellets and Class B biosolids hauling. 2026 onward, costs for only pellets would be counted toward material disposition.



5.1 Round 2 Alternatives

Discussions from Workshop 4 held in December 2017 resulted in screening out most of the alternatives that were evaluated in the previous round. The following provided the basis for selecting the top five alternatives to be evaluated on cost and non-cost criteria:

- RDTs were chosen as the preferred thickening technology for all alternatives.
- Mesophilic, thermophilic 15-day, and thermophilic 10-day digestion processes were retained for evaluation.
- Centrifuges were chosen as the preferred dewatering technology for all alternatives; however, the existing centrifuges require mechanical upgrades.
- One and two dryers were retained for evaluation. The alternatives with one dryer would now include provisions for a full-fledged truck loadout that facilitates easy thoroughfare for trucks to haul Class B biosolids, following input from EWA staff.
- Engines and pipeline injection were chosen as the preferred energy alternative due to the significant economic advantages it offers over engines only.
- The baseline energy alternative (engines only) was evaluated with the thermophilic 15-day process and two dryers. This option offers a reliable way to achieve Class B and allows for higher quantity of HSW to be accepted and it offers a different way of utilizing the energy while still being competitive with the other alternatives.

	Table 5-1. Overview of Solids Alternatives Evaluated (Round 2)								
Alternative No.	Stream Thickened	Thickening Process	SSO Input	Digestion Process	Dewatering Process	Cake	No. of Dryers	Pellets	Pipeline Injection
1	WAS + PS	RDT	Yes	Mesophilic	Centrifuge	Class B	1	Yes	Yes
2	WAS + PS	RDT	Yes	Mesophilic	Centrifuge	None	2	Yes	Yes
3	WAS + PS	RDT	Yes	Thermophilic, 15-day	Centrifuge	Class B	1	Yes	Yes
4	WAS + PS	RDT	Yes	Thermophilic, 15-day	Centrifuge	None	2	Yes	No
5	WAS + PS	RDT	Yes	Thermophilic, 10-day	Centrifuge	None	2	Yes	Yes

A summary of alternatives considered for Round 2 is shown in Table 5-1 below.

5.2 Economic Evaluation of Top Five Alternatives

Table 5-2 shows the breakdown of the capital and running cost along with the overall 20-year NPV for the top five selected alternatives.



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	Table 5-2. Cost Summary for Top Alternatives							
Number	Description	Capital Cost (\$M)	0&M (\$M)	Total NPV (\$M)				
1	RDT-Meso-CD-1D	\$62.5	\$86.1	\$148.6				
2	RDT-Meso-CD-2D	\$72.2	\$93.7	\$165.9				
3	RDT-Thermo15d-CD-1D	\$65.8	\$74.4	\$140.2				
4	RDT-Thermo15d-CD-2D (engines only)	\$61.8	\$94.1	\$155.9				
5	RDT-Thermo10d-CD-2D	\$73.9	\$57.1	\$131.0				

Figure 5-1 below shows results from the SWEET life-cycle analysis of the selected top five alternatives.

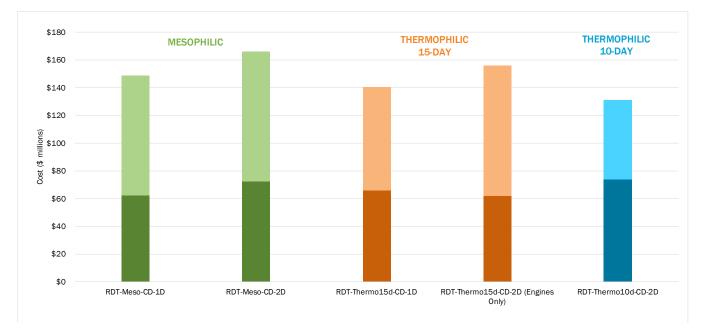


Figure 5-1. Overall NPV for top five alternatives

The results suggest that NPV for the mesophilic digestion options is slightly higher than those for the thermophilic 15-day and 10-day alternatives. The key differentiators between the three digestion scenarios are mainly the quantity of HSW imported. The thermophilic options provide a higher organic loading and therefore can allow for larger quantities of HSW to be digested. This in turn provides more benefits in terms of tipping and energy utilization. The thermophilic 10-day has the lowest NPV and this is attributed mainly to the fact that it can accept the highest quantity of HSW compared to the other alternatives.

Overall, the NPV results of the selected top five alternatives are comparable given the level of analysis; therefore, it was essential to evaluate them based on non-cost criteria as well for EWA to make a decision moving forward.



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5.3 Implementation Schedule

The following discusses certain factors that played a key role in determining a phasing timeline for the alternatives and the implementation schedule for the top five alternatives from Round 2 of SWEET.

5.3.1 Digester Excess Capacity Evaluation

The following sections describe excess digester capacity scenarios with existing DAFs and RDTs, respectively. These charts were developed assuming high strength waste at 12 percent solids content would be imported into the mesophilic digesters for co-digestion. The digester capacity available in excess of that required to handle sludge was plotted over time at various service conditions.

5.3.1.1 Digester Excess Capacity (DAF)

Figure 5-2 represents when EWA would run out of digester capacity (mesophilic digestion) under different service conditions while DAFs are in operation. It is evident that at maximum month condition with the largest digester out of service, EWA would run out of digester capacity to import any HSW by 2020. At the annual average condition with the largest digester out of service, digester capacity would be completely utilized by 2031. Only the peak 2-week service condition would allow for importation of HSW over the entire planning period; however, the volume of HSW imported would reduce over time.

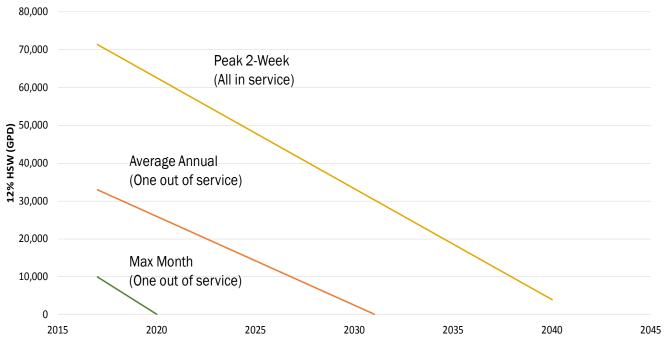


Figure 5-2. Excess digester capacity available for importing 12 percent HSW with DAF



5.3.1.2 Digester Excess Capacity (RDT)

The following Figure 5-3 represents when EWA would run out of digester capacity (mesophilic digestion) under different service conditions if RDTs are installed for co-thickening of PS and WAS. At maximum month condition with the largest digester out of service, EWA would run out of digester capacity to import any HSW by 2026. At the annual average condition with the largest digester out of service, digester capacity would be completely utilized by 2038. Only the peak 2-week service condition would comfortably allow for importation of HSW over the entire planning period.

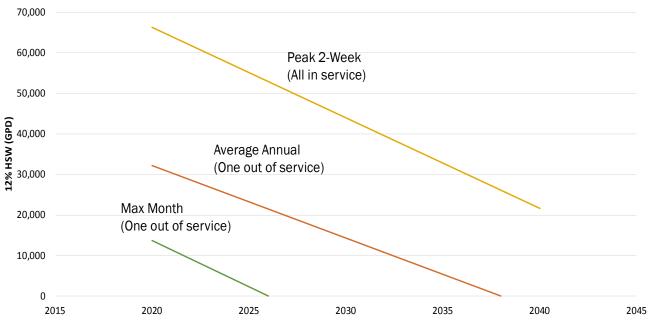


Figure 5-3. Excess digester capacity available for importing 12 percent HSW with RDTs

Based on this evaluation, to successfully implement a food waste program, it is imperative to install RDTs for thickening as it buys EWA more digester capacity without having to build a new digester. It also provides EWA with enough time in the future to make any enhancements to its existing digesters in terms of installing Omnivore or switching to a thermophilic digestion process.

5.3.2 Implementation Schedules for Top Five Alternatives

The previous sections on digester capacity tie in to the development of the implementation schedule for each alternative as they provide information on when the digester projects are required over the planning period whilst maintaining a reliable food-waste program.

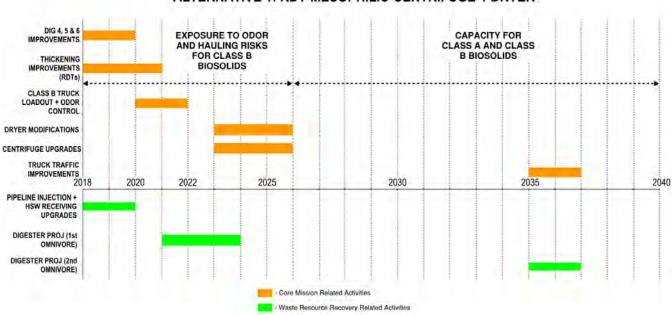
The following sections outline a phasing schedule for different project elements listed under each of the selected top five alternatives. The width of each bar in the graphics indicate the project duration and they commonly range from 2 to 3 years. The projects identified in this BEE Plan are divided into two main categories (represented above and below x-axis in the following figures):

- **Core Mission Related Activities.** These projects are imperative to maintaining capacity and redundancy in the overall solids treatment process for EWA over the course of the planning period.
- Waste Resource Recovery Related Activities. These projects provide opportunistic pathways for EWA to enhance their energy recovery and utilization.



5.3.2.1 Alternative 1 Implementation Schedule

Alternative 1 includes installation of RDTs for thickening, mesophilic digestion with Omnivore technology, centrifuge dewatering, operation of one dryer, and pipeline injection. Figure 5-4 below represents various projects related to core mission and waste resource recovery for EWA over the 20-year timeline.



ALTERNATIVE 1: RDT-MESOPHILIC-CENTRIFUGE-1 DRYER

Figure 5-4. Implementation schedule for Alternative 1

Core Mission Projects: Digester improvements for Digesters 4, 5, and 6, and installation of RDTs, must be implemented as early as possible (2018). Upon installation of RDTs (2021), the digester capacity will be adequate to handle sludge loads until 2038. Construction of a new truck loadout with odor control for effective hauling of Class B biosolids should be completed by 2022. Modifications to the existing dryer shall be completed by 2026 due to the limited useful life on the mechanical parts on the unit. The existing centrifuges would be upgraded at the same time. Future projects, such as truck traffic improvements, shall be completed later in the timeline as it is not critical to the effective operation of the overall solids process.

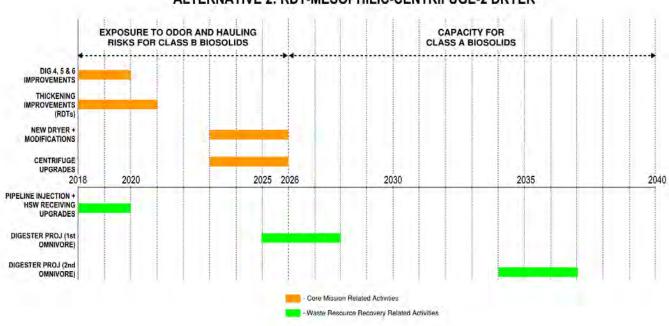
Waste Resource Recovery Projects: Implementation of pipeline injection along with HSW receiving upgrades as early as 2018 will allow EWA to derive maximum benefits from RINS and LCFS as well as accept larger quantities of HSW, Conversion of one of the small digesters into an Omnivore tank shall be completed by 2024 which will provide adequate digester capacity to handle sludge loads beyond 2040. Future conversion of a second small digester to an Omnivore tank may happen later in the timeline (2035); however, it is not critical to the effective operation of the overall solids process.



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5.3.2.2 Alternative 2 Implementation Schedule

Alternative 2 includes installation of RDTs for thickening, mesophilic digestion with Omnivore technology, centrifuge dewatering, operation of two dryers, and pipeline injection. Figure 5-5 below represents various projects related to core mission and waste resource recovery for EWA over the 20-year timeline.



ALTERNATIVE 2: RDT-MESOPHILIC-CENTRIFUGE-2 DRYER

Figure 5-5. Implementation schedule for Alternative 2

Core Mission Projects: Digester improvements for Digesters 4, 5, and 6, and RDTs, must be implemented as early as possible (2018). On installation of RDTs (2021), the digester capacity will be adequate to handle sludge loads until 2038. Until the installation of a second dryer, improvements to the existing truck load out need to be made to facilitate Class B biosolids hauling. Installation of a new second dryer, modifications to the existing dryer and centrifuge upgrades shall be completed by 2026. This implies that beyond 2026, Class A pellets will be the only end-product produced by EWA.

Waste Resource Recovery Projects: Implementation of pipeline injection, along with HSW receiving upgrades, as early as 2018 will allow EWA to derive maximum benefits from RINS and LCFS as well as accept larger quantities of HSW, Conversion of one of the small digesters into an Omnivore tank shall be completed by 2028, which will provide adequate digester capacity to handle sludge loads beyond 2040. Future conversion of a second small digester to an Omnivore tank may happen later in the timeline (2034); however, it is not critical to the effective operation of the overall solids process.



5.3.2.3 Alternative 3 Implementation Schedule

Alternative 3 includes installation of RDTs for thickening, thermophilic 15-day digestion with Omnivore technology, centrifuge dewatering, operation of one dryer and pipeline injection. Figure 5-6 below represents various projects related to core mission and waste resource recovery for EWA over the 20-year timeline.

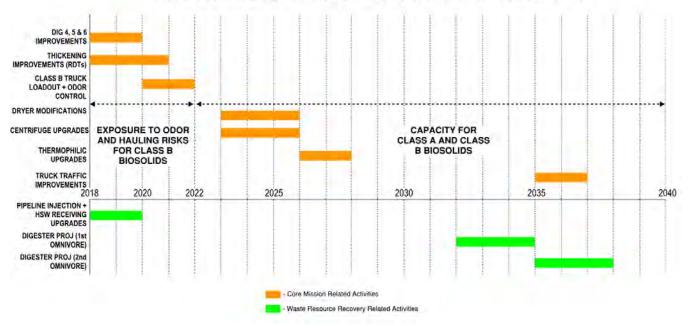




Figure 5-6. Implementation schedule for Alternative 3

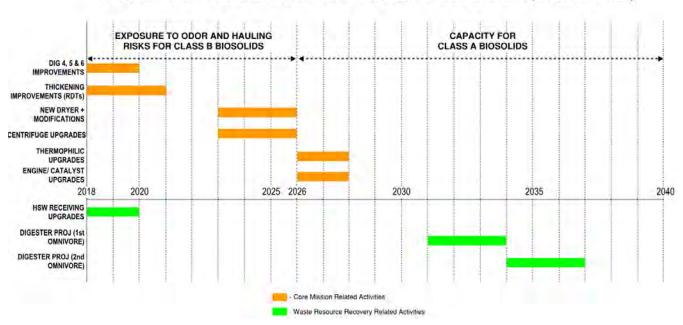
Core Mission Projects: Digester improvements for Digesters 4, 5, and 6, and RDTs, must be implemented as early as possible (2018). On installation of RDTs (2021), the digester capacity will be adequate to handle sludge loads until 2038. Construction of a new truck loadout with odor control for effective hauling of Class B biosolids shall be completed by 2022. Modifications to existing dryer shall be completed by 2026 due to the limited useful life on the mechanical parts on the unit. The existing centrifuges shall be upgraded at the same time. In this alternative, the existing mesophilic digesters shall be converted into thermophilic digesters by 2028. Future projects, such as truck traffic improvements, shall be completed later in the timeline as they are not critical to the effective operation of the overall solids process.

Waste Resource Recovery Projects: Implementation of pipeline injection, along with HSW receiving upgrades, as early as 2018 will allow EWA to derive maximum benefits from RINS and LCFS as well as accept larger quantities of HSW, Thermophilic digestion provides more organic loading capacity than traditional mesophilic digestion and therefore pushes out conversion of one of the small digesters into an Omnivore tank by 2035, which will provide adequate digester capacity to handle sludge loads beyond 2040. Future conversion of a second small digester to an Omnivore tank may happen later in the timeline (2035); however, it is not critical to the effective operation of the overall solids process.



5.3.2.4 Alternative 4 Implementation Schedule

Alternative 4 includes installation of RDTs for thickening, thermophilic 15-day digestion with Omnivore technology, centrifuge dewatering, operation of two dryers and engines only with no pipeline injection. Figure 5-7 below represents various projects related to core mission and waste resource recovery for EWA over the 20-year timeline.



ALTERNATIVE 4: RDT-THERMOPHILIC 15-DAY-CENTRIFUGE-2 DRYER (ENGINES ONLY)

Figure 5-7. Implementation schedule for Alternative 4

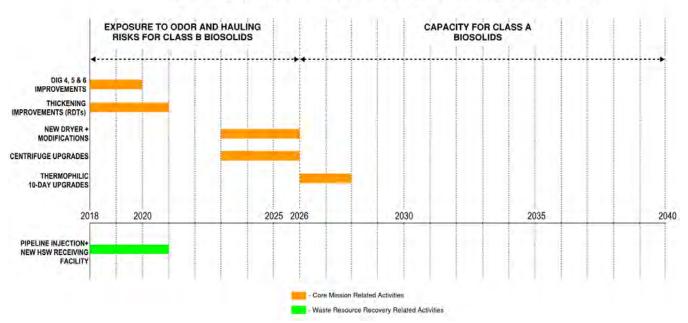
Core Mission Projects: Digester improvements for Digesters 4, 5, and 6, and RDTs, must be implemented as early as possible (2018). On installation of RDTs (2021), the digester capacity will be adequate to handle sludge loads until 2038. Until the installation of a second dryer, improvements to the existing truck load out need to be made to facilitate Class B biosolids hauling. Installation of a new second dryer, modifications to the existing dryer, and centrifuge upgrades shall be completed by 2026. This implies that beyond 2026, Class A pellets will be the only product produced by EWA. The existing engines catalyst shall be upgraded by 2026 which will bring about additional engine capacity to beneficially use the increased production of digester gas.

Waste Resource Recovery Projects: Implementation of HSW receiving upgrades as early as 2018 will allow EWA to accept larger quantities of HSW, Thermophilic digestion provides more organic loading capacity than traditional mesophilic digestion and therefore pushes out conversion of one of the small digesters into an Omnivore tank by 2034, which will provide adequate digester capacity to handle sludge loads beyond 2040. Future conversion of a second small digester to an omnivore tank may happen later in the timeline (2034); however, it is not critical to the effective operation of the overall solids process.



5.3.2.5 Alternative 5 Implementation Schedule

Alternative 5 includes installation of RDTs for thickening, thermophilic 10-day digestion with Omnivore technology, centrifuge dewatering, operation of two dryers and pipeline injection. Figure 5-8 below represents various projects related to core mission and waste resource recovery for EWA over the 20-year timeline.



ALTERNATIVE 5: RDT-THERMOPHILIC 10-DAY-CENTRIFUGE-2 DRYER

Figure 5-8. Implementation schedule for Alternative 5

Core Mission Projects: Digester improvements for Digesters 4, 5, and 6, and RDTs, must be implemented as early as possible (2018). Upon installation of RDTs (2021), the digester capacity will be adequate to handle sludge loads until 2038. Until the installation of a second dryer, improvements to the existing truck load out need to be made to facilitate Class B biosolids hauling. Installation of a new second dryer, modifications to the existing dryer, and centrifuge upgrades shall be completed by 2026. This implies that beyond 2026, Class A pellets will be the only end-product produced by EWA. In this alternative, the existing mesophilic digesters shall be converted into thermophilic digesters by 2028. On switching to a thermophilic 10-day digestion process, the digester capacity shall be sufficient to handle sludge loads beyond 2040.

Waste Resource Recovery Projects: Implementation of pipeline injection as early as 2018 will allow EWA to derive maximum benefits from RINS and LCFS. Thermophilic digestion with a 10-day retention time allows EWA to accept increased quantities of HSW; therefore, construction of a new HSW receiving facility is required for effective operation. This shall be completed along with the pipeline injection project.



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Section 6: Non-Economic Evaluation of Top Five Alternatives

The economic evaluation of the top 5 alternatives indicated that the NPV results of these alternatives were similar and within the anticipated margin of accuracy for this level of analysis. Therefore, a consideration of non-cost criteria and risks is warranted in selection of a preferred alternative for implementation.

The following criteria were used to determine the feasibility of the alternatives from a non-economic standpoint:

- Solids process facilitates access to multiple end-use markets
- Provides consistency with energy sustainability goals
- Provides consistency with overall goals and objectives of EWA
- Addresses neighborhood impacts (encompasses truck traffic, odors, and dust)
- Provides a strategic investment to manage risks
- · Addresses impacts to liquids stream process/future nutrient removal and/or recycled water
- Serves as a resource recovery facility (food waste acceptance) in a manner that benefits member agencies' communities
- Maximizes user rate stability in the long term

6.1.1 Mesophilic versus Thermophilic Comparison on Non-Cost Criteria

The following provides information on comparing mesophilic digestion and thermophilic digestion processes from a non-economic standpoint:

- Mesophilic digestion is the current process at EWA.
- Mesophilic digestion process is well known and understood by EWPCF staff.
- Mesophilic digestion and Thermophilic digestion processes are widely used in the industry.
- Mesophilic digestion provides enough digester gas to meet energy recovery goals.
- Conversion to a thermophilic process is easy and can be implemented at any time.
- Implementation of enhanced co-digestion could pay for future upgrades.
- Deferring implementation of the thermophilic process allows time to investigate impacts of thermophilic sludge on the dryer, which was identified as a risk, as no installations of drum dryers coupled with thermophilic digestion could be identified.

The following Table 6-1 ranks the three digestion processes on the non-cost criteria.

Table 6-1. Digestion Process Non-Cost Ranking Matrix							
Non-Cost Criteria	Mesophilic	Thermophilic 15-day	Thermophilic 10-day				
Meets goals and objectives of EWA	+	+	+				
Multiple end-use markets	+	+	+				
Energy sustainability	+	+	+				
Neighborhood impacts	+	+	+				
Risk management	+	0	0				
Impact to liquids stream processes	+	+	+				
Resource recovery	+	+	+				
Long-term user rate stability	+	+	+				



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From the ranking and analysis of the three digestion processes, it is recommended to continue mesophilic digestion at EWA until capacity or energy recovery goals change.

6.1.2 One-Dryer versus Two-Dryer Comparison on Non-Cost Criteria

The following provides information on comparing one dryer and two dryers from a non-economic standpoint:

- Operation of the dryer greatly reduces truck traffic
- A dryer provides end-use resilience through Class A
- Regional options for dried product can diversify management of end-product
- A dryer reduces offsite odors related to truck traffic and loadout

Table 6-2 below ranks one dryer versus two dryers on non-cost criteria.

Table 6-2. Dryer Non-Cost Ranking Matrix							
Non-Cost Criteria	One Dryer	Two Dryers					
Meets goals and objectives of EWA	-	+					
Multiple end-use markets	0	+					
Energy sustainability	+	0					
Neighborhood impacts		+					
Risk management	0	+					
Impact to liquids stream processes	0	0					
Resource recovery	+	0					
Long-term user rate stability	0	0					

From the ranking and analysis of dryer options, it is recommended to plan for the implementation of a second dryer in the future.

6.1.3 Engines versus Engines/Pipeline

The following provides information on comparing running engines only versus running engines and injecting gas into the pipeline from a non-cost standpoint:

- Engines are currently used at EWPCF and are a generally accepted form of energy recovery.
- Pipeline injection includes more risk but greater potential to deliver rewards, both economic and environmental.
- Pipeline will pay for gas system upgrades and has potential for large economic benefit. In general, DG is most valuable as CNG (shown on Figure 6-1).
- Pipeline injection allows use of natural gas in the engines and dryer.



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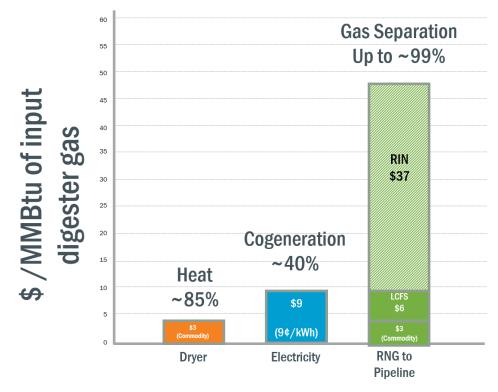


Figure 6-1. Relative value of DG energy based on alternative

The following Table 6-3 ranks one engine versus engines/pipeline on non-cost criteria.

Table 6-3. Engine Utilization Non-Cost Ranking Matrix							
Non-Cost Criteria	Engines	Engines + Pipeline					
Meets goals and objectives of EWA	+	+					
Multiple end-use markets	0	+					
Energy sustainability	0	+					
Neighborhood impacts	0	0					
Risk management	+						
Impact to liquids stream processes	0	0					
Resource recovery	0	+					
Long-term user rate stability	0	+					

From the ranking and analysis of engine utilization options, it is recommended to consider implementation of gas scrubbing to pipeline to capitalize on market opportunity.



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6.1.4 Non-Cost Ranking Recommendations

The following are the recommendations BC is providing based on the non-cost criteria evaluation:

- Continue operation of mesophilic digestion until capacity or energy recovery goals change.
- Plan for implementation of a second dryer in the future.
- Consider implementation of gas scrubbing to pipeline to capitalize on market opportunities.

Section 7: Final Phasing Considerations for the Recommended Alternative (Alternative 2)

Based on ongoing discussion with EWA and interactive project workshops on evaluating EWA's next steps at modifying its existing solids process, key project elements were identified and categorized based on near-, short-, and long-term projects for the recommended alternative. Figure 7-1 represents the implementation schedule of the recommended alternative.

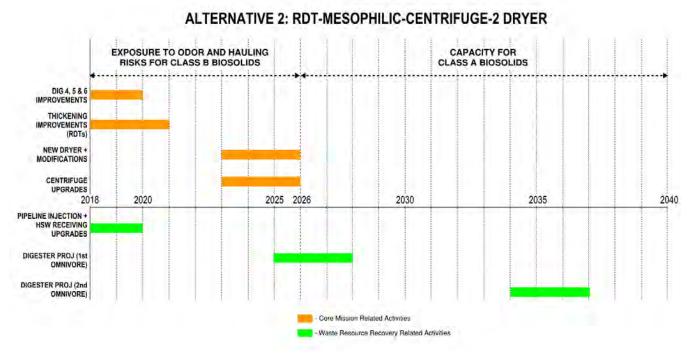


Figure 7-1. Implementation schedule for Alternative 2



For purposes of framing implementation of the capital improvements associated with the recommended alternatives, the BC team divided the projects into near-term (defined as 0 to 5 years), short-term (5 to 10 years) and long-term (10 to 20 years). The near-term projects include those that were generally common among the top five alternatives and address immediate constraints and opportunities associated with the solids and energy processes at EWPCF. These are as follows:

- **Digester Improvements:** This includes mixing upgrades and structural modifications to existing Digesters 4, 5, and 6.
- High Strength Waste Receiving Upgrades: This includes mechanical upgrades to existing equipment.
- Thickening Improvements (RDTs): This includes installing RDTs for co-thickening of PS and WAS.
- **Pipeline Injection:** This includes sending a portion of the digester gas to the pipeline. This would apply to all alternatives except thermophilic 15-day with two dryers.

The short-term projects address a mixture of aging equipment (such as the dryer and centrifuges) as well as some desirable improvements to support high-strength waste receiving and biosolids beneficial use. The major short-term projects are:

- **Truck Loadout Improvements:** This includes improving the existing truck loadout area and addressing any odor related issues. This project can be customized to the degree of improvement of the loadout found necessary at the time.
- **Dryer Modifications:** This includes modifications to the existing dryer building, replacement of the dryer drum, and other associated mechanical upgrades.
- **Omnivore Project I:** This includes repurposing one of the small digesters (1 or 2) to serve as an Omnivore tank.
- **Centrifuge Upgrades:** This includes replacement of existing centrifuges with larger and more efficient units.

The long-term projects allow for full implementation of the recommended alternative. Most of these projects address the increase in loads to the EWPCF and include:

- Second Dryer: This includes installing a second dryer.
- **Omnivore Project II:** This includes repurposing the second small digester to serve as another Omnivore tank in the event of requiring more digester capacity.
- **Truck Traffic Improvements:** This includes modifications to the road within EWA to facilitate easy thoroughfare of trucks in and out of the facility.

Section 8: Summary

A plethora of solids and energy alternatives were evaluated using the SWEET life-cycle analysis tool. This tool allowed for evaluating alternatives based on different process parameters as well as costs. From an economic evaluation standpoint, the SWEET tool was used through multiple rounds to arrive at top five alternatives that performed best on an NPV basis. Regular progress calls and interactive workshops with EWA facilitated the decision making to arrive at the top five alternatives. Implementation schedules were created for each of the top five alternatives. On observing almost comparable NPVs for each of the top five alternatives. a non-economic evaluation was performed on the alternatives and ranked against specific key non-cost criteria. BC's recommendations from the evaluation are mentioned in the following sub-sections.



8.1 Solids Next Steps and Recommendations

BC recommends the following next steps related to solids and energy utilization:

- Implement common project elements such as RDTs, digester improvements, food waste receiving, and truck loadout.
- Continue operation of mesophilic digestion until capacity or energy recovery needs change.
- Plan for implementation of a second dryer.

8.2 Energy Next Steps and Recommendations

BC recommends the following next steps related to the energy alternatives:

- Pursue pipeline injection with SDG&E and initiate capacity analysis to determine pipeline location and feasibility of accepting biomethane. If pipeline injection is feasible, pursue a private-public partnership arrangement to deliver a gas upgrading project without requiring a capital outlay from EWA.
- Pursue a new air permit with CO catalyst to unlock additional engine capacity and initiate discussions with SDG&E for NEM electrical rate schedule to potentially lower power bills and export power.
- Consider construction of gas scrubbing to pipeline to capitalize on market opportunities and offset costs for needed gas conditioning equipment.

Based on the results of the SWEET model effort, multiple energy alternatives can meet the goals of the BEE project; therefore, there is no single recommended alternative. The best steps forward are to initiate conversations with SDG&E and San Diego Air Pollution Control District, and pursue a private-public partnership in parallel to learn more about costs and challenges to implementing the alternatives that show economic benefit and meet the BEE project goals. If the barriers to achieving an alternative are too difficult to overcome (for example, an air permit revision cannot be obtained), EWA can eliminate that as a feasible option.





Technical Memorandum

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- Project No.: 150871.008

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- Date: May 23, 2018
- To: Scott McClelland, Assistant General Manager
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Limitations:

This document was prepared solely for Encina Wastewater Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between Encina Wastewater Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by Encina Wastewater Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Encina Wastewater Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List o	f Figures	iii
List o	f Tables	iii
Exec	utive Summary	1
Secti	on 1: Introduction	1
1.1	Purpose and Scope	1
	Potential Projects	
	on 2: Overviews of Grants and Incentives	
2.1	Renewable Fuel Standard	2
	Low Carbon Fuel Standard	
2.3	Pipeline Interconnection Incentive Program	3
2.4	SoCalGas Biogas Conditioning/Upgrading Services Tariff	4
2.5	California Energy Commission Grant Opportunities	5
2.6	CalRecycle	6
2.7	Self-Generation Incentive Program	6
	on 3: State and Local Greenhouse Gas Reduction Goals	
3.1	Local Greenhouse Gas Reduction Goals	6
	State Greenhouse Gas Reduction Goals	
3.3	Impact of Renewable Natural Gas Production on Greenhouse Gas Emissions	7



List of Figures

Figure 2-1. Two primary components of an interconnection eligible for CPUC incentive	4
Figure 2-2. SoCalGas BCUS Tariff process to plan, design, procure, construct, own, operate, and maintain	
biogas conditioning and upgrade equipment process	5

List of Tables



Executive Summary

The Encina Water Pollution Control Facility (EWPCF) currently has four 750-kilowatt (nameplate) internal combustion engines to utilize some of the digester gas (DG) and sends remaining DG to the biosolids dryer or flare. Brown and Caldwell is evaluating alternative technologies to utilize any DG beyond what is used in the engines. For one of the potential projects identified in Technical Memorandum (TM) 7, where digester gas is converted to renewable natural gas (RNG) and injected to the pipeline, grants and incentives are available. For projects where the output of the existing cogeneration facility is increased—reaching the point of net metering—no funding is likely to be available. The grants and incentive programs discussed in this TM include:

- Renewable Fuel Standard (RFS)
- Low Carbon Fuel Standard (LCFS)
- Pipeline Interconnection Incentive Program
- SoCalGas Biogas Conditioning/Upgrading Services Tariff
- California Energy Commission (CEC)
- CalRecycle
- Self-Generation Incentive Program (SGIP)

Additionally, state and local greenhouse gas (GHG) reduction goals are summarized in this TM.

Section 1: Introduction

Encina Wastewater Authority (EWA) has undertaken a Biosolids Energy and Emissions (BEE) Plan which will be used to update the previous Energy and Emissions Strategic Plan and integrate pertinent recommendations arising from the recently completed Process Master Plan. The BEE Plan has several goals:

- 1. Provide a comprehensive analysis of all project elements including biosolids treatment, gas use, energy generation, and waste heat;
- 2. Address capacity limitations in the solids handling process at the EWPCF;
- 3. Assess which alternative is likely to be the most cost effective and sustainable solution for EWA;
- 4. Move the EWPCF toward greater energy independence; and
- 5. Reduce greenhouse gas (GHG) emissions.

1.1 Purpose and Scope

This TM is preceded by TMs 1 to 7 which address the following subjects:

- TM 1 Baseline Energy Profiles and Projections
- TM 2 Technology Evaluations for Biosolids Handling
- TM 3 Technology Evaluations for Alternative Power Production
- TM 4 Technology Evaluations for Biogas Production
- TM 5 Technology Evaluations for Waste Heat
- TM 6 Air Emissions
- TM 7 Alternatives Development, Evaluation, and Selection

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The purpose of TM 8 is to provide an overview of the available funding and incentive opportunities to offset capital cost associated with the potential alternatives. This TM also includes a discussion of the GHG impacts of the preferred alternative identified in TM 7 to describe how the BEE project supports state and local goals.

1.2 Potential Projects

There are several viable projects identified in TM 7 which could offer economic benefit and a reduction in GHG emissions. These projects can be implemented as standalone or in parallel and include the following:

- Engines (current operation)
- Engines with oxidation catalyst for carbon monoxide (CO²) reduction
- Gas conditioning to remove hydrogen sulfide, moisture, and siloxanes
- Digester gas upgrading to produce RNG for pipeline injection

Section 2: Overviews of Grants and Incentives

An overview of the various grants and incentives for RNG production projects is provided in this section. The overview includes background information, program descriptions, eligibility requirements, and available funding. Additionally, discussions of how each program applies to the RNG production project at EWPCF are included in this section.

2.1 Renewable Fuel Standard

The RFS is a federal program administered by the Environmental Protection Agency (EPA) that incentivizes reducing GHG emissions from petroleum-based transportation fuels and expanding the renewable fuels sector. The program operates in a cap-and-trade manner by requiring a certain quantity of petroleum-based transportation fuels to be replaced by renewable fuels every year. The quantity of non-renewable fuels that must be replaced is set to increase annually through 2022. Petroleum refiners and petroleum fuel importers, known as the obligated parties, are required to demonstrate compliance with the RFS. These organizations can demonstrate compliance by obtaining RFS credits, which are called Renewable Identification Numbers (RINs).

RINs are generated when a gallon of renewable fuel is produced. The obligated parties must obtain a certain amount of RINs each year to offset the quantity of petroleum-based transportation fuel that was sold. RINs can be obtained by physically blending renewable fuels that have attached RINs, purchasing gallons of renewable fuel that have attached RINs, or directly purchasing RINs from the market. Market trading of RINs creates an economic opportunity for organizations that produce renewable transportation fuels because renewable fuel producers can generate additional revenue through the sale of RINs to obligated parties. Renewable fuel producers can sell RINs directly to obligated parties; however, these producers typically hire a RINs broker to assist with credit acquisitions, transactions, and quality assurance.

Four categories of renewable fuels are covered under the RFS program and include biomass-based diesel, cellulosic biofuel, advanced biofuel, and conventional renewable fuel. Each of these categories has a different GHG reduction threshold that the renewable fuel must meet to be eligible for RINs. The categories also have different assigned economic values and are identified by their respective "D codes" (D3 through D7). Typically, RNG produced at a wastewater treatment plant is categorized as D3 (cellulosic) RINs. However, there is an ongoing debate on whether digester gas derived from co-digestion of high strength waste (i.e., food waste, source separated organics; fats, oils and grease; and brewery waste) should be



considered a D3 or D5 (advanced biofuel) RIN. The EPA currently categorizes co-digestion product RINs as D5, which is valued two to three times less than a D3 RIN.

Any RNG produced at the EWPCF would be eligible for RINs credits. To obtain these credits, EWA would need to demonstrate the RNG is used as vehicle fuel. Even if RNG is injected to the utility pipeline and is not physically transferred to a vehicle fleet, EWA can reach an agreement with a natural gas fuel purchaser and complete a "paper transaction." D3 RINs values have fluctuated from less than \$1 per RIN to over \$2 per RIN; these credits can provide a significant source of income for any renewable natural gas that EWA sends to the utility pipeline.

2.2 Low Carbon Fuel Standard

The LCFS is a program enacted by the State of California (State) to reduce the carbon intensity of transportation fuels used in the state. This program is part of a larger set of California regulations to reduce GHG emissions and cut statewide petroleum use in half by 2030. Like the RFS, the LCFS program operates as a cap-and-trade system. The EWPCF's potential RNG pipeline injection project is eligible for LCFS credits.

In the case of the LCFS program, carbon intensity, which is a measure of the GHG emissions produced throughout the life-cycle of a fuel, is used to compare the various non-renewable and renewable transportation fuels. Carbon intensity is expressed in grams of CO² equivalent per megajoule (g CO₂/MJ) of energy provided by the fuel. A baseline carbon intensity standard was set by the State and this baseline standard will decrease annually until 2020, after which the standard will remain constant until 2030. Entities that produce transportation fuels with higher carbon intensities than the standard operate at a deficit and must obtain LCFS credits from entities that produce transportation fuels with carbon intensities that are lower than the standard.

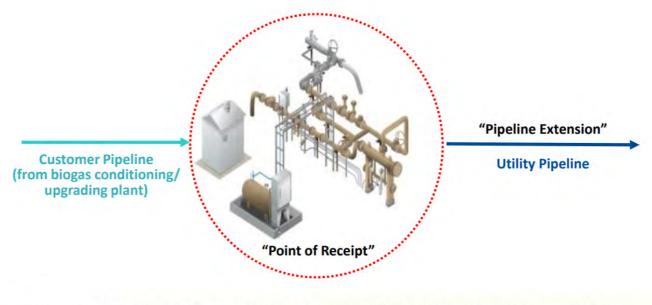
LCFS credits are generated when a transportation fuel that has a lower carbon intensity than the standard is produced. These credits can be sold to petroleum refiners or other organizations that exceed the carbon intensity compliance limit. To generate and sell LCFS credits, a low carbon fuel producer must register with the California Air Resources Board (CARB) to become a regulated party. Once registered, the renewable fuel producer can track the amount of low carbon intensity fuel that is produced using CARB's LCFS Reporting Tool. LCFS credits are then received, based on the carbon intensity and the quantity of the fuel. The accounting and transaction processes for LCFS credits are similar to the RINs' processes.

CARB has compiled a database of LCFS fuel pathways that lists the life-cycle carbon intensities of various types of fuels. According to the database, the carbon intensity of RNG produced at a wastewater treatment plant is between 7.8 g CO_2/MJ and 30.9 g CO_2/MJ , which is significantly lower than gasoline that has a carbon intensity of 96 g CO_2/MJ . LCFS credits typically fluctuate around \$1 per diesel gallon equivalent (DGE) based on the carbon intensity values for RNG, but decrease annually.

2.3 Pipeline Interconnection Incentive Program

The California Public Utilities Commission (CPUC) has adopted an incentive program which provides funds for biomethane projects that interconnect to California utility natural gas pipeline systems. Funds provided by the incentive program may be used for up 50 percent of the eligible interconnection costs and each project can apply for up to \$3 million in funding. Eligible project costs include the compression equipment for product gas, utility point of receipt, and utility pipeline extension as depicted on Figure 2-1.





"Interconnection" = "Point of Receipt" + "Pipeline Extension"

Figure 2-1. Two primary components of an interconnection eligible for CPUC incentive Source: <u>https://www.socalgas.com/1443741248177/PowerofWaste_SoCalGas_Lucas.pdf</u>

Total program funding for all projects is capped at \$40 million, and the program is open to eligible biomethane projects through December 31, 2021. If EWA decides to upgrade digester gas to pipeline quality biomethane, this incentive program may serve as a viable opportunity to reduce interconnection costs.

2.4 SoCalGas Biogas Conditioning/Upgrading Services Tariff

The SoCalGas Biogas Conditioning/Upgrading Services (BCUS) Tariff is an optional tariff service that would allow SoGalGas to plan, design, procure, construct, own, operate, and maintain biogas conditioning and upgrading equipment at a customer's facility. This relationship is illustrated on Figure 2-2. This BCUS tariff was originally investigated as a potential partnering option, but since EWA is not a SoCalGas customer, the EWPCF is not eligible.



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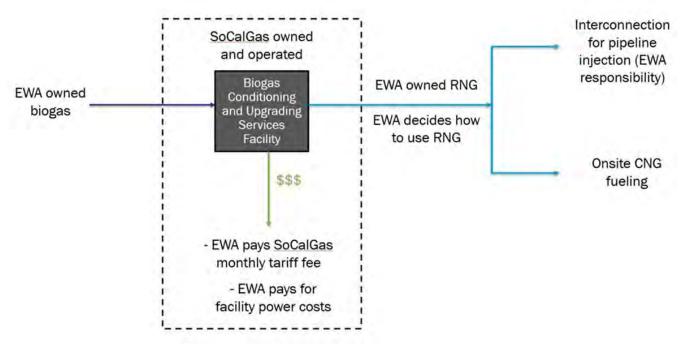


Figure 2-2. SoCalGas BCUS Tariff process to plan, design, procure, construct, own, operate, and maintain biogas conditioning and upgrade equipment process

Under this tariff, the customer would own, operate, and maintain all equipment and facilities upstream of the BCUS receipt point for the untreated biogas and downstream of the BCUS point of service delivery for the treated gas (RNG). The customer would also be responsible for providing electric and natural gas services to run the equipment. This optional tariff will remain open until 2025 for new customers. Actual costs associated with this tariff will require further discussion with SoCalGas and would cover the full cost to provide capital and operation and maintenance services. The program does not bear any risk to SoCalGas ratepayers. A breakdown of assigned responsibilities to the customer and SoCalGas for a theoretical tariff arrangement is shown in Table 2-1.

	Table 2-1. SoCalGas BCUS Tariff Responsibilities						
Responsible Parties	Upfront investment for upgrading facility	On-going mainte- nance of upgrading facility	Parasitic load (utility costs to run the facility)	Owns the biogas and RNG	Determines the contract term	Interconnection with the utility	
SoCalGas	Х	Х			Negotiable		
EWA			Х	Х	(typically 10 to 20 years)	Х	

2.5 California Energy Commission Grant Opportunities

The CEC has historically offered grants for projects that develop alternative and renewable fuels through the Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP). The ARFVTP provides funding to promote changes to transportation fuels and vehicles used in California to ultimately help the state meet its



GHG reduction goals. Each year of the past 3 years, the CEC has allocated approximately \$100 million to the ARFVTP and about \$20 million has been reserved for biomethane projects. Two ARFVTP funding opportunities for Biofuel Production and Supply have been proposed for 2018 under the Alternative Fuel Production Investment Plan Category. As of February 9, 2018, grant solicitations for these two opportunities have not been released. Additionally, the ARFVTP has been extended through 2024; future biofuel grants can be expected.

2.6 CalRecycle

The California Department of Resources Recycling and Recovery, more commonly known as CalRecycle, oversees State solid waste programs. CalRecycle instituted the Greenhouse Gas Reduction Grant and Loan Programs (Grant and Loan Programs) after the State established the Greenhouse Gas Reduction Fund in 2012. The Grant and Loan Programs incentivize capital projects that reduce GHG emissions by diverting more material from landfills and using the diverted material to produce beneficial products (e.g., RNG). CalRecycle funding opportunities have been released annually; however, State allocations for CalRecycle GHG reduction programs have fluctuated between \$25 and \$60 million.

The Organics Grant Program is one of the Grant and Loan Programs' overseen by CalRecycle. This program provides funding for digestion and compost projects that divert organic materials from landfills. Although the EWPCF does not have an on-site food waste diversion or pre-processing program, the Organics Grant Program may be applicable if a food waste digestion partnership with Waste Management or another solid waste hauler is pursued.

2.7 Self-Generation Incentive Program

The SGIP provides funding for the installation of technologies that generate or store electrical energy to meet a portion of or all a facility's electrical requirements. The program is overseen by the CPUC and is administered by the State utilities companies. Incentives are provided based on the generating capacity of the equipment. To be eligible for SGIP funding, electricity-generating equipment must be commercially available, interconnected to the local utility's distribution system, and permanently installed on site. Any equipment that has been interconnected for more than 12 months before submission of an application is not eligible for SGIP incentives. Therefore, if cogeneration were expanded at the EWPCF through the installation of gas conditioning and oxidation catalysts and by pursuing a new permit, this project would not be eligible for SGIP funding because new generating equipment is not being installed.

Section 3: State and Local Greenhouse Gas Reduction Goals

The grants and incentives described in Section 2 all serve to incentivize projects that reduce GHG emissions in California. The overarching State and local GHG reduction goals and the impact of RNG production on these GHG goals are discussed in this section.

3.1 Local Greenhouse Gas Reduction Goals

The County of San Diego (County) has completed a Draft Final Climate Action Plan that identifies the County's GHG reduction targets and strategies to meet these targets. GHG reduction goals for the County include:

- Two (2) percent below 2014 levels by 2020
- Forty (40) percent below 2014 levels by 2030
- Seventy-seven (77) percent below 2014 levels by 2050

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Currently, the most significant GHG emissions in the County are from on-road transportation, which comprised approximately 45 percent of the total GHG emissions in 2014. The County has identified multiple strategies to reduce GHG emissions from on-road transportation in the Climate Action Plan. One of these strategies is the use of alternative fuels in County projects, and RNG is listed as one of the viable renewable fuels. Additionally, the County also intends to reduce fleet emissions, and expansion of alternative fuels use has been identified as an option to achieve this goal.

3.2 State Greenhouse Gas Reduction Goals

In 2006, the State passed Assembly Bill 32, which set initial GHG emissions reduction goals to achieve 1990 GHG levels by 2020. The State expanded on this initiative through Senate Bill 32, which mandates further reductions of GHG emissions to 40 percent below 1990 levels by 2030. Ultimately, the State hopes to reduce GHG emissions to 80 percent below 1990 levels by 2050.

Every 5 years, since the passage of Assembly Bill 32, the State has developed a Climate Change Scoping Plan. In the 2017 plan, the State identified the transportation sector as the largest emitter of GHGs, making up about 39 percent of statewide emissions. As a key strategy to reduce emissions from the transportation sector, the State aims to promote, research, develop, and deploy low carbon fuels such as RNG. The State has already worked to realize this strategy through the LCFS and ARFVTP programs discussed in Section 2. Additionally, the State aims to integrate the strategies to reduce emissions from the transportation sector with other State initiatives. This integration plan has been advanced through the Short-Lived Climate Pollutants Plan, which requires reductions in methane emissions from landfills, wastewater treatment facilities, and dairies, and incentives for using diverted methane for vehicle fuel and alternative power.

3.3 Impact of Renewable Natural Gas Production on Greenhouse Gas Emissions

The GHG impact of upgrading digester gas to RNG was discussed in TM 6. Within the scope boundary of the EWPCF, upgrading digester gas to RNG for pipeline injection will increase anthropogenic GHG emissions because sending all digester gas to the pipeline will result in increasing natural gas-fired combustion in the engines or purchasing electricity directly from San Diego Gas and Electric. Carbon dioxide in the tail gas from the biogas separation process may also add to GHG emissions.

However, within the scope of local and State GHG reduction goals, upgrading to RNG may have an overall net GHG reduction. RNG produced at the EWPCF may ultimately be used as vehicle fuel, which would supplant a high carbon intensity, petroleum-based fuel (e.g., diesel). Petroleum-based diesel has a much higher carbon intensity than California pipeline natural gas. Thus, the benefits of using RNG to replace diesel for vehicle fuel would outweigh the costs of switching from digester gas to pipeline natural gas in the engines at the EWPCF. Additionally, increasing the availability of RNG for vehicle fuel use aligns with local and State GHG reduction goals of expanding low carbon fuel use.



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Technical Memorandum

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This is a draft memorandum and is not intended to be a final representation of the work done or recommendations made by Brown and Caldwell. It should not be relied upon; consult the final memorandum.

This document was prepared solely for the Encina Water Authority in accordance with professional standards at the time the services were performed and in accordance with the contract between the Encina Water Authority and Brown and Caldwell dated June 28, 2017. This document is governed by the specific scope of work authorized by the Encina Water Authority; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the Encina Water Authority and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Table of Contents

List of Tables	ii
List of Abbreviations	iii
Section 1: Introduction	
1.1 Purpose and Scope	
Section 2: Basis of Evaluation	
2.1 Existing Digester Capacity	
2.2 HSW Feedstocks Identification and Characteristics	5
Section 3: Existing HSW Co-Digestion	6
3.1 Existing Facility HSW Co-Digestion Capacity	
3.2 Process Improvements to Accept HSW	
3.3 Solids Process Impacts	10
Section 4: Biogas Production and Utilization	
4.1 DG Production with HSW	
4.2 Existing Gas Management and Utilization Capacity	
4.3 Gas Management Improvements to Increase Gas Utilization	
4.3.1 NG Use	
4.4 Basis of Evaluation for Pipeline Injection	
Section 5: Present Worth Cost Analysis	
5.1 Capital Costs	
5.2 Operating Costs	
5.3 Benefits5.4 Results	
Section 6: Waste Hauler Coordination	
Section 7: Summary	
Section 8: Recommended Next Steps	21
Attachment A: LACSD SSO Specifications	A-1
Attachment B: Calculations	B-1



List of Tables

Table 2-1. Digester Capacity at EWPCF	5
Table 2-2. Summary of Existing AFRF Infrastructure	5
Table 2-3. Summary of SSO Characteristics	6
Table 3-1. Digester Loading Rates for Capacity Evaluation	7
Table 3-2. Maximum Quantities of SSO Can Be Accepted for Co-Digestion with Existing Digesters	7
Table 3-3. Digester Loading Criteria for HSW Digestion1,2	8
Table 3-4. Maximum Quantities of HSW Can Be Accepted with Digesters 1 and 3	8
Table 3-5. Maximum Quantities of HSW Can Be Accepted with Digesters 1, 3 and 4	9
Table 4-1. Scenario 1: Projected DG Production with HSW with Digesters 1 and 3 for HSW Digestion, scfm	10
Table 4-2. Scenario 2: Projected DG Production with HSW with Digesters 1, 3 and 4 for HSW Digestion, scfm	11
Table 4-3. Summary of NG Demand with Pipeline Injection Alternative	13
Table 4-4. Scenario 1 RNG Production Estimates for D3 and D5 RINs	14
Table 5-1. Summary of Project Cost for Proposed Alternatives1	16
Table 5-2. Summary of Unit Costs	17
Table 5-3. Summary of Benefit Unit Costs	
Table 5-1. Summary of Proposed Alternatives	19



ii

List of Abbreviations

\$	dollar(s)	O&M	operations and maintenance
\$/DGE	dollars per diesel gallons equivalents	00S	out of service
\$/gal	dollars per gallon	RIN	Renewable Identification Number
\$/lb	dollars per pound	RNG	renewable natural gas
\$/MMscf	dollars per million standard cubic feet	SB	Senate Bill
\$/therm	dollars per therm	scf	standard cubic feet
\$/wet ton	dollars per wet ton	scfm	standard cubic foot/feet per minute
\$/year	dollars per year	SCR	selective catalytic reduction
BC	Brown and Caldwell	SRT	solids retention time
AFRF	Alternative Fuel Receiving Facility	SS0	source-separated organics
BEE	Biosolids Energy and Emissions	TM	technical memorandum
d	day(s)	TOU	time of use
DG	digester gas	TS	total solids
DG/lb	digester gas per pound	VS	volatile solids
DGE	Diesel Gallons Equivalents	WM	Waste Management
EBS	Engineered Bio Slurry		
EWA	Encina Wastewater Authority		
EWPCF	Encina Water Pollution Control Facility		
FOG	fats, oil, and grease		
gal	gallon(s)		
GCS	gas conditioning system		
gpd	gallon(s) per day		
gpm	gallons per minute		
HSW	high-strength waste		
IC	internal combustion		
kW	kilowatt(s)		
kWh	kilowatt hour		
lb	pound(s)		
LACSD	Sanitation Districts of Los Angeles County		
lb	pound(s)		
lb/ft ³ /d	pounds per cubic feet per day		
lb VS/ft ³	pounds per volatile solids per cubic feet		
LCFS	Low Carbon Fuel Standard		
MMBtu/lb	million British thermal units per pound		
MMscf	million standard cubic feet		
MWh	megawatt hour		
NG	natural gas		
OLR	organic loading rate		

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Section 1: Introduction

Brown and Caldwell recently submitted a comprehensive Biosolids Energy and Emission (BEE) Plan to Encina Wastewater Authority (EWA). Technical Memorandum ™ 7 of the BEE Plan developed various alternative scenarios for solids processing as well as energy production and digester gas (DG) utilization. This TM 9, a high-strength waste (HSW) acceleration study, provides additional capital and life-cycle costs associated with increasing the HSW receiving and renewable energy recovery programs at the Encina Water Pollution Control Facility (EWPCF). EWA has indicated that TM 9 is to be based around the alternative of rehabbing Digesters 1 and 3 to accept HSW and DG upgrading for pipeline injection.

1.1 Purpose and Scope

TM 9 evaluates the feasibility of implementing a HSW or food waste program at the EWPCF's Alternative Fuel Receiving Facility (AFRF) within the next 24 months. This TM provides a summary of the impacts of employing an HSW program upon facilities within the plant such as waste comingling, digestion capacity, solids handling, biogas production and utilization, biosolids disposition, and expected costs.

This TM will be combined with the BEE project. The previous TMs associated with the BEE project include the following:

- . TM 1: Baseline Energy Profiles and Projections
- TM 2: Technology Evaluations for Biosolids Handling
- TM 3: Technology Evaluations for Alternative Power Production
- TM 4: Technology Evaluations for Biogas Production
- TM 5: Technology Evaluations for Waste Heat
- . TM 6: Air Emissions
- . TM 7: Alternatives Development, Evaluation, and Selection
- . TM 8: Grant and Incentive Programs Summary

Section 2: Basis of Evaluation

This section summarizes the excess capacity of the existing digesters for HSW and HSW characteristics.

2.1 Existing Digester Capacity

A digester capacity evaluation was performed on the solids handling process, tracking total and volatile solids (VS) through the treatment process at the EWPCF to determine baseline process operating conditions. Calculations were primarily based on 2-year average flows and loads using process data ranging from May 2015 to June 2017 provided by EWA Operations staff. The results of the digester capacity evaluation are summarized in Table 2-1.



	Table 2-1. Digester Capacity at EWPCF																															
		No. of Units			Design Load-	Measured	Percent of																									
Process	Technology	Total	Normal Service	Condition	ing Rate ¹	Value	Capacity Used																									
Digestion	Mesophilic Digesters	• • • • •		Average VS Loading; all units in service	0.15 lb/ft3/d	0.08 lb/ft3/d	40%																									
			3	3		Average VS Loading; two units in service	0.18 lb/ft3/d	0.12 lb/ft3/d	67%																							
					3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	Peak 2-week ² VS Loading; all units in service	0.18 lb/ft3/d
				Hydraulic Loading; two units in service	15 days	19.6 days	77%																									
				Hydraulic Loading; all units in service	15 days	29.3 days	51%																									

¹ Digester capacities based on BC standard design criteria for mesophilic digestion.

² Peaking condition was applied using the peaking factors developed in BEE Plan TM1-Baseline Energy Profiles

As shown in Table 2-2, the existing digesters have extra capacity for HSW co-digestion at current solids flows and loads. The digester capacity evaluation was based on a digester feed total solids (TS) of 4.6 percent. Due to changes in the operation of the primary clarifiers, the digesters are currently fed at a lower sludge TS. Therefore, there is no excess hydraulic loading capacity for co-digestion under current operation.

The existing HSW receiving facility, AFRF, consists of one HSW transfer pump and two 22,500-gallon storage tanks. Food waste is pre-processed off site to remove contaminants and to process organic waste into a pumpable liquid/slurry. HSW is pumped into each of the two tanks with a single transfer pump. Each tank is equipped with a mixing pump to keep the HSW mixed. HSW is then fed to Digesters 5 and 6 using digester feed pumps. The capacity of the AFRF is summarized in Table 2-2.

Table 2-2. Summary of Existing AFRF Infrastructure					
Condition	Value	Operation			
Total storage volume, gallons	45,000	Each tank is 13' diameter, 25' height, sloped bottom			
Rock trap/grinder, gpm	200	Constant speed			
Bypass screening equipment, gpm	200				
Mixing pumps, gpm	300	One per tank			
Digester feed pumps, gpm	5-50	One per tank, variable frequency drive control			

2.2 HSW Feedstocks Identification and Characteristics

The EWA currently receives approximately 7,100 gallons per day (gpd) of brewery waste and 7,500 gpd of fats, oil, and grease (FOG) for co-digestion. This analysis assumes that EWA will continue to receive the same amount of brewery waste and FOG in the future.

EWA has been researching and evaluating potential HSW for co-digestion to increase gas production. This TM focuses on pre-processed source separated organic (SSO) waste as potential substrate co-digestion at the EWA. This section describes the characteristics of the anticipated pre-processed food waste for EWA's facility.



The solids concentration of the pre-processed SSO is expected to range from 12 to 15 percent and may vary in pH ranging from 3 to 7, with the expected pH value being around 5. As part of the development of the pre-processed SSO receiving program, it is assumed EWA will develop standards for quality related to minimum screen size, debris removal rates, and presence/absence of manufactured inerts.

Generation of the pre-processed SSO will be accomplished off site by a third party. Raw SSO will be processed into an organic feedstock, nearly free of contaminants, pulped, extruded, and/or slurried into a pumpable liquid. Attachment A summarizes the SSO requirements that the Sanitation Districts of Los Angeles County (LACSD) has developed for its pre-processed SSO receiving program. Other pertinent requirements include recent requirements developed by CalRecycle under its new composting regulations (California Code of Regulations Title 14, Chapter 3.1, Section 17868), included to provide some guidance on physical contamination requirements, which EWA may wish to incorporate (Attachment A).

On the whole, these can be used as a guide for the desired feedstock quality for the partners that will provide EWA with a pumpable slurry that can be offloaded in a contained manner using trucks and hoses.

Table 2-3. Summary of SSO Characteristics			
Parameter	Value		
TS, %	12		
VS, % of TS	85		
Specific gravity	1.0		

Characteristics of the SSO used for this evaluation is summarized in Table 2-3.

Section 3: Existing HSW Co-Digestion

This section summarizes the existing facility HSW co-digestion capacity, process improvements to accept more HSW, and process impacts.

3.1 Existing Facility HSW Co-Digestion Capacity

Two loading conditions were used to evaluate the process operating conditions and assess conformance with the process limit criteria. The following loading conditions were used to evaluate the digestion system capacity.

- **Peak Loading Condition**. The peak average 14-day sludge flow and load to the digestion system will be used to assess the peak loading conditions experienced by the digesters with all units in service.
- Service Condition. The service condition is assessed at the average annual flow and load to the digesters assuming the largest unit is out of service. Evaluating at this condition will allow plant staff to take a digester unit out of service at a reduced risk of process upset, assuming that sludge production follows a relatively predictable seasonal pattern. It may be possible to avoid this design condition by identifying alternative sludge offloading or upstream-storage practices; although, these would necessitate use of these alternative plans for sustained periods of time (4 to 8 months at a time for digester cleaning).

Digesters 4, 5, and 6 are used for this evaluation. The following process limit criteria (Table 3-1) were used to evaluate available digester capacities for co-digestion at various conditions.



Table 3-1. Digester Loading Rates for Capacity Evaluation					
Parameter	Peak Condition	Service Condition			
Solids flow and load condition	Peak 14-day	Annual average			
Number of digesters in service	3	2			
Solids retention time, day (min)	15	15			
Organic loading rate, Ib VS/ft ³ (max)	0.18	0.18			

The preliminary evaluation results show that the service condition is the limiting condition. The quantities of HSW can be co-digested with the existing digesters are summarized in Table 3-2.

Table 3-2. Maximum Quantities of SSO Can Be Accepted for Co-Digestion with Existing Digesters					
Year	SSO, gpd	Limiting Criterion			
2020	36,000	OLR			
2021	34,300	OLR			
2022	32,600	OLR			
2023	30,900	OLR			
2024	29,200	OLR			
2025	27,500	OLR			
2026	25,800	OLR			
2027	24,000	OLR			
2028	22,300	OLR			
2029	20,600	SRT			
2030	16,100	SRT			
2031	11,600	SRT			
2032	7,100	SRT			
2033	2,600	SRT			
2034	0	SRT			
2035	0	SRT			
2036	0	SRT			
2037	0	SRT			
2038	0	SRT			
2039	0	SRT			
2040	0	SRT			

As shown in Table 3-2, the existing digesters will run out of capacity by 2033. There will be no excess digester capacity available for co-digestion starting in 2034.



3.2 Process Improvements to Accept HSW

Two digesters (1 and 3), each with a capacity of 300,000 gallons, could be retrofitted to accept HSW and increase capacity for co-digestion. In order to maximize the production of renewable energy and the utilization of the existing facility, this evaluation was based on retrofitting Digesters 1 and 3 for HSW digestion. The following digester loading criteria were used to evaluate the quantity of HSW can be digested with Digesters 1 and 3 (Table 3-3).

Table 3-3. Digester Loading Criteria for HSW Digestion ^{1,2}					
Condition Unit Value					
Solids Retention Time	day	15			
Organic Loading Rate Ib VS/ft ³ 0.5					

¹ Assume both Digesters 1 and 3 are in service.

² HSW will only be added to Digesters 1 and 3. Existing digesters are for sludge only.

The amount of HSW that can be digested was estimated for two scenarios. Scenario 1 assumes HSW will be digested in Digesters 1 and 3. The three larger digesters will be used for sludge digestion only. This allows one large digester to be taken offline for maintenance and still meet the design hydraulic and organic loading rates.

Scenario 2 assumes one large digester and Digesters 1 and 3 will be used for HSW until 2033. The other two large digesters will be used for sludge digestion. Starting from 2034, all three large digesters will be used for sludge digesters 1 and 3.

The HSW quantities digested under Scenario 1 are shown in Table 3-4. With both digesters in service, Digesters 1 and 3 can accommodate approximately 40,000 gpd of HSW until 2033, when projected sludge flows and loads exceed the capacity of the three existing digesters. Some sludge needs to be diverted to Digesters 1 and 3, reducing the amount of HSW that can be digested.

Since the EWPCF receives approximately 14,600 gpd of FOG and brewery waste, the additional SSO that can be digested is approximately 25,400 gpd.

Table 3-4. Maximum Quantities of HSW Can Be Accepted with Digesters 1 and 3					
Year	FOG and Brewery Waste	SSO	Total HSW, gpd	Limiting Criterion	
2020	14,600	25,400	40,000	SRT	
2021	14,600	25,400	40,000	SRT	
2022	14,600	25,400	40,000	SRT	
2023	14,600	25,400	40,000	SRT	
2024	14,600	25,400	40,000	SRT	
2025	14,600	25,400	40,000	SRT	
2026	14,600	25,400	40,000	SRT	
2027	14,600	25,400	40,000	SRT	
2028	14,600	25,400	40,000	SRT	
2029	14,600	25,400	40,000	SRT	



Table 3-4. Maximum Quantities of HSW Can Be Accepted with Digesters 1 and 3					
Year	FOG and Brewery Waste	SS0	Total HSW, gpd	Limiting Criterion	
2030	14,600	25,400	40,000	SRT	
2031	14,600	25,400	40,000	SRT	
2032	14,600	25,400	40,000	SRT	
2033	14,600	25,400	40,000	SRT	
2034	14,600	23,400	38,000	SRT	
2035	14,600	18,900	33,500	SRT	
2036	14,600	14,400	29,000	SRT	
2037	14,600	9,900	24,500	SRT	
2038	14,600	5,400	20,000	SRT	
2039	14,600	900	15,500	SRT	
2040	11,000	0	11,000	SRT	

Scenario 2 HSW digested quantities are shown in Table 3-5. With all digesters in service, Digesters 1, 3, and 4 can accommodate approximately 176,700 gpd of HSW until 2033, when projected sludge flows and loads exceed the capacity of the three existing digesters. Digester 4 will be converted to a sludge only digester. HSW will only be digested in Digesters 1 and 3.

Since the EWPCF receives approximately 14,600 gpd of FOG and brewery waste, the additional SSO can be digested is approximately 162,100 gpd.

Table 3-5. Maximum Quantities of HSW Can Be Accepted with Digesters 1, 3 and 4						
Year	FOG and Brewery Waste	SS0	Total HSW, gpd	Limiting Criterion		
2020	14,600	162,100	176,700	SRT		
2021	14,600	162,100	176,700	SRT		
2022	14,600	162,100	176,700	SRT		
2023	14,600	162,100	176,700	SRT		
2024	14,600	162,100	176,700	SRT		
2025	14,600	162,100	176,700	SRT		
2026	14,600	162,100	176,700	SRT		
2027	14,600	162,100	176,700	SRT		
2028	14,600	162,100	176,700	SRT		
2029	14,600	162,100	176,700	SRT		
2030	14,600	162,100	176,700	SRT		
2031	14,600	162,100	176,700	SRT		
2032	14,600	162,100	176,700	SRT		
2033	14,600	162,100	176,700	SRT		
2034	14,600	23,400	38,000	SRT		
2035	14,600	18,900	33,500	SRT		

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Table 3	Table 3-5. Maximum Quantities of HSW Can Be Accepted with Digesters 1, 3 and 4						
Year	FOG and Brewery Waste	SS0	Total HSW, gpd	Limiting Criterion			
2036	14,600	14,400	29,000	SRT			
2037	14,600	9,900	24,500	SRT			
2038	14,600	5,400	20,000	SRT			
2039	14,600	900	15,500	SRT			
2040	11,000	0	11,000	SRT			

Currently, the AFRF is reaching its capacity receiving an average of 14,600 gpd of FOG and brewery waste. Therefore, a new SSO receiving facility would be required.

Scenario 1 would require a new SSO receiving facility with a capacity slightly larger than the existing AFRF to receive the additional SSO and FOG/brewery waste. Scenario 2 would require a new SSO receiving facility significantly larger than the existing AFRF.

3.3 Solids Process Impacts

Digestion of HSW would have impacts on the solids process downstream of digestion including dewatering and biosolids disposal. A large portion of HSW would be reduced during the digestion process, and the remainder would be transferred to the dewatering process. The increased hydraulic and solids loads to the dewatering process would increase polymer consumption, power consumption of the dewatering process, and may even require more dewatering equipment.

The existing dryer is operating close to its design capacity; excess solids are being hauled off site for Class B land application. Digestion of HSW would increase dewatered biosolids to be disposed of as Class B biosolids, increasing hauling and land application costs.

Section 4: Biogas Production and Utilization

This section provides a summary of the anticipated DG production resulting from the additional HSW, the existing DG management system and equipment capacities, and potential DG management improvements to increase the amount of DG that can be beneficially used.

4.1 DG Production with HSW

DG production estimates for Scenarios 1 and 2 are summarized in Tables 4-1 and 4-2, respectively. These DG production estimates were then used as the basis of evaluation to determine annual operations and maintenance (0&M) costs, sizing of the gas upgrading system, and capital costs.

Table 4-1. Scenario 1: Projected DG Production with HSW with Digesters 1 and 3 for HSW Digestion, scfm						
Year	DG from Sludge	DG from FOG and Brewery Waste	DG from SSO	Total DG		
2020	446	143	180	769		
2021	456	143	180	779		
2022	465	143	180	789		
2023	475	143	180	798		



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Table 4-1. Scena	Table 4-1. Scenario 1: Projected DG Production with HSW with Digesters 1 and 3 for HSW Digestion, scfm					
Year	DG from Sludge	DG from FOG and Brewery Waste	DG from SSO	Total DG		
2024	485	143	180	808		
2025	494	143	180	817		
2026	504	143	180	827		
2027	513	143	180	836		
2028	523	143	180	846		
2029	532	143	180	855		
2030	542	143	180	865		
2031	551	143	180	875		
2032	561	143	180	884		
2033	571	143	180	894		
2034	580	143	166	889		
2035	590	143	134	867		
2036	599	143	102	844		
2037	609	143	70	822		
2038	618	143	38	800		
2039	628	143	6	777		
2040	637	143	0	780		

Table 4-2. Scenario 2: Projected DG Production with HSW with Digesters 1, 3 and 4 for HSW Digestion, scfm					
Year	DG from Sludge	DG from FOG and Brewery Waste	DG from SSO	Total DG	
2020	446	143	1,149	1,710	
2021	456	143	1,149	1,719	
2022	465	143	1,149	1,729	
2023	475	143	1,149	1,738	
2024	485	143	1,149	1,748	
2025	494	143	1,149	1,757	
2026	504	143	1,149	1,767	
2027	513	143	1,149	1,776	
2028	523	143	1,149	1,786	
2029	532	143	1,149	1,796	
2030	542	143	1,149	1,805	
2031	551	143	1,149	1,815	
2032	561	143	1,149	1,824	
2033	571	143	1,149	1,834	
2034	580	143	166	889	
2035	590	143	134	867	

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Table 4-2. Scenario 2: Projected DG Production with HSW with Digesters 1, 3 and 4 for HSW Digestion, scfm						
Year	DG from Sludge	DG from Sludge DG from FOG and Brewery Waste DG from SSO				
2036	599	143	102	844		
2037	609	143	70	822		
2038	618	143	38	800		
2039	628	143	6	777		
2040	637	143	0	780		

4.2 Existing Gas Management and Utilization Capacity

The EWPCF currently utilizes DG in four 750-kilowatt (kW) internal combustion (IC) engines and a biosolids dryer. The current air permit allows up to 280 million standard cubic feet (MMscf) of biogas and natural gas (NG), with a maximum of 28 MMscf of NG as is limited on a carbon monoxide basis. Assuming full DG utilization in the engines, the EWPCF is permitted to fuel the engines on an average of 533 standard cubic feet per minute (scfm), which is approximately 2.5 engines at 100 percent load, on average.

DG that cannot be utilized in the engines can be used in the biosolids dryer, which is capable of operating on a maximum blend of 82 percent DG and 18 percent NG; the dryer can run on 100 percent NG but is limited on DG (Table 4-2).

Table 4-2. Summary of Current Gas Management System and Equipment Capacities				
Equipment DG Capacity (scfm) Notes				
IC engines	533	Air permit limits DG use up to 28 MMscf on annual basis in 4 x 750 kW units		
Thermal dryer	190 ¹	Andritz DDS40 can utilize a maximum of 82 percent DG 0.0023 MMBtu/lb solids load to digesters (4.11 scf DG/lb)		
Total beneficial use	723	Based on current IC engines air permit and thermal dryer max DG use		
Flare (existing)	750	Flare vendor rated capacity		

¹ Based on current baseline digester loading from TM 1, Figure ES-1. With HSW addition, increased loads to the digester will not significantly impact dryer load since most of the load will be volatilized to DG.

The current gas management system allows for up to 750 scfm of DG production, 723 scfm of which can be used in the engines and thermal dryer. Based on the assumptions outlined in Sections 2 and 3, EWA can accept a maximum of 43,000 gallons per day of HSW at current solids loadings without any major capital improvements. This evaluation also assumes that the existing digester infrastructure, including DG laterals and manifolds, pressure relief valves, and flare are sized adequately for peak instantaneous production.

4.3 Gas Management Improvements to Increase Gas Utilization

If EWA seeks to expand the HSW program by rehabilitating Digesters 1 and 3 and increasing the reliability of the AFRF, additional gas management improvements are required. Once DG production exceeds a threshold of 750 scfm, a new flare is required to safely dispose of DG in an event where the engines and solids dryer are offline, as a minimum. EWA has indicated the preferred use of DG for this evaluation is for pipeline injection, which would benefit from the revenue associated with producing renewable identification numbers



(RINs) under the Federal Renewable Fuel Standard and Credits under California Air Resources Board's Renewable Fuel Standard and Low Carbon Fuel Standard (LCFS).

As such, some alternatives consider all DG will go to pipeline injection with NG purchased to fuel the existing IC engines and provide heat to the thermal dryer. Exhaust treatment with selective catalytic reduction (SCR) will be required for this scenario. Purchasing NG to run the engines with SCR exhaust treatment was demonstrated to provide financial value rather than purchasing electricity from San Diego Gas & Electric (TM 7, alternatives 9 and 9S).

4.3.1 NG Use

It is assumed that the thermal dryer is already operating at capacity as identified in TM 7; therefore, the calculation for energy input is based on the current demands determined in TM 1. This evaluation assumes that the engines will be retrofitted with SCR for exhaust gas treatment in order to meet air permit requirements. Engine output in this analysis is limited to the current and projected plant electricity demands determined in TM 1 since approximately 2.5 engines are required to meet plant demand, the incremental cost of pursuing net electrical metering and exporting power at a lower value is not feasible for the quantity of power that can be exported. This analysis assumes engines will operate to meet full plant demand, thereby eliminating non-coincident demand charges and power costs. A summary of the NG demands for the pipeline injection alternative is included in Table 4-3.

	Table 4-3. Summary of NG Demand with Pipeline Injection Alternative				
Equipment	Energy Input Required Million therms per year	Notes			
IC engines	1.6 to 1.7	NG demand to engines increases as plant power demand increases. Power demand is assumed linear and is based on the predictions in TM1. Ranges between 16,000 to 17,200 MWh per year.			
Thermal dryer	0.6	Based on current baseline digester loading from TM 1, Figure ES-1. With HSW addition, increased loads to the digester will not significantly impact dryer load since most of the load will be volatilized to DG.			
Total demand	2.2 to 2.3	Varies depending on plant demand.			

4.4 Basis of Evaluation for Pipeline Injection

The basis of evaluation for the life-cycle cost analysis is dependent on the quantity of renewable natural gas (RNG) produced. Table 4-4 summarizes the estimated D3, D5, and Diesel Gallons Equivalents (DGE) production on an annual basis. These values will be used to estimate the total revenue from RNG sale. As the regulations are currently written, DG generated from municipal wastewater solids are classified as a D3 cellulosic biofuel RIN. DG generated from food waste, FOG, or any other HSW not coming through the headworks of the plant are classified as a D5 advanced biofuel. Co-mingled waste streams are classified as a D5 RIN; however, by physically separating the digesters with municipal sludge and HSW and metering individual DG production headers, EWA can still maintain the higher value D3 RINs for municipal sludge gas. This approach is recommended and is the basis for the evaluation and costs in this TM. It is assumed that HSW is fed to Digesters 1 and 3 while municipal sludge is sent to the remainder of the digesters, thus separating RINs.



Table 4-4. Scenario 1 RNG Production Estimates for D3 and D5 RINs					
Year	D5 Production, RIN/year ¹	D3 Production, RIN/year ¹	DGE Production, DGE/year ²		
2020	850,000	1,690,000	1,510,000		
2021	850,000	1,720,000	1,530,000		
2022	850,000	1,760,000	1,550,000		
2023	850,000	1,790,000	1,570,000		
2024	850,000	1,830,000	1,600,000		
2025	850,000	1,860,000	1,620,000		
2026	850,000	1,900,000	1,640,000		
2027	850,000	1,930,000	1,660,000		
2028	850,000	1,960,000	1,680,000		
2029	850,000	2,000,000	1,700,000		
2030	850,000	2,030,000	1,720,000		
2031	850,000	2,070,000	1,740,000		
2032	810,000	2,100,000	1,740,000		
2033	720,000	2,140,000	1,700,000		
2034	620,000	2,170,000	1,670,000		
2035	520,000	2,210,000	1,630,000		
2036	430,000	2,240,000	1,590,000		
2037	330,000	2,280,000	1,560,000		
2038	240,000	2,310,000	1,520,000		
2039	140,000	2,340,000	1,480,000		
2040	50,000	2,380,000	1,450,000		

¹ Based on methane capture efficiency of 99.5% and equipment uptime of 95%. 1 RIN = 77,000 Btu (LHV).

² Based on methane capture efficiency of 99.5% and equipment uptime of 95%. 1 DGE = 129,000 Btu (LHV).

Five pipeline injection alternatives were evaluated to determine potential project payback periods with and without the large Digester 4 in service to accept HSW. The initial analysis of the pipeline injection alternatives assumes the following parameters:

Alternative 1: All DG to Pipeline, NG Engines plus SCR, Large Digester Out of Service (OOS):

- Scenario 1: Municipal sludge to Digesters 4 through 6, HSW to Digesters 1 and 3
- Large digester OOS: 25,400 gpd of additional HSW capacity
- All DG to pipeline: biogas upgrading sized for 800 scfm
- Engines produce enough power for plant (fueled on NG) and SCR
- New HSW receiving facility



- Alternative 2: D3 DG to Pipeline, D5 DG to Engines plus SCR, Large Digester OOS:
 - Scenario 1: Municipal sludge to Digesters 4 through 6, HSW to Digesters 1 and 3
 - Large digester OOS: 25,400 gpd of additional HSW capacity
 - D3 gas to pipeline, D5 gas to engines
 - Biogas upgrading/gas conditioning sized for 800 scfm
 - Engines produce enough power for plant (supplement with NG) and SCR
 - New HSW receiving facility
- Alternative 2.5 D3 DG to Pipeline, D5 DG to Engines:
 - Scenario 1: Municipal sludge to Digesters 4 through 6, HSW to Digesters 1 and 3
 - Large digester OOS: 25,400 gpd of additional HSW capacity
 - D3 gas to pipeline, D5 gas to engines
 - Biogas upgrading sized for 1200 scfm; no separate gas conditioning. Engines get pipeline quality gas.
 - Engines produce enough power for plant and oxidation catalyst installed (time of use [TOU] peak shaving)
 - New HSW receiving facility
 - Assume Alternative 2 operating costs
- Alternative 2.75 D3 DG to Pipeline, D5 DG to Engines plus SCR:
 - Scenario 1: Municipal sludge to Digesters 4 through 6, HSW to Digesters 1 and 3
 - Large digester OOS: 25,400 gpd of additional HSW capacity
 - D3 gas to pipeline, D5 gas to engines
 - Biogas upgrading sized for 1,200 scfm; no separate gas conditioning. Engines get pipeline quality gas
 - Engines produce enough power for plant and SCR plus oxidation catalyst installed (TOU peak shaving)
 - New HSW receiving facility
 - Assume Alternative 2 operating costs
- Alternative 3 D3 DG to Pipeline, D5 DG to Engines, Large Digester in Service:
 - Scenario 2: Municipal sludge to Digesters 5 and 6, HSW to Digesters 1, 3, and 4
 - Large digester in service: import HSW to produce enough DG for engines at 60,000 gpd
 - D3 gas to pipeline, D5 gas to engines
 - Biogas upgrading sized for 600 scfm; gas conditioning system (GCS) sized for 650 scfm
 - Engines produce enough power for plant and oxidation catalyst installed
 - New HSW receiving facility



- Alternative 4 All DG to Pipeline, Large Digester OOS:
 - Scenario 1: Municipal sludge to Digesters 4 6, HSW to Digesters 1 and 3.
 - Large digester OOS: 25,400 gpd of additional HSW capacity
 - All DG to pipeline: biogas upgrading sized for 800 scfm
 - Engines produce enough power for plant (fueled on NG) and SCR installed
 - New HSW receiving facility
- Alternative 5 All DG to Pipeline, Large Digester in Service:
 - Scenario 2: Municipal sludge to Digesters 5 and 6, HSW to Digesters 1, 3, and 4
 - Large digester in service for HSW until 2033: 162,000 gpd of additional HSW capacity
 - All DG to pipeline: biogas upgrading 2,000 scfm capacity
 - Engines produce enough power for plant (fueled on NG) and SCR
 - New, large HSW receiving facility and site truck traffic modifications

Section 5: Present Worth Cost Analysis

A present worth cost analysis was performed to identify capital and operating costs associated with upgrading EWPCF to accept HSW for co-digestion and beneficially reuse the gas through NG pipeline injection. The analysis uses an escalation rate of 2.0 percent and a discount rate of 2.5 percent performed over a 20-year period from 2020 to 2040. The analysis was ultimately used to determine the payback period (year) required for the net benefits derived from HSW and DG upgrades to pay off the capital investments.

The following sections describe the various assumptions made on capital costs, operating costs, and benefits along with results from the present worth cost analysis.

5.1 Capital Costs

Conservative cost assumptions were made on the following items which are required for the upgrade of EWPCF to accept HSW and beneficially reuse the gas through NG pipeline injection. Detailed cost estimating was not performed, but costs available from relevant projects around Southern California were used.

Table 5-1 provides a summary of capital cost investments required for the various alternatives.

	Table 5-1. Summary of Project Cost for Proposed Alternatives ¹						
	Alt 1 - All DG to Pipeline, NG Engines + SCR, Large Digester OOS	Alt 2 - D3 DG to Pipeline, D5 DG to Engines, SCR, Large Digester OOS	Alt 2.5 - D3 DG to Pipeline, D5 DG to Engines	Alt 2.75 - D3 DG to Pipeline, D5 DG to Engines	Alt 3 - D3 DG to Pipeline, D5 DG to Engines, Large Dig in Service	Alt 4 -All DG to Pipeline, Large Digester OOS	Alt 5 - All DG to Pipeline, Large Digester in Service
Biogas Upgrading System	\$16.9M (800 scfm)	\$16.9M (800 scfm)	\$21.2M (1,200 scfm)	\$21.2M (1,200 scfm)	\$15.3M (650 scfm)	\$24.0M (2,000 scfm)	\$24.0M (2,000 scfm)
Oxidation Catalyst			\$1.0M	\$1.0M	\$1.0M		
Gas Conditioning					\$4.3M (600 scfm)		

Brown No Caldwell

	Table 5-1. Summary of Project Cost for Proposed Alternatives ¹						
	Alt 1 - All DG to Pipeline, NG Engines + SCR, Large Digester OOS	Alt 2 - D3 DG to Pipeline, D5 DG to Engines, SCR, Large Digester OOS	Alt 2.5 - D3 DG to Pipeline, D5 DG to Engines	Alt 2.75 - D3 DG to Pipeline, D5 DG to Engines	Alt 3 - D3 DG to Pipeline, D5 DG to Engines, Large Dig in Service	Alt 4 -All DG to Pipeline, Large Digester OOS	Alt 5 - All DG to Pipeline, Large Digester in Service
SCR	\$4.0M	\$4.0M		\$3.9M		\$4.0M	\$4.0M
HSW Receiving Facility	\$2.0M	\$2.0M	\$3.0M	\$3.0M	\$3.0M	\$6.0M	\$6.0M
Digesters 1 & 3 Upgrades ²	\$5.5M	\$5.5M	\$5.5M	\$5.5M	\$5.5M	\$5.5M	\$5.5M
Project Cost	\$28.4M	\$28.4M	\$30.7M	\$34.6M	\$29.1M	\$39.5M	\$39.5M

¹ Costs shown in 2020 dollars.

² Cost for digester upgrades includes new mixing systems, heat exchangers, sludge circulation pumps mechanical piping and minor structural upgrades.

5.2 Operating Costs

To the best degree possible, the following operating cost estimates reflect the actual operating parameters and unit costs at EWPCF. Information was requested during the BEE Plan from EWA staff for chemicals; utilities such as water, NG, electricity; and biosolids trucking/dispositions costs and used in this evaluation.

The following Table 5-2 summarizes the unit costs used for operating cost analysis.

Table 5-2. Summary of Unit Costs					
Parameter	Unit	Cost			
NG (Dryer)	\$/therm	0.31			
NG (Engine)	\$/therm	0.31			
Cogen O&M	\$/kWh	0.015			
SCR 0&M	\$/kWh	0.015			
DG upgrading O&M	\$/MMscf	540			
Class B cake hauling and disposal	\$/wet ton	48			
Dewatering polymer	\$/lb	1.2			
Electricity	\$/kWh	0.09			
Non-coincident demand charge	\$/year	01			

¹ Current non-coincident demand charges are \$255K annually. Evaluation assumes that since there is engine redundancy and SCR will eliminate air permit restrictions on fuel usage, EWA will be able to run engines to meet plant demand, thereby eliminating the noncoincident demand charge.



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5.3 Benefits

Table 5-3 shows a summary of benefit cost assumptions used in the analysis. The D3, D5, and LCFS credit values all assumed a 1 percent deflation value over the 20-year analysis as there is uncertainty in future values of these attributes. Note that these values have been updated to reflect the current market value for RINs since the initial BEE project. The current market values as of October 2018 are approximately 25 percent higher than the values used in the analysis; actual revenue is de-rated to account for broker and verification fees that subtract from the RIN revenue. A sensitivity analysis was performed for the various alternatives that determined potential project payback period with low and high RIN and LCFS credit values. For the high incentive values, the D3 RIN was assumed to be \$2.25/RIN, the D5 RIN was \$0.75/RIN; the LCFS credit value was \$1.15/DGE. These are included in the Attachment B calculations.

Table 5-3. Summary of Benefit Unit Costs											
Parameter	Unit	Cost									
HSW Tip Fee	\$/gal	0.04									
D3 RIN value	\$	1.50									
D5 RIN value	\$	0.25									
LCFS value	\$/DGE	0.80									
NG Sale	\$/therm	0.25									

Attachment B includes a calculation that summarizes the annual estimated revenue from pipeline injection for RINs, LCFS, the commodity value of the fuel, and HSW tipping fees. These economic benefits range from \$4 to \$10 million annually, with the D3 RIN revenue generating approximately half of the total.

5.4 Results

The results from the present worth analysis for the presented alternatives are provided in Table 5-1.

All alternatives offset capital and operating investments and provided a positive return on investment ranging from \$5.6 million to 22.5 million over a 20-year project life.



			Table 5-1. Summary of P	roposed Alternatives			
	Alt 1 - All DG to Pipeline, NG Engines + SCR, Large Digester OOS	Alt 2 - D3 DG to Pipeline, D5 DG to Engines, Large Digester OOS	Alt 2.5 - D3 DG to Pipeline, D5 DG to Engines	Alt 2.75 - D3 DG to Pipeline, D5 DG to Engines	Alt 3 - D3 DG to Pipeline, D5 DG to Engines, Large Digester in Service	Alt 4 -All DG to Pipeline, Large Digester OOS	Alt 5 - All DG to Pipeline, Large Digester in Service
Description	 All DG to pipeline: biogas upgrading sized for 800 scfm Engines produce enough power for plant (fueled on NG) and SCR Large digester OOS: 25,400 gpd of additional HSW capacity New HSW receiving facility 	 D3 gas to pipeline, D5 gas to engines Biogas upgrading/gas conditioning sized for 800 scfm Engines produce enough power for plant (supplement with NG) and SCR Large digester OOS: 25,400 gpd of additional HSW capacity New HSW receiving facility 	 D3 gas to pipeline, D5 gas to engines Biogas upgrading sized for 1200 scfm; no separate gas conditioning. Engines get pipeline quality gas. Engines produce enough power for plant and oxidation catalyst installed (TOU peak shaving) Large digester OOS: 25,400 gpd of additional HSW capacity New HSW receiving facility Assume Alt 2 operating costs 	 D3 gas to pipeline, D5 gas to engines Biogas upgrading sized for 1200 scfm; no separate gas conditioning. Engines get pipeline quality gas Engines produce enough power for plant and SCR + oxidation catalyst installed (TOU peak shaving) Large digester OOS: 25,400 gpd of additional HSW capacity New HSW receiving facility Assume Alternative 2 operating costs 	 Large digester in service: import HSW to produce enough DG for 	 All DG to pipeline: biogas upgrading sized for 800 scfm Engines produce enough power for plant (fueled on NG) and SCR installed Large digester OOS: 25,400 gpd of additional HSW capacity New HSW receiving facility 	 All DG to pipeline: biogas upgrading 2,000 scfm capacity Engines produce enough power for plant (fueled on NG) and SCR New, large HSW receiving facility and site truck traffic modifications Large digester in service for HSW until 2033: 162,000 gpd of additional HSW capacity
Project Cost	\$28.4M	\$28.4M	\$30.7M	\$34.6M	\$29.1M	\$39.5M	\$39.5M
20-year Net Present Cost	(\$21.9M)	(\$11.7M)	(\$9.5M)	(\$5.6M)	(\$20.4M)	(\$10.8M)	(\$22.5M)
Payback Period – Current RIN Value	11.5 years	15.9 years	16.1 years	18.1 years	12.8 years	16 years	11.9 years
Payback Period - Iow RIN	20 years (change to \$1.1/D3, LCFS to \$0.65/DGE)	20 years (change to \$1.16/D3)	20 years (change to \$1.22/D3)	20 years (change to \$1.34/D3)	20 years (change to \$0.90/D3)	20 years (\$1.19/D3)	20 years (\$0.85/D3)
Payback Period - high RIN	6.3 years	8.5 years	10.0 years	11.3 years	7.8 years	8.8 years	5.7 years
Class B Hauling Volume (2020), wtpd	18	18	18	18	41	18	118
Class B Hauling Cost (2020)	\$324,000	\$324,000	\$324,000	\$324,000	\$714,000	\$324,000	\$2,067,000
HSW Volume (2020), gal/day	25,400	25,400	25,400	25,400	56,000	25,400	162,000
Tipping Fee HSW Revenue (2020)	\$371,000	\$371,000	\$371,000	\$371,000	\$818,000	\$371,000	\$2,366,000



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Section 6: Waste Hauler Coordination

EWA and Brown and Caldwell have held calls with waste haulers near the EWPCF would take interest in providing a HSW feedstock. Potential waste haulers include Waste Management (WM), EDCO, and Republic Services amongst others. Legislation in California is continuing to evolve in favor of diverting organics from landfills. While current Assembly Bill 1826 requires businesses that generate a specified amount of organic waste per week to arrange for recycling services, there is no penalty for non-compliance. The main legislation that will drive a shift in California's approach to organics waste management is the upcoming Short-Lived Climate Pollutants Senate Bill (SB) 1383, which will require a 50 percent reduction in organic waste disposal in comparison to 2014 levels by 2020 and 75 percent by 2025. SB 1383 will also include compliance requirements and penalties beginning in 2020 (with increasing requirements in both 2022 and 2025).

WM has organics pre-processing facilities in Los Angeles and Orange counties, and an upcoming facility in El Cajon. The El Cajon station will be a "next-generation" CORe v3.0 facility with an Engineered Bio Slurry (EBS) product with minimal grit capable of processing up to 250 tons per day. This station will service Carlsbad, El Cajon, and San Diego. WM is working with Orange County Sanitation District and LACSD as potential offtakers. WM will be pursuing the upcoming organics diversion grant money; EWA should consider applying for money to cover the cost of a feed-in-station or at least join the WM El Cajon application as a "letter of interest" partner.

WM provided their EBS specification for feedstock for the CORe product which is also verified by a third party. Several of the key parameters and values from the specification include the following:

- . TS: 14 to 16 percent
- . Total VS: 88 to 92 percent
- Total physical inerts: 0.05 to 0.25 percent dry weight

The CORe product is a high quality, pre-processed, pumpable slurry, making it a good HSW feedstock for EWA to pursue. It is recommended that if EWA plans to move ahead with the HSW acceleration project, the agency should continue to coordinate with other potential haulers to ensure that pre-processing is performed off site and the material is pumpable and free of contaminants to ensure EWA will not be responsible for waste handling at the plant.

Section 7: Summary

Due to changes in the operation of the primary clarifiers, Digesters 4, 5, and 6 are currently fed with sludge at a lower sludge TS. Therefore, there is no excess capacity for co-digestion under current operation. The results of this evaluation suggest that the digesters will have capacity for HSW co-digestion after the design and construction of the new rotary drum thickening process. The available digester for co-digestion will decrease as more solids are produced in the future. Existing digesters will run out of capacity by 2033.

Two scenarios were evaluated for the EWPCF to import additional HSW for digestion. Both scenarios assume the smaller digesters, Digesters 1 and 3, will be retrofitted to accept HSW. Scenario 1 assumes all HSW, including FOG, brewery waste, and SSO would be sent to Digesters 1 and 3. With both small digesters in service, Digesters 1 and 3 can accommodate approximately 40,000 gpd of HSW until 2033, when projected sludge flows and loads exceed the capacity of Digesters 4, 5 and 6. Some sludge needs to be diverted to Digesters 1 and 3, reducing the amount of HSW that can be digested. The EWPCF currently receives approximately 14,600 gpd of FOG and brewery waste. Therefore, additional SSO can be digested is approximately 25,400 gpd.



Scenario 2 assumes one large digester and Digesters 1 and 3 will be used for HSW digestion. Under this scenario, the additional SSO can be digested is estimated to be approximately 162,100 gpd until 2033. Starting in 2034, all three large digesters will be used for sludge digestion only. HSW will be digested in Digesters 1 and 3.

The existing AFRF is reaching its capacity with FOG and brewery waste. Therefore, a new receiving facility will be required to accept SSO.

A net present worth evaluation was conducted to evaluate the payback period for the capital expenditure for several co-digestion and energy recovery alternatives. All alternatives offset capital and operating investments and provided a positive return on investment ranging from \$5.6 million to 22.5 million over a 20-year project life.

Section 8: Recommended Next Steps

This analysis identified that there is a financial incentive for EWA to further investigate the potential for HSW co-digestion and energy recovery through gas upgrade to pipeline quality. To this end, it is recommended that further investigations are conducted to refine the project elements, costs, and assumptions.

Specifically, the following next steps are recommended to further refine project elements and increase confidence in project economics:

- Analyze potential funding and grant options for the project.
- Schedule a discussion with Southern California Gas Company to obtain a firm interconnection cost and begin negotiation of contract terms.
- Attend a site tour of an existing biogas upgrade installations to assist with technology selection.
- Review local air quality management district permitting requirements to determine pretreatment and tail gas treatment needs.
- · Request firm proposals from upgrade system vendors.
- · Develop detailed site layouts to confirm footprint requirements
- · Integrate project benefits into member communities' climate action plans.
- Continue dialogue with waste management companies and discuss quality and capacity criteria.



Attachment A: LACSD SSO Specifications



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A-1

Detailed Summary of food waste characteristics from LACSD

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ArsenicLess than 1 mg/LLACSD SSO SPECIFICATIONCalciumLess than 3,000 mg/LLACSD SSO SPECIFICATIONChlorideLess than 3,000 mg/LLACSD SSO SPECIFICATIONChromiumLess than 2 mg/LLACSD SSO SPECIFICATIONMagnesiumLess than 500 mg/LLACSD SSO SPECIFICATIONMercuryLess than 1 mg/LLACSD SSO SPECIFICATIONNickelLess than 5 mg/LLACSD SSO SPECIFICATIONPotassiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONSodiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONTotal Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal Limits1 mg/LOrdinance OCSD-48Ordinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Total Carbon	Greater than 9,000 mg/L	LACSD SSO SPECIFICATION
CalciumLess than 3,000 mg/LLACSD SSO SPECIFICATIONChlorideLess than 3,000 mg/LLACSD SSO SPECIFICATIONChromiumLess than 2 mg/LLACSD SSO SPECIFICATIONMagnesiumLess than 500 mg/LLACSD SSO SPECIFICATIONMercuryLess than 1 mg/LLACSD SSO SPECIFICATIONNickelLess than 5 mg/LLACSD SSO SPECIFICATIONPotassiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONSodiumLess than 50 mg/LLACSD SSO SPECIFICATIONSodiumCabes than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)1 mg/LOrdinance OCSD-48Chromium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Electrical Conductivity	Less than 15 millimho/cm	LACSD SSO SPECIFICATION
ChlorideLess than 3,000 mg/LLACSD SSO SPECIFICATIONChromiumLess than 2 mg/LLACSD SSO SPECIFICATIONMagnesiumLess than 500 mg/LLACSD SSO SPECIFICATIONMercuryLess than 1 mg/LLACSD SSO SPECIFICATIONNickelLess than 5 mg/LLACSD SSO SPECIFICATIONPotassiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONSodiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONTotal Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal Limits1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Arsenic	Less than 1 mg/L	LACSD SSO SPECIFICATION
ChromiumLess than 2 mg/LLACSD SSO SPECIFICATIONMagnesiumLess than 500 mg/LLACSD SSO SPECIFICATIONMercuryLess than 1 mg/LLACSD SSO SPECIFICATIONNickelLess than 5 mg/LLACSD SSO SPECIFICATIONPotassiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONSodiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONTotal Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal LimitsSpecific Heavy Metal LimitsOrdinance OCSD-48Ordinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Calcium	Less than 3,000 mg/L	LACSD SSO SPECIFICATION
MagnesiumLess than 500 mg/LLACSD SSO SPECIFICATIONMercuryLess than 1 mg/LLACSD SSO SPECIFICATIONNickelLess than 5 mg/LLACSD SSO SPECIFICATIONPotassiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONSodiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONTotal Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal LimitsSpecific Heavy Metal LimitsOrdinance OCSD-48Cadmium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Chloride	Less than 3,000 mg/L	LACSD SSO SPECIFICATION
MercuryLess than 1 mg/LLACSD SSO SPECIFICATIONNickelLess than 5 mg/LLACSD SSO SPECIFICATIONPotassiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONSodiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONTotal Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal LimitsCadmium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Chromium	Less than 2 mg/L	LACSD SSO SPECIFICATION
NickelLess than 5 mg/LLACSD SSO SPECIFICATIONPotassiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONSodiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONTotal Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal LimitsSpecific Heavy Metal LimitsOrdinance OCSD-48Cadmium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Magnesium	Less than 500 mg/L	LACSD SSO SPECIFICATION
PotassiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONSodiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONTotal Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal LimitsSpecific Heavy Metal LimitsOrdinance OCSD-48Cadmium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Mercury	Less than 1 mg/L	LACSD SSO SPECIFICATION
SodiumLess than 3,000 mg/LLACSD SSO SPECIFICATIONTotal Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal LimitsSpecific Heavy Metal LimitsSpecific Heavy Metal LimitsCadmium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Nickel	Less than 5 mg/L	LACSD SSO SPECIFICATION
Total Heavy Metals (Ag, As, Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Less than 50 mg/LLACSD SSO SPECIFICATIONSpecific Heavy Metal LimitsCadmium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LCopper (Cu)25 mg/LOrdinance OCSD-48	Potassium	Less than 3,000 mg/L	LACSD SSO SPECIFICATION
Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V, and Zn)Specific Heavy Metal LimitsSpecific Heavy Metal LimitsCadmium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOpper (Cu)25 mg/L	Sodium	Less than 3,000 mg/L	LACSD SSO SPECIFICATION
Cadmium (Cd)1 mg/LOrdinance OCSD-48Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Ba, Cd, Co, Cr, Cu, Hg, Mo, Ni, Pb, Sb, Se, Ti Sr, Sn, V,	Less than 50 mg/L	LACSD SSO SPECIFICATION
Chromium (Cr)35 mg/LOrdinance OCSD-48Copper (Cu)25 mg/LOrdinance OCSD-48	Specific Heavy Metal Limits		
Copper (Cu) 25 mg/L Ordinance OCSD-48	Cadmium (Cd)	1 mg/L	Ordinance OCSD-48
	Chromium (Cr)	35 mg/L	Ordinance OCSD-48
Lead (Pb) 10 mg/L Ordinance OCSD-48	Copper (Cu)	25 mg/L	Ordinance OCSD-48
	Lead (Pb)	10 mg/L	Ordinance OCSD-48
Nickel (Ni) 10 mg/L Ordinance OCSD-48	Nickel (Ni)	10 mg/L	Ordinance OCSD-48

ITEM	VALUE	REFERENCE
Zinc (Zn)	50 mg/L	Ordinance OCSD-48
Physical Contamination ⁽¹⁾ (greater than 4 millimeters)	0.5% by dry weight	Title 14 -Section 17868.3.1 – Physical Contamination Limits
Film Plastic (greater than 4 millimeters)	20% by dry weight of Physical Contamination	Title 14 -Section 17868.3.1 – Physical Contamination Limits

<u>Note</u>:

1. "Physical Contaminants" means human-made inert products contained within feedstocks, including, but not limited to, glass, metal, and plastic (Title 14 Section 17381).

Attachment B: Calculations



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B-1

ALTERNATIVE 1

	Year of analysi Escalation rat Discount rat	is 2020	k adjustments (+/- per	rcent): Benefits Capital costs Running costs	0% 0% 0%										HSW	Alternative Study Alternative ernative Cost Ana						
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2020	2030	2031	2032	2033	2034	Year 2035	2036	2037	2038	2039	2040
Expressed in 2020 dollars, un	escalated dollars	2020	2021	2022	2023	2024	2025	2026	2027	2028	2025	2030	2031	2032	2033	2034	2035	2030	2037	2036	2039	2040
Capital Outlays																						
	BUS - 800 scfm + Interconnection SCR	16,945,847 4,000,000																				
	HSW Receiving Facility Dig 1&3 Improvements	2,000,000																				
	Total capital outlays	28,445,847	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																						
	D3 RINs D5 RINs	2,346,827	2,372,328	2,396,794 154,519	2,420,224	2,442,619 151,266	2,463,979 149,639	2,484,303 148.013	2,503,592 146,386	2,521,846 144,760	2,539,065 143,133	2,555,248 141,507	2,570,417 139,880	2,584,550 138,254	2,597,648 136,627	2,609,710 124,604	2,620,736 99,415	2,630,726 74,804	2,639,681 50,772	2,647,599 27,316	2,654,482 4,439	2,660,329
	LCFS	1,287,788	1,290,332	1,292,547	1,294,433	1,295,988	1,297,215	1,298,111	1,298,678	1,298,916	1,298,824	1,298,402	1,297,657	1,296,583	1,295,172	1,273,585	1,226,510 637,898	1,180,215	1,134,694	1,089,947	1,045,974	1,034,880
	Natural Gas Sale HSW Tipping Fee	370,840	573,224 370,840	370,840	587,280 370,840	594,308 370,840	370,840	608,364 370,840	615,392 370,840	370,840	629,448 370,840	636,476 370,840	643,508 370,840	650,539 370,840	370,840	654,398 342,280	276,419	621,398 210,558	604,899 144,697	588,399 78,836	12,975	574,295 0
	Total benefits	(4,729,422)	(4,762,869)	(4,794,952)	(4,825,669)	(4,855,021)	(4,883,009)	(4,909,631)	(4,934,889)	(4,958,782)	(4,981,310)	(5,002,473)	(5,022,302)	(5,040,767)	(5,057,858)	(5,004,576)	(4,860,978)	(4,717,702)	(4,574,742)	(4,432,097)	(4,289,768)	(4,269,504)
Annual Running Costs:																						
	Engine O&M SCR O&M	240,000 240,000	240,900 240,900	241,800 241,800	242,700 242,700	243,600 243,600	244,500 244,500	245,400 245,400	246,300 246,300	247,200 247,200	248,100 248,100	249,000 249,000	249,900 249,900	250,800 250,800	251,700 251,700	252,600 252,600	253,500 253,500	254,400 254,400	255,300 255,300	256,200 256,200	257,100 257,100	258,000 258,000
	Biogas Upgrading O&M NC Demand	207,470	210,046	212,621	215,196	217,771	220,347	222,922	225,497	228,073	230,648	233,223	235,800	238,376	240,953	239,790	233,744	227,698	221,652	215,606	209,560	210,438
	Natural Gas Purchased - Dryer	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835
	Natural Gas Purchased - Engine HSW Facility O&M	490,537 100,000	492,376 100,000	494,216 100,000	496,055 100,000	497,895 100,000	499,734 100,000	501,574 100,000	503,413 100,000	505,253 100,000	507,092 100,000	508,932 100,000	510,771 100,000	512,611 100,000	514,450 100,000	516,290 100,000	518,130 100,000	519,969 100,000	521,809 100,000	523,648 100,000	525,488 100,000	527,327 100,000
	Dig 1 & 5 O&M Dewatering Polymer	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7 456	600,000 7 456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000	600,000 5,558	600,000 4 233	600,000 2,909	600,000	600,000	600,000
	Dewatering Power	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	9,575	7,733	5,890	4.048	2.205	363	0
	Class B Hauling Total running costs	323,901 2,406,574	323,901 2,412,789	323,901 2,419,003	323,901 2,425,218	323,901 2,431,433	323,901 2,437,648	323,901 2,443,862	323,901 2,450,077	323,901 2,456,292	323,901 2,462,507	323,901 2,468,722	323,901 2,474,938	323,901 2,481,154	323,901 2,487,370	298,956 2,463,528	241,431 2,400,430	183,906 2,337,333	126,382 2,274,235	68,857 2,211,137	11,332 2,148,039	2,140,600
Net Benefit/(cost)	·	26.122.999	(2.350.081)	(2.375.948)	(2.400.451)	(2.423.588)	(2.445.361)	(2.465.769)	(2.484.812)	(2,502,490)	(2.518.803)	(2.533.751)	(2.547.365)	(2,559,613)	(2,570,489)	(2.541.048)	(2.460.548)	(2,380,369)	(2.300.507)	(2.220.960)	(2.141.729)	(2,128,903)
			(2,000,000)	(_,,,-	(=, :==, := :)	(=, -==,-==,	(_,,	(2,,)	(_,,	(2,222,222)	(_,_ ,_ ,_ ,_ ,_ ,_ ,_ ,_ ,_ ,_ ,_ ,_ ,_	(=,===,==)	(_,-,-,)	(_,,	(2,000,000)	(_, ,)	(_,,)	(_,,)	(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	(=)===)===)	(=,,.==)	(_,,)
Expressed in escalated dollars	with sensitivity adjustments																					
Exprosoca in coodiatoa aonan	s mai sensitivity adjasanento																					
Capital Outlays		_																				
	BUS - 800 scfm + Interconnection	16,945,847	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BUS - 800 scfm + Interconnection SCR Dig 1&3 Improvements	4,000,000 5,500,000	0 0 0	0	0	0	0	0	0 0 0	0	0 0 0	0	0	0	0	0	0	0 0 0	0 0 0	0 0 0 0	0 0 0	0 0 0
	BUS - 800 scfm + Interconnection SCR	4.000.000	0 0 0 0	0 0 0	0 0 0 0	0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
	BUS - 800 scfm + Interconnection SCR Dig 143 Improvements Total capital outlays (Pvs)	4,000,000 5,500,000 28,445,847	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
	BUS - 800 scfm + Interconnection SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs	4,000,000 5,500,000 28,445,847 2,346,827 157,772	0 0 0 2,419,774 159,268	0 0 0 2,493,624 160,761	0 0 0 2.568.361 162.251	0 0 0 2,643,969 163,735	0 0 0 2.720,432 165,214	0 0 0 2,797,729 166,687	0 0 0 2,875,841 168,152	0 0 0 2,954,745 169,609	0 0 0 3,034,417 171,058	0 0 0 3,114,833 172,496	0 0 0 3,195,990 173,924	0 0 0 3,277,835 175,339	0 0 0 3,360,335 176,742	0 0 0 3,443,457 164,412	0 0 0 3,527,166 133,800	0 0 0 3,611,423 102,691	0 0 0 3,696,190 71,092	0 0 0 3,781,424 39,014	0 0 0 3,867,079 6,466	0 0 0 3,953,109 0
	BUS 800 scfm + Interconnection SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS	4,000,000 5,500,000 28,445,847 2,346,827 157,772 1,287,788 566,196	159,268 1,316,139 584,688	0 0 0 2,493,624 160,761 1,344,766 6003,694	162,251 1,373,662	163,735 1,402,820	165,214 1,432,230			169,609 1,521,887	171,058 1,552,215 752,249		173,924 1,613,474 800,121	175,339 1,644,381					0 0 0 3.696.190 71.092 1.588.846 847.004		6,466 1,523,786	0 1,537,777
	BUS - 800 scfm + Interconnection SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee	4,000,000 5,500,000 28,445,847 2,346,827 157,772 1,287,788 566,196 370,840	159,268 1,316,139 584,688 378,257	160,761 1,344,766 603,694 385,822	162,251 1,373,662 623,226 393,538	163,735 1,402,820 643,298 401,409	165,214 1,432,230 663,924 409,437	166,687 1,461,884 685,117 417,626	168,152 1,491,773 706,892 425,979	169,609 1,521,887 729,264 434,498	171,058 1,552,215 752,249 443,188	172,496 1,582,745 775,861 452,052	173,924 1,613,474 800,121 461,093	175,339 1,644,381 825,041 470,315	176,742 1,675,444 850,638 479,721	164,412 1,680,469 863,464 451,631	133,800 1,650,721 858,527 372,023	102,691 1,620,183 853,047 289,051	71,092 1,588,846 847,004 202,610	39,014 1,556,713 840,378 112,597	6,466 1,523,786 833,149 18,902	0 1,537,777 853,372 0
	BUS - 800 scfm + Interconnection SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Cas Sale	4,000,000 5,500,000 28,445,847 2,346,827 157,772 1,287,788 566,196	159,268 1,316,139 584,688	160,761 1,344,766 603,694	162,251 1,373,662 623,226	163,735 1,402,820 643,298	165,214 1,432,230 663,924	166,687 1,461,884 685,117	168,152 1,491,773 706,892	169,609 1,521,887 729,264	171,058 1,552,215 752,249	172,496 1,582,745 775,861	173,924 1,613,474 800,121	175,339 1,644,381 825,041	176,742 1,675,444 850,638	164,412 1,680,469 863,464	133,800 1,650,721 858,527	102,691 1,620,183 853,047	71,092 1,588,846 847,004	39,014 1,556,713 840,378	6,466 1,523,786 833,149	0 1,537,777
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits	4,000,000 5,500,000 28,445,847 157,772 1,287,788 566,196 370,840 (4,728,422)	159,268 1,316,139 584,688 378,257 (4,858,127)	160,761 1,344,766 603,694 385,822 (4,988,668)	162,251 1,373,662 623,226 393,538 (5,121,038)	163,735 1,402,820 643,298 401,409 (5,255,231)	165,214 1,432,230 663,924 409,437 (5,391,236)	166,687 1,461,884 685,117 417,626 (5,529,042)	168,152 1,491,773 706,892 425,979 (5,668,636)	169,609 1,521,887 729,264 434,498 (5,810,003)	171,058 1,552,215 752,249 443,188 (5,953,126)	172,496 1,582,745 775,861 452,052 (6,097,986)	173,924 1,613,474 800,121 461,093 (6,244,602)	175,339 1,644,381 825,041 470,315 (6,392,911)	176,742 1,675,444 850,638 479,721 (6,542,879)	164,412 1,680,469 863,464 451,631 (6,603,432)	133,800 1,650,721 858,527 372,023 (6,542,236)	102,691 1,620,183 853,047 289,051 (6,476,394)	71,092 1,588,846 847,004 202,610 (6,405,743)	39,014 1,556,713 840,378 112,597 (6,330,126)	6,466 1,523,786 833,149 18,902 (6,249,382)	0 1,537,777 853,372 0 (6,344,258)
	BUS - 800 scfm + Interconnection SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINS D5 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M	4,000,000 5,500,000 28,446,847 2,346,827 1,57,772 1,287,788 5,666,196 370,840 (4,729,422) (4,729,422) 240,000	159,268 1,316,139 584,688 378,257 (4,858,127) (4,739,636) 245,718	160,761 1,344,766 603,694 385,822 (4,988,668) (4,748,286) 251,569	162,251 1,373,662 623,226 393,538 (5,121,038) (4,755,393) 257,555	163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680	165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948	166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360	168,152 1,491,773 706,892 425,979 (5,668,636) (4,768,827) 282,921	169,609 1,521,887 729,264 434,498 (5,810,003) (4,768,540) 289,634	171,058 1,552,215 752,249 443,188 (5,953,126) (4,766,837) 296,502	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737)	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291) 310,719	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482	39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546	0 1,537,777 853,372 0 (6,344,258) (3,871,716) 383,374
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M	4,000,000 5,500,000 28,445,847 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422)	159,268 1,316,139 584,688 378,257 (4,858,127) (4,739,636)	160,761 1,344,766 603,694 385,822 (4,988,668) (4,748,286)	162,251 1,373,662 623,226 333,538 (5,121,038) (4,755,393)	163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980)	165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067)	166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676)	168,152 1,491,773 706,892 425,979 (5,668,636) (4,768,827)	169,609 1,521,887 729,264 434,498 (5,810,003) (4,768,540)	171,058 1,552,215 752,249 443,188 (5,953,126) (4,766,837)	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737)	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291)	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487)	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338)	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428)	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189)	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660)	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823)	39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661)	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162)	0 1,537,777 853,372 0 (6,344,258) (3,871,716)
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand	4,000,000 5,500,000 28,445,847 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 240,000	159,268 1,316,139 584,688 378,257 (4,858,127) (4,739,636) 245,718 245,718	160,761 1,344,766 603,694 385,822 (4,988,668) (4,748,286) 251,569 251,569	162.251 1,373.662 623.226 333.538 (5,121,038) (4,755,393) 257,555 257,555 228,368 0	163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 263,680 235,723 0	165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 269,948 269,948 269,948 0	166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 0	168,152 1,491,773 706,892 425,979 (5,688,636) (4,768,827) 282,921 282,921	169.609 1.521.887 729.264 434.498 (5.810.003) (4,768,540) 289.634 289.634 289.634 267.223 0	171,058 1,552,215 752,249 443,188 (5,953,126) (4,766,837) 296,502 296,502 275,645 0	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 284,298 0	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291) 310,719 310,719 293,187 0	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 318,075 302,319 0	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,589 0	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237	71,092 1,568,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 310,366 0	39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 374,546 305,290 0	0 1,537,777 853,372 0 (6,344,258) (3,871,716) 383,374 383,374 383,374 312,700 0
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M	4,000,000 5,500,000 28,445,847 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 240,000 240,000 240,000 240,000 207,470 0 0	159,268 1,316,139 584,688 378,257 (4,858,127) (4,739,636 245,718 245,718 245,718 245,718 0	160,761 1,344,766 603,694 385,822 (4,988,668) (4,748,286) 251,569 251,569 251,569 221,211 0	162,251 1,373,662 623,226 393,538 (5,121,038) (4,755,393) 257,555 257,555	163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 263,680	165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 269,948	166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360	168,152 1,491,773 706,892 425,979 (5,668,636) (4,768,827) 282,921 282,921 282,921 285,025 0	169,609 1,521,887 729,264 434,498 (5,810,003) (4,768,540) 289,634 289,634	171,058 1,552,215 752,249 443,188 (5,953,126) (4,766,837) 296,502 296,502	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291) 310,719 310,719	175,339 1,644,381 825,041 470,315 (6,382,911) (4,753,487) 318,075 318,075	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 316,388 0	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237 349,237 342,281 0	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482	39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 307,839 0	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546	0 1,537,777 853,372 0 (6,344,258) (3,871,716) 383,374 383,374
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINS D5 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M	4 000.000 5 5500.000 28,445,847 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 240,000 240,000 240,000 0 168,835 490,537 490,537 600,000	159,268 1,316,139 584,688 378,257 (4,658,127) (4,739,636) 245,718 245,718 245,718 214,246 0 0 190,572 502,224 612,000	160,761 1,344,766 603,694 385,822 (4,385,665) (4,745,266) 251,569 251,569 221,211 0 194,383 514,182 624,240	162.251 1.373.662 623.226 393.538 (5,121.038) (4,755.383) 257.555 257.555 257.555 257.555 267.555 268.88 0 198.271 526.418 	163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 263,680 263,680 263,680 202,236 538,937 538,937 649,459	165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 269,948 243,281 0 0 206,281 551,747 551,747	166.687 1,461.884 685.117 417.626 (5,529.042) (4,767.676) 276.360 276.360 251.046 0 0 210.407 564.854 675.697	168,152 1,491,73 706,802 425,979 (5,686,535) (4,768,827) 282,921 282,921 282,921 259,025 0 214,615 578,264 689,211	169.609 1.521.887 729.284 434.498 (5.810.003) (4.768.540) 289.634 289.634 289.634 289.634 267.223 0 0 218.907 591.984 702.996	171.058 1.552.215 752.249 443.188 (5,953,126) (4,766,837) 296.502 276,645 275,645 0 223,285 606,022 7117,056	172,496 1,582,745 775,861 452,052 (6,037,866) (4,763,737) 303,530 303,530 284,298 0 227,751 620,385 731,397	173.924 1613.474 800.121 461.093 (6,244.602) (4,759.291) 310.719 310.719 310.719 293.187 0 232.306 635.080 746.025	175,339 1,644,381 825,041 470,315 (6,392,911) (4,783,487) 318,075 318,075 302,319 0 236,952 650,115 760,945	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0 241,691 665,497 776,184	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 336,398 0 246,525 681,234 791,687	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,899 0 0 251,455 697,334 807,521	102.691 1.620.183 853.047 289.051 (6.476,334) (4.362,660) 349.237 349.237 349.237 349.237 349.237 342,581 0 0 256,485 713,806 823,671	71.092 1.588.846 847.004 202,610 (6,405,743) (4,209,823) 357.482 357.482 310.366 0 261.614 730,658 840,145	39,014 1,556,713 840,378 112,507 (6,330,126) (4,058,661) 365,917 365,917 307,939 0 266,847 7,47,899 7	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 305,290 0 0 272,184	0 1,537,777 853,372 0 (6,344,258) 383,374 383,374 383,374 312,700 0 277,627
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs D5 RINs D5 RINs UCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine	4,000,000 5,5500,000 28,446,847 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 240,000 240,000 207,470 0 168,835 490,537	159.268 1,316,139 584,688 378,257 (4,739,636) 245,718 245,718 245,718 245,718 214,246 0 190,572 502,224	160.761 1,344,766 603.694 385,822 (4,988,668) (4,748,286) 251,569 251,569 221,211 0 194,383 514,182	162.251 1,373.662 623.226 393.538 (1,121.038) (4,755,593) 257.555 228.368 0 198.271 526.418	163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 263,680 263,680 263,680 202,236 538,937	165.214 1,432.230 663.924 409.437 (5,391.236) (4,765,067) 269.948 269.948 243.281 0 200.281 551,747	166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 251,046 0 210,407 564,854	168,152 1,491,773 706,892 425,979 (6,668,636) (4,768,827) 282,921 282,921 282,921 289,025 0 214,615 578,264	169.609 1,521.887 729.264 434.498 (5,810.003) (4,768,540) 289.634 289.634 269.634 267.223 0 218.907 591.984	171.058 1,552,215 752,249 443,188 (9,953,126) (4,766,837) 296,502 296,502 275,645 0 223,285 606,022 606,022	172,496 1,582,745 775,861 (4,252) (6,097,986) (4,763,737) 303,530 303,530 303,530 284,298 0 227,751 620,385	173.924 1,613,474 800,121 461,093 (6,244,602) (4,759,291) 310,719 310,719 293,187 0 232,306 635,080	175,339 1,644,381 825,041 470,315 (6,332,911) (4,753,487) 318,075 318,075 318,075 318,075 302,319 0 236,952 650,115	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0 241,691 665,497	164,412 1,680,469 863,464 451,631 (6,603,422) (4,673,428) 333,300 333,300 333,300 316,398 0 0 246,525 681,234	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 0,0 251,455 697,334	102,691 1,620,183 863,047 289,051 (4,362,660) 349,237 349,237 349,237 349,237 349,237 0 266,485 713,806	71.092 1.588.846 847.004 202.610 (6.405,743) (4.209.823) 357.482 357.482 357.482 310.366 0 261.614 730.658	39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 0 0 266,847 747,898	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 305,290 0 0 272,184 765,536	0 1,537,777 853,372 0 (6,344,258) 383,374 383,374 383,374 312,700 0 277,627 783,580
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M SCR 0&M Biogas Upgrading 0&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer	4 000.000 5.500.000 28,446,847 2.346,827 1.57,772 1.287,783 5.66(,16) 370,840 (4,729,422) 240,000 27,782 27,782 27,782 240,000 240,000 27,784 27,784 27,785 27,787 27,778 240,000 240,000 27,770 0,777 0,77	159.268 1.316.139 584.688 378.257 (4.858.127) (4.739.636) 245.718 245.718 245.718 245.718 245.718 245.718 0.572 502.224 612.000 7.605	160,761 1,344,766 603,694 385,622 (4,985,669) 251,569 251,569 251,569 251,569 221,211 0 194,383 514,182 624,240 624,240 7,757	162.251 1.373.662 623.226 623.226 163.538 (5.121.038) (4.755.393) (4.755.393) (4.755.393) (4.755.393) 0 198.271 526.418 636.725 7.913	163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 263,690 263,680 26	165.214 1,432.20 663.924 409.437 (5,391,236) (4,765,067) 269,948 269,948 243,281 0 206,281 551,747 662,448 8,232	166.687 1.461.884 685.117 417.626 (5,529.042) (4,767,676) 276.360 276.360 251.046 0 210.407 564.854 675.697 8.397	168,152 1,491,773 706,892 425,979 (5,668,836) (4,768,827) 282,921 282,921 282,925 0 0 214,615 578,264 689,211 8,565	169.609 1.521.887 729.264 434.498 (5,810.003) (4,768,540) 289.634 289.634 289.634 289.634 267.223 0 218.907 591.984 702.996 8,736	171,088 1,552,215 7,552,249 443,188 (5,953,126) (4,766,337) 296,502 275,645 0 223,285 606,022 717,056 8,911	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 284,298 0 227,751 620,385 731,397 9,089	173.924 1613.474 800.121 401.093 (6,244.602) (4,759,291) 310,719 310,719 203,187 0 232,306 635,080 746,025 9.271	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 318,075 302,319 0 226,952 650,115 760,945 9,456	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 311,698 0 241,691 665,497 776,164 9,645	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 316,388 0 0 246,525 661,234 791,687 9,081	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,459 0 251,455 697,334 807,521 7,480	102.691 1.620.183 853.047 289.051 (6.476.394) (4.362.660) 349.237 349.237 349.237 349.237 0 256.485 713.806 823.671 5.812	71,022 1,588,846 847,004 202,810 (6,405,743) (4,209,823) 357,482 357,482 310,386 0 261,614 730,658 840,145 4,074	39,014 1,556,713 840,378 112,597 (6,330,126) (4,055,661) 365,917 365,917 365,917 307,399 0 266,847 747,898 856,948 856,948	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 374,546 374,546 372,184 765,538 874,067 380	0 1,537,777 853,372 0 (6,344,258) 383,374 383,374 383,374 312,700 0 277,627 783,580
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 18.3 Improvements Total capital outlays (Pvs) DS RINS DS RINS DS RINS DS RINS CFS Natural Cas Sale HSW Toping Fee Total benefits Discounted Benefits (in 20205) Engine 0&M SCR 0&M Biogas Upgrading 0&M NG Demand Natural Cas Purchased - Dryer Natural Cas Purchased - Dryer Natural Cas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4 000.000 5 5500.000 28,445,847 157,772 1,287,788 566.196 370.840 (4,729,422) (4,729,422) (4,729,422) (4,729,422) 240,000 207,470 0 168.835 490,537 600.000 7,456 10,374 322,901 2,306,574	159.288 1,316,139 584.688 377.257 (4,858,127) (4,739,636) 4739,636 245,718 245,718 245,718 241,246 0 100,572 502.224 612,000 7,805 10,582 303,379 2,359,044	160,761 1,344,766 603,894 385,682 (4,988,669) (4,748,286) 251,569 251,569 251,569 251,569 251,569 251,569 251,569 251,549 25	162.251 1.373.662 623.226 623.226 393.538 (5.121.038) (4.755.393) 4.755.393) 4.755.55 227.555 228.368 0 198.271 526.418 636.725 7.913 11.009 343.726 2.47.540	163,735 1,402,820 643,286 401,409 (\$,255,231) (4,760,980) 263,680 263,680 263,773 0 202,236 538,937 649,459 8,071 11,229 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,025	165.214 1,432.20 663.924 409.437 (6,391,236) (4,765,067) 288.948 243,281 0 206.281 551,747 662,448 8,232 11,454 337,613 2,580,952	166.687 1,461.884 685.117 417.628 (4,562 ,942) (4,767 ,676) 276.360 276.360 275.1046 0 210,407 564.854 675.697 1,1,683 364.765 2,639.570	168,152 1,491,773 706,802 425,979 (5,668,838) (4,768,827) 4,768,827) 282,921 285,025 0 0 214,615 578,264 689,211 8,565 11,917 372,061 2,699,500	169.609 1.521.887 729.264 434.498 (5.810.003) (4.768.540) 289.634 289.635 289.655 289.655 289.655 289.655 289.655 289.655 289.655 289.655 200.5555 200.5555 200.5555 200.5555 200.555 200.555	171.088 1.552.215 752.249 4.43.188 (5.953.156) (4,766.857) 296.502 295.502 205.502 205.502 205.504 0 0 223.285 606.022 717.056 8.911 12.388 387.092 2.823.414	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 4,763,7450,757,757 4,765,757 4,765,757,757 4,765,757,757 4,765,757,757 4,765,757,757 4,765,757,757,757,757,757,757,757,757,757	173.924 1613.474 800.121 461.093 (6,244.602) (4,759.291) 310,719 310,719 293.187 0 232.306 635,080 746,025 9,271 12,899 402,730 2952,937	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 302,319 0 226,952 650,115 760,945 9,456 13,157 410,785 3,019,879	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0 241,661 665,497 776,184 9,645 13,420 419,001 3,088,317	164.412 1.880.469 863.464 451.631 (6.603.432) (4.673.428) 333.300 333.300 333.300 0 246.525 661.234 791.687 9.081 12.634 334.466 3,118.625	133,800 1,650,721 858,527 372,023 (6,642,236) (4,517,189) 341,178 341,178 341,178 341,178 341,599 0 0,251,455 697,334 807,521 7,480 10,407 3,24,934 3,096,076	102.691 1.620.183 853.047 289.051 (6.476.394) (4.362.660) 349.237 342.287 342.281 0 256.485 713.806 252.464 3,071.378	71,092 1,588,846 847,004 202,610 (6,445,743) (4,209,823) 357,482 357,482 310,366 0 216,1614 730,658 840,145 4,074 5,668 176,965 3,044,454	39,014 1,556,713 840,378 112,597 (6,330,126) (4,056,661) 366,917 366,917 367,939 0 266,847 747,898 856,948 2,264 3,150 98,345 3,015,223	6,466 1,523,786 833,149 18,902 (6,243,382) (3,909,162) 374,546 374,546 374,546 374,546 305,290 0 0 272,184 765,538 874,087 874,087 380 529 16,509 2,983,606	0 1.53777 853.372 0 (6,344,258) (3,871,716) 383.374 383.580 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits: Annual Running Costs:	BUS - 800 scfm + Interconnection SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINS D5 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	4 000.000 5 5500.000 28,445,847 157,772 1,287,788 566.196 370.840 (4,729,422) (4,729,422) (4,729,422) (4,729,422) 240,000 207,470 0 168.835 490,537 600.000 7,456 10,374 322,901 2,306,574 2,306,574	159.288 1.316.139 584.688 376.257 (4.858,127) (4.739,636) 245.716 245.716 244.246 0 100,572 502.224 612.000 7.605 10.582 303.379 2,359,044 2,301,507 0	160,761 1,344,766 603,694 385,682 (4,988,669) (4,748,266) 251,569 221,211 0 194,383 514,182 624,240 7,757 10,793 336,987 2,212,691 2,226,434	162.251 1.373.662 623.226 623.226 933.538 (6.121.038) (4.755.393) (4.755.393) 267.555 228.368 0 198.271 526.418 526.418 526.418 526.418 228.368 0 198.271 526.418 228.368 0 246.755 247.540 2,291,356	163 735 1.402 820 643 286 401 409 (6,255,231) (4,760,980) 263 680 263 680 265 723 0 202 236 538 937 649 459 8.071 11,229 8.071 11,229 8.071 11,229 8.071 12,228,273	165.214 1,432.20 663.924 409.437 (5,391.236) 269.948 269.948 269.948 243.281 0 206.281 551.747 662.448 8,232 11,454 337,613 2,580.952 2,281,185	166.687 1,461.884 665.117 417.629 (4,578,576) 276.360 276.360 275.1046 0 210.407 564.854 675.697 11.683 384.755 2433,870 2,233,870	168,152 1,491,773 706,892 425,979 (5,668,836) (4,768,827) 282,921 285,925 0 214,615 578,264 689,211 8,565 11,917 372,061 2,699,500 2,270,996	169.609 1.521.887 729.264 434.498 (5.810.003) (4.768.540) 289.634 200.6772 2.265.884 200.6772 2.265.884 200.6772 2.265.884 200.635 200.655 200.655 200.655 200.655 200.655 200.655 20	171.088 1.552.215 752.249 4.43.188 (5.953.156) (4,766.837) 296.502 275.645 0 233.285 606.022 717.056 8.911 1.2.388 387.092 2,823.414 2,260,788	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 303,530 284,288 0 227,751 620,385 731,397 9,089 12,646 334,834 2,887,488 2,255,678	173.924 1613.474 800.121 461.093 (6,244.602) (4,759.291) 310.719 293.187 0 232.306 635.080 746.025 9.271 12.899 402.730 2,952,937 2,250,565	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) (4,753,487) (4,753,487) (4,753,487) 0 0 0 236,952 650,115 760,945 9,456 13,157 410,785 3,019,879 2,245,449	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 311,698 0 241,691 665,497 776,164 9,645 13,420 419,001 3,088,317 2,240,328	164.412 1.680.469 863.464 451.631 (6.603.432) (4.673.428) 333.300 333.300 335.300 335.300 336.388 0 246.525 681.234 791.687 9.081 12.634 334.466 3.118.625 2.207.136	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 341,59 0 0,251,455 697,334 807,521 7,480 10,407 324,934 3,096,076 2,137,734	102.691 1.620.183 853.047 269.051 (6.476.394) (4.362.660) 349.237 349.237 342.581 0 256.445 713.806 823.671 5.812 8.086 252.464 3.071.378 2.068.957	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 310,368 0 0 261,614 730,658 840,145 4,074 5,668 176,965 3,044,454 2,000,800	39,014 1,556,713 840,376 112,597 (6,330,126) (4,056,661) 365,917 365,917 307,939 0 266,847 747,898 856,948 2,264 3,150 99,345 3,015,223 1,933,258	6,466 1,523,786 833,149 18,902 (6,243,382) (3,909,162) 374,546 374,546 305,290 0 0 0 272,184 765,536 874,087 874,087 380 529 1,659 2,983,606 1,866,328	0 1.537.777 853.372 0 (6,344,258) (3,871,716) 383.374 383.3
Capital Outlays Benefits:	BUS - 800 scfm + Interconnection SCR Dig 18.3 Improvements Total capital outlays (Pvs) DS RINS DS RINS DS RINS DS RINS CFS Natural Cas Sale HSW Toping Fee Total benefits Discounted Benefits (in 20205) Engine 0&M SCR 0&M Biogas Upgrading 0&M NG Demand Natural Cas Purchased - Dryer Natural Cas Purchased - Dryer Natural Cas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4 000.000 5 5500.000 28,445,847 157,772 1,287,788 566.196 370.840 (4,729,422) (4,729,422) (4,729,422) (4,729,422) 240,000 207,470 0 168.835 490,537 600.000 7,456 10,374 322,901 2,306,574	159.288 1,316,139 584.688 377.257 (4,858,127) (4,739,636) 4739,636 245,718 245,718 245,718 241,246 0 100,572 502.224 612,000 7,805 10,582 303,379 2,359,044	160,761 1,344,766 603,894 385,682 (4,988,669) (4,748,286) 251,569 251,569 251,569 251,569 251,569 251,569 251,569 251,549 25	162.251 1.373.662 623.226 623.226 393.538 (5.121.038) (4.755.393) 4.755.393) 4.755.55 227.555 228.368 0 198.271 526.418 636.725 7.913 11.009 343.726 2.47.540	163,735 1,402,820 643,286 401,409 (\$,255,231) (4,760,980) 263,680 263,680 263,773 0 202,236 538,937 649,459 8,071 11,229 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,023,618 12,025	165.214 1,432.20 663.924 409.437 (6,391,236) (4,765,067) 288.948 243,281 0 206.281 551,747 662,448 8,232 11,454 337,613 2,580,952	166.687 1,461.884 685.117 417.628 (4,562 ,942) (4,767 ,676) 276.360 276.360 275.1046 0 210,407 564.854 675.697 1,1,683 364.765 2,639.570	168,152 1,491,773 706,802 425,979 (5,668,838) (4,768,827) 4,768,827) 4,768,827) 282,921 285,025 0 0 214,615 578,264 689,211 8,565 11,917 372,061 2,699,500	169.609 1.521.887 729.264 434.498 (5.810.003) (4.768.540) 289.634 289.635 289.655 289.655 289.655 289.655 289.655 289.655 289.655 289.655 200.5555 200.5555 200.5555 200.5555 200.5555 200.55	171.088 1.552.215 752.249 4.43.188 (5.953.156) (4,766.857) 296.502 295.502 205.502 205.502 205.504 0 0 223.285 606.022 717.056 8.911 12.388 387.092 2.823.414	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 4,763,7450,757,757 4,765,757 4,765,757,757 4,765,757,757 4,765,757,757 4,765,757,757 4,765,757,757,757,757,757,757,757,757,757	173.924 1613.474 800.121 461.093 (6,244.602) (4,759.291) 310,719 310,719 293.187 0 232.306 635,080 746,025 9,271 12,899 402,730 2952,937	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 302,319 0 226,952 650,115 760,945 9,456 13,157 410,785 3,019,879	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0 241,661 665,497 776,184 9,645 13,420 419,001 3,088,317	164.412 1.880.469 863.464 451.631 (6.603.432) (4.673.428) 333.300 333.300 333.300 0 246.525 661.234 791.687 9.081 12.634 334.466 3,118.625	133,800 1,650,721 858,527 372,023 (6,642,236) (4,517,189) 341,178 341,178 341,178 341,178 341,599 0 0,251,455 697,334 807,521 7,480 10,407 3,24,934 3,096,076	102.691 1.620.183 853.047 289.051 (6.476.394) (4.362.660) 349.237 342.287 342.281 0 256.485 713.806 252.464 3,071.378	71,092 1,588,846 847,004 202,610 (6,445,743) (4,209,823) 357,482 357,482 310,366 0 216,1614 730,658 840,145 4,074 5,668 176,965 3,044,454	39,014 1,556,713 840,378 112,597 (6,330,126) (4,056,661) 366,917 366,917 367,939 0 266,847 747,898 856,948 2,264 3,150 98,345 3,015,223	6,466 1,523,786 833,149 18,902 (6,243,382) (3,909,162) 374,546 374,546 374,546 374,546 305,290 0 0 272,184 765,538 874,087 874,087 380 529 16,509 2,983,606	0 1.53777 853.372 0 (6,344,258) (3,871,716) 383.374 383.580 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits: Annual Running Costs:	BUS - 800 scfm + Interconnection SCR Dig 18.3 Improvements Total capital outlays (Pvs) DS RINS DS RINS DS RINS DS RINS CFS Natural Cas Sale HSW Toping Fee Total benefits Discounted Benefits (in 20205) Engine 0&M SCR 0&M Biogas Upgrading 0&M NG Demand Natural Cas Purchased - Dryer Natural Cas Purchased - Dryer Natural Cas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4 000.000 5 5500.000 28,445,847 157,772 1,287,788 566.196 370.840 (4,729,422) (4,729,422) (4,729,422) (4,729,422) 240,000 240,000 207,470 0 168.835 490,537 600.000 7,456 10,374 322,901 2,306,574 2,306,574	159.288 1.316.139 584.688 376.257 (4.858,127) (4.739,636) 245.716 245.716 244.246 0 100,572 502.224 612.000 7.605 10.582 303.379 2,359,044 2,301,507 0	160,761 1,344,766 603,694 385,682 (4,988,669) (4,748,266) 251,569 221,211 0 194,383 514,182 624,240 7,757 10,793 336,987 2,212,691 2,226,434	162.251 1.373.662 623.226 623.226 933.538 (6.121.038) (4.755.393) (4.755.393) 267.555 228.368 0 198.271 526.418 526.418 526.418 526.418 228.368 0 198.271 526.418 228.368 0 246.755 247.540 2,291,356	163 735 1.402 820 643 286 401 409 (6,255,231) (4,760,980) 263 680 263 680 265 723 0 202 236 538 937 649 459 8.071 11,229 8.071 11,229 8.071 11,229 8.071 12,228,273	165.214 1,432.20 663.924 409.437 (5,391.236) 269.948 269.948 269.948 243.281 0 206.281 551.747 662.448 8,232 11,454 337,613 2,580.952 2,281,185	166.687 1,461.884 665.117 417.629 (4,578,576) 276.360 276.360 275.1046 0 210.407 564.854 675.697 11.683 384.755 2433,870 2,233,870	168,152 1,491,773 706,892 425,979 (5,668,636) (4,768,827) 282,921 285,925 0 214,615 578,264 689,211 8,565 11,917 372,061 2,699,500 2,270,996	169.609 1.521.887 729.264 434.498 (5.810.003) (4.768.540) 289.634 200.6772 2.265.884 200.6772 2.265.884 200.6772 2.265.884 200.635 200.655 200.655 200.655 200.655 200.655 200.655 20	171.088 1.552.215 752.249 4.43.188 (5.953.156) (4,766.837) 296.502 275.645 0 233.285 606.022 717.056 8.911 1.2.388 387.092 2,823.414 2,260,788	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 303,530 284,288 0 227,751 620,385 731,397 9,089 12,646 334,834 2,887,488 2,255,678	173.924 1613.474 800.121 461.093 (6,244.602) (4,759.291) 310.719 293.187 0 232.306 635.080 746.025 9.271 12.899 402.730 2,952,937 2,250,565	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) (4,753,487) (4,753,487) (4,753,487) 0 0 0 236,952 650,115 760,945 9,456 13,157 410,785 3,019,879 2,245,449	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 311,698 0 241,691 665,497 776,164 9,645 13,420 419,001 3,088,317 2,240,328	164.412 1.680.469 863.464 451.631 (6.603.432) (4.673.428) 333.300 333.300 335.300 335.300 336.388 0 246.525 681.234 791.687 9.081 12.634 334.466 3.118.625 2.207.136	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 341,59 0 0,251,455 697,334 807,521 7,480 10,407 324,934 3,096,076 2,137,734	102.691 1.620.183 853.047 269.051 (6.476.394) (4.362.660) 349.237 349.237 342.581 0 256.445 713.806 823.671 5.812 8.086 252.464 3.071.378 2.068.957	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 310,368 0 0 261,614 730,658 840,145 4,074 5,668 176,965 3,044,454 2,000,800	39,014 1,556,713 840,376 112,597 (6,330,126) (4,056,661) 365,917 365,917 307,939 0 266,847 747,898 856,948 2,264 3,150 99,345 3,015,223 1,933,258	6,466 1,523,786 833,149 18,902 (6,243,382) (3,909,162) 374,546 374,546 305,290 0 0 0 272,184 765,536 874,087 874,087 380 529 1,659 2,983,606 1,866,328	0 1.537.777 853.372 0 (6,344,258) (3,871,716) 383.374 383.3
Capital Outlays Benefits: Annual Running Costs: Net escalated benefit/(cost) Life cycle cost analysis PVs in 2020	BUS - 800 scfm + Interconnection SCR Dig 18.3 Improvements Total capital outlays (Pvs) DS RINS DS RINS DS RINS DS RINS CFS Natural Cas Sale HSW Toping Fee Total benefits Discounted Benefits (in 20205) Engine 0&M SCR 0&M Biogas Upgrading 0&M NG Demand Natural Cas Purchased - Dryer Natural Cas Purchased - Dryer Natural Cas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4 000.000 5 5500.000 28,445,847 157,772 1,287,788 566.196 370.840 (4,729,422) (4,729,422) (4,729,422) (4,729,422) 240,000 240,000 207,470 0 168.835 490,537 600.000 7,456 10,374 322,901 2,306,574 2,306,574	159.288 1.316.139 584.688 376.257 (4.858,127) (4.739,636) 245.716 245.716 244.246 0 100,572 502.224 612.000 7.605 10.582 303.379 2,359,044 2,301,507 0	160,761 1,344,766 603,694 385,682 (4,988,669) (4,748,266) 251,569 221,211 0 194,383 514,182 624,240 7,757 10,793 336,987 2,212,691 2,226,434	162.251 1.373.662 623.226 623.226 933.538 (6.121.038) (4.755.393) (4.755.393) 267.555 228.368 0 198.271 526.418 526.418 526.418 526.418 228.368 0 198.271 526.418 228.368 0 246.755 247.540 2,291,356	163 735 1.402 820 643 286 401 409 (6,255,231) (4,760,980) 263 680 263 680 265 723 0 202 236 538 937 649 459 8.071 11,229 8.071 11,229 8.071 11,229 8.071 12,228,273	165.214 1,432.20 663.924 409.437 (5,391.236) 269.948 269.948 269.948 243.281 0 206.281 551.747 662.448 8,232 11,454 337,613 2,580.952 2,281,185	166.687 1,461.884 665.117 417.629 (4,578,576) 276.360 276.360 275.1046 0 210.407 564.854 675.697 11.683 384.755 2433,870 2,233,870	168,152 1,491,773 706,892 425,979 (5,668,636) (4,768,827) 282,921 285,925 0 214,615 578,264 689,211 8,565 11,917 372,061 2,699,500 2,270,996	169.609 1.521.887 729.264 434.498 (5.810.003) (4.768.540) 289.634 200.6772 2.265.884 200.6772 2.265.884 200.6772 2.265.884 200.635 200.655 200.655 200.655 200.655 200.655 200.655 20	171.088 1.552.215 752.249 4.43.188 (5.953.156) (4,766.837) 296.502 275.645 0 233.285 606.022 717.056 8.911 1.2.388 387.092 2,823.414 2,260,788	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 303,530 284,288 0 227,751 620,385 731,397 9,089 12,646 334,834 2,887,488 2,255,678	173.924 1613.474 800.121 461.003 (6,244,602) (4,759,291) 310,719 310,719 310,719 203,187 0 223,06 635,080 746,025 9,271 12,699 402,730 2,552,937 2,250,565 (3,291,665) (2,508,726)	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) (4,753,487) (4,753,487) (4,753,487) 0 0 0 236,952 650,115 760,945 9,456 13,157 410,785 3,019,879 2,245,449	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 311,698 0 241,691 665,497 776,164 9,645 13,420 419,001 3,088,317 2,240,328	164.412 1.880.489 863.464 451.631 (6,603.432) (4,673.428) 333.300 336.333.00 336.333.00 336.389 0 246.525 661.234 - 791.687 9.081 12.634 394.466 3.118.625 2.207.136 (3,484.807) (2,466.283)	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 341,459 0 251,455 697,334 807,521 7,480 10,407 324,934 3,096,076 2,137,734 (3,446,160)	102.691 1.620.183 853.047 289.051 (6,476,394) (4,362,660) 349.237 349.2577 349.2577 349.2577 349.2577 349.2577 349.2577 349.2	71,082 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 310,366 0 261,614 730,658 0 261,614 176,965 3,044,454 2,000,800 (3,361,289) (2,209,023)	39,014 1,556,713 840,376 112,597 (6,330,126) (4,056,661) 365,917 365,917 307,939 0 266,847 747,898 856,948 2,264 3,150 99,345 3,015,223 1,933,258	6,466 1,523,786 833,149 18,902 (6,243,382) (3,909,162) 374,546 374,546 305,290 0 0 0 272,184 765,536 874,087 874,087 380 529 1,659 2,983,606 1,866,328	0 1.537.777 853.372 0 (6,344,258) (3,871,716) 383.374 383.3
Capital Outlays Benefits: Annual Running Costs: Net escalated benefit/(cost) Life cycle cost analysis	BUS - 800 scfm + Interconnection SCR Dig 18.3 Improvements Total capital outlays (Pvs) DS RINS DS RINS DS RINS DS RINS CFS Natural Cas Sale HSW Toping Fee Total benefits Discounted Benefits (in 20205) Engine 0&M SCR 0&M Biogas Upgrading 0&M NG Demand Natural Cas Purchased - Dryer Natural Cas Purchased - Dryer Natural Cas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4 000.000 5 5500.000 28,446,847 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) 240,000 240,0	159.288 1.3161.39 584.688 378.257 (4.858,127) (4.739,636) 245.718 245.718 2445.718 244.245 0 190.572 502.224 612.000 7.605 10.582 330.379 330.379 0 (2,499.662)	160,761 1,344,766 603,894 385,822 (4,385,868) (4,748,286) 251,569 251,569 251,569 221,211 0 194,383 514,182 624,240 7,767 10,793 336,987 2,412,691 2,296,434 (2,575,977)	162,251 1,373,662 623,226 623,226 303,538 (5,121,038) (4,755,393	163,735 1,402,820 643,286 401,409 (\$255,231] (4,760,980) 263,880 263,880 225,723 0 202,236 538,937 649,459 8,071 11,229 350,601 2,236,273 (2,731,613)	165,214 1,432,230 663,924 409,437 (6,391,236) (4,765,067) 269,948 269,958 26,849 26,840 26,940	166.687 1,461.884 985.117 417.626 (5,529,942) (4,767,676) 276,360 276,360 277,360 277,360 271,046 0 210,407 564,854 0 210,407 564,854 675,697 11,683 364,765 24,694,763 2,2689,473)	168,152 1,491,773 706,892 425,979 (5,668,836) (4,768,827) 282,921 282,921 282,921 282,921 282,925 0 0 214,615 578,264 689,211 8,565 11,917 372,061 2,699,500 2,270,986 (2,969,136)	169.609 1.521.887 729.264 434.498 (5,810.003) (4,768,540) (4,768,540) 289,534 289,534 289,534 289,534 289,634 267,223 0 218,907 591,984 702.996 8,736 12,155 379,502 2,760,772 2,265,894 (3,049,232)	171.088 1582.215 752.249 443.188 (5.953.126) (4.766,337) 296.502 275.645 0 223.285 606.022 717.086 8.911 12.398 387.092 2,823.414 2,260,788 (3,129,712)	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 284,298 0 227,751 620,385 731,397 731,397 12,646 394,834 2,887,458 2,255,678 (3,210,528)	173.924 1613.474 800,121 401,093 (6,244.602) (4,759,291) (4,759,291) 310,719 310,719 310,719 203,187 0 223,306 635,080 746,025 9,271 12,899 402,730 2,952,937 2,250,665 (3,291,665)	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 3318,075 332,319 0 226,552 650,115 760,945 9,456 13,157 410,785 3,019,879 2,245,449 (3,373,032)	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 325,601 325,601 325,601 325,601 342,602 0 241,691 665,497 776,184 9,645 13,420 419,001 3,088,347 2,240,328 (3,454,562)	164.412 1.680.469 863.464 451.631 (6,603.432) (4,673.428) 333.300 333.300 333.300 333.300 346.398 0 246.525 681.234 791.687 9.081 12.634 394.466 3,118.625 2,207.136 (3,484,607)	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 0 0,251,455 697,334 807,521 7,480 10,407 3,24,934 3,096,076 2,137,734 (3,446,160)	102.691 1.620.183 853.047 269.051 (6.476.394) (4.362,660) (4.362,660) 349,237	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 310,386 0 261,814 730,688 840,145 5,668 176,965 17	39,014 1,556,713 840,378 112,597 (6,330,126) 365,917 365,917 365,917 365,917 307,939 0 266,847 747,898 856,948 856,948 2,264 3,150 98,345 3,015,223 1,933,258 (3,314,903)	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 374,546 374,546 305,290 0 0 272,184 765,538 874,067 380 529 16,509 2,983,606 1,866,328 (3,265,776)	0 1.537.777 853.372 0 (6.344,258) (3.871,716) 383.374 383.580 891.586 0 0 0 0 0 0 0 0 0 0 0 0 0

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ALTERNATIVE 2

	Year of analysis Escalation rate Discount rate	Ri 2020 2.00% 2.50%	sk adjustments	(+/- percent): Benefits Capital costs Running costs	0% 0% 0%											Alternative Study Alternativ ternative Cost A						
Expressed in 2020 dollars, unes	calated dollars	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Year 2036	2037	2038	2039	2040
Capital Outlays																						
Capital Outlays	BUS 800 scfm	16,945,847																				
	SCR HSW Receiving Facility	4,000,000 2,000,000																				
	Dig 1&3 Improvements Total capital outlays	5,500,000 28,445,847	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:				·														· ·				
2010101	D3 RINs	2,346,827	2,372,328	2,396,794	2,420,224	2,442,619	2,463,979	2,484,303	2,503,592	2,521,846	2,539,065	2,555,248	2,570,417	2,584,550	2,597,648	2,609,710	2,620,736	2,630,726	2,639,681	2,647,599	2,654,482	2,660,329
	LCFS	747,102	755,220	763,010	770,469	777,599	784,399	790,870	797,011	802,823	808,305	813,457	818,280	822,780	826,950	830,790	834,301	837,482	840,333	842,854	845,046	846,908
	Natural Gas Sale HSW Tipping Fee	328,475 370,840	335,503 370,840	342,531 370,840	349,559 370,840	356,587 370,840	363,615 370,840	370,643 370,840	377,671 370,840	384,699 370,840	391,727 370,840	398,755 370,840	405,787 370,840	412,818 370,840	419,850 370,840	426,881 342,280	433,913 276,419	440,944 210,558	447,975 144,697	455,007 78,836	462,038 12,975	469,070 0
	Total benefits	(3,793,243)	(3,833,891)	(3,873,174)	(3,911,092)	(3,947,645)	(3,982,833)	(4,016,656)	(4,049,115)	(4,080,208)	(4,109,937)	(4,138,300)	(4,165,324)	(4,190,988)	(4,215,288)	(4,209,661)	(4,165,368)	(4,119,710)	(4,072,685)	(4,024,296)	(3,974,541)	(3,976,306)
Annual Running Costs:	En sins ORM	040.000	040.000	0.11.000	040 700	040.000	044.500	045 400	040.000	047.000	040 400	0.40,000	040.000	050.000	054 700	050.000	050 500	054 400	055 000	050.000	057.400	050.000
	Engine O&M SCR O&M	240,000 240,000	240,900 240,900	241,800 241,800	242,700 242,700	243,600 243,600	244,500 244,500	245,400 245,400	246,300 246,300	247,200 247,200	248,100 248,100	249,000 249,000	249,900 249,900	250,800 250,800	251,700 251,700	252,600 252,600	253,500 253,500	254,400 254,400	255,300 255,300	256,200 256,200	257,100 257,100	258,000 258,000
	Biogas/GCS Upgrading O&M	207,470	210,046	212,621	215,196	217,771	220,347	222,922	225,497	228,073	230,648	233,223	235,800	238,376	240,953	239,790	233,744	227,698	221,652	215,606	209,560	210,438
	Natural Gas Purchased - Dryer Natural Gas Purchased - Engine	186,835 195,775	186,836 197,614	186,837 199,454	186,838 201,294	186,839 203,133	186,840 204,973	186,841 206,812	186,842 208,652	186,843 210,491	186,844 212,331	186,845 214,170	186,846 216,010	186,847 217,849	186,848 219,689	186,849 234,181	186,850 265,198	186,851 296,215	186,852 327,232	186,853 358,249	186,854 389,266	186,855 396,853
	HSW Facility O&M	100,000	100,001	100,002	100,003	100,004	100,005	100,006	100,007	100,008	100,009	100,010	100,011	100,012	100,013	100,014	100,015	100,016	100,017	100,018	100,019	100,020
	Dig 1 & 5 O&M Dewatering Polymer	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 6,882	600,000 5,558	600,000 4,233	600,000 2,909	600,000 1,585	600,000 261	600,000 0
	Dewatering Power Class B Hauling	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	9,575 298,956	7,733 241,431	5,890 183,906	4,048 126,382	2,205 68,857	363 11,332	0
	Total running costs	2,111,812	2,118,029	2,124,245	2,130,462	2,136,679	2,142,896	2,149,113	2,155,329	2,161,546	2,167,763	2,173,980	2,180,198	2,186,416	2,192,634	2,181,447	2,147,529	2,113,610	2,079,692	2,045,774	2,011,855	2,010,166
Net Benefit/(cost)		26,764,416	(1,715,863)	(1,748,929)	(1,780,630)	(1,810,966)	(1,839,937)	(1,867,544)	(1,893,785)	(1,918,662)	(1,942,174)	(1,964,320)	(1,985,126)	(2,004,572)	(2,022,654)	(2,028,214)	(2,017,839)	(2,006,099)	(1,992,993)	(1,978,522)	(1,962,685)	(1,966,140)
Expressed in escalated dollars v	vith sensitivity adjustments																					
Capital Outlays																						
	BUS 800 scfm SCR	16,945,847 4,000,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dig 1&3 Improvements	5,500,000	0	0	0	0	Ő	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total capital outlays (Pvs)	28,445,847	U	U	U	U	U	U	U	U	0	U	U	U	U	0	U	U	U	U	U	U
Benefits:	D3 RINs	2,346,827	2,419,774	2,493,624	2,568,361	2,643,969	2,720,432	2,797,729	2,875,841	2,954,745	3,034,417	3,114,833	3,195,990	3,277,835	3,360,335	3,443,457	3,527,166	3,611,423	3,696,190	3,781,424	3,867,079	3,953,109
	LCFS	0 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Natural Gas Sale	747,102 328,475	770,325 342,213	793,835 356,369	817,628 370,955	841,698 385,981	866,040 401,460	890,648 417,404	915,515 433,826	940,635 450,737	965,999 468,150	991,599 486,081	1,017,428 504,545	1,043,483 523,553	1,069,748 543,120	1,096,210 563,261	1,122,859 583,989	1,149,683 605,322	1,176,669 627,274	1,203,803 649,862	1,231,072 673,103	1,258,460 697,013
	HSW Tipping Fee Total benefits	370,840 (3,793,243)	378,257 (3,910,569)	385,822 (4,029,650)	393,538 (4,150,482)	401,409 (4,273,058)	409,437 (4,397,370)	417,626 (4,523,407)	425,979 (4,651,160)	434,498 (4,780,614)	443,188 (4,911,755)	452,052 (5,044,565)	461,093 (5,179,056)	470,315 (5,315,187)	479,721 (5,452,924)	451,631 (5,554,558)	372,023 (5,606,037)	289,051 (5,655,478)	202,610 (5,702,743)	112,597 (5,747,686)	18,902 (5,790,155)	0 (5,908,582)
	Discounted Benefits (in 2020\$)	(3,793,243)	(3,815,189)	(3,835,479)	(3,854,135)	(3,871,180)	(3,886,634)	(3,900,520)	(3,912,859)	(3,923,673)	(3,932,981)	(3,940,806)	(3,947,191)	(3,952,138)	(3,955,662)	(3,931,112)	(3,870,775)	(3,809,671)	(3,747,814)	(3,685,220)	(3,621,903)	(3,605,836)
Annual Running Costs:		·																				
	Engine O&M SCR O&M	240,000 240,000	245,718 245,718	251,569 251,569	257,555 257,555	263,680 263,680	269,948 269,948	276,360 276,360	282,921 282,921	289,634 289,634	296,502 296,502	303,530 303,530	310,719 310,719	318,075 318,075	325,601 325,601	333,300 333,300	341,178 341,178	349,237 349,237	357,482 357,482	365,917 365,917	374,546 374,546	383,374 383,374
	Biogas/GCS Upgrading O&M	207,470	214,246 0	221,211	228,368	235,723	243,281	251,046	259,025	267,223	275,645	284,298	293,187	302,319 0	311,698	316,398	314,589	312,581	310,366	307,939	305,290	312,700
	Natural Gas Purchased - Dryer Natural Gas Purchased - Engine	186,835 195,775	190,573 201,567	194,385 207,512	198,274 213,614	202,241 219,878	206,287 226,306	210,413 232,904	214,623 239,675	218,917 246,624	223,296 253,755	227,763 261,072	232,320 268,581	236,967 276,285	241,708 284,191	246,543 308,997	251,476 356,921	256,507 406,639	261,638 458,204	266,872 511,667	272,211 567,087	277,657 589,703
	Dig 1 & 5 O&M	600,000	612,000	624,240	636,725	649,459	662,448	675,697	689,211	702,996	717,056	731,397	746,025	760,945	776,164	791,687	807,521	823,671	840,145	856,948	874,087	891,568
	Dewatering Polymer Dewatering Power	7,456 10,374	7,605 10,582	7,757 10,793	7,913 11,009	8,071 11,229	8,232 11,454	8,397 11,683	8,565 11,917	8,736 12,155	8,911 12,398	9,089 12,646	9,271 12,899	9,456 13,157	9,645 13,420	9,081 12,634	7,480 10,407	5,812 8,086	4,074 5,668	2,264 3,150	380 529	0
	Class B Hauling	323,901	330,379	336,987	343,726	350,601	357,613	364,765	372,061	379,502	387,092	394,834	402,730	410,785	419,001	394,466	324,934	252,464	176,965	98,345	16,509	0
	Total running costs Discounted Running Costs (in 2020\$	2,011,812 2,011,812	2,058,388 2,008,184	2,106,023 2,004,543	2,154,740 2,000,890	2,204,563 1,997,225	2,255,517 1,993,548	2,307,627 1,989,859	2,360,919 1,986,159	2,415,421 1,982,448	2,471,157 1,978,726	2,528,158 1,974,993	2,586,451 1,971,250	2,646,065 1,967,497	2,707,028 1,963,733	2,746,407 1,943,707	2,755,684 1,902,705	2,764,234 1,862,057	2,772,023 1,821,760	2,779,018 1,781,812	2,785,185 1,742,210	2,838,377 1,732,179
Net escalated benefit/(cost)		26,664,416	0 (1,852,181)	(1,923,627)	(1,995,743)	(2,068,495)	(2,141,853)	(2,215,781)	(2,290,241)	(2,365,193)	(2,440,597)	(2,516,407)	(2,592,605)	(2,669,122)	(2,745,896)	(2,808,151)	(2,850,353)	(2,891,245)	(2,930,720)	(2,968,667)	(3,004,971)	(3,070,205)
Life cycle cost analysis																						
PVs in 2020 Cumulative Benefits Payback NPV as of 2020		26,664,416 26,664,416 (11,730,879)	(1,807,006) 24,857,410		(1,853,245) 21,173,229	(1,873,955) 19,299,274	(1,893,086) 17,406,188	(1,910,661) 15,495,527	(1,926,700) 13,568,827	(1,941,224) 11,627,603	(1,954,255) 9,673,348	(1,965,813) 7,707,534	(1,975,941) 5,731,594	(1,984,641) 3,746,952	(1,991,929) 1,755,024	(1,987,405) (232,381)	(1,968,071) (2,200,452)	(1,947,615) (4,148,067)	(1,926,055) (6,074,121)			(1,873,657)

ALTERNATIVE 2.5

	Year of analysis Escalation rate Discount rate	s 2020 e 2.00%	Risk adjustments	(+/- percent): Benefits Capital costs Running costs	0% 0% 0%										HSW	Alternative Study Alternativ ernative Cost Ar						
Expressed in 2020 dollars, un	escalated dollars	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Year 2036	2037	2038	2039	2040
Capital Outlays																						
	BUS 1200 scfm + Interconnection Oxicat	1,000,000																				
	HSW Receiving Facility Dig 1&3 Improvements	3,000,000 5,500,000																				
	Total capital outlays	30,700,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:	D3 RINs	2,346,827	2,372,328	2,396,794	2,420,224	2,442,619	2,463,979	2,484,303	2,503,592	2,521,846	2,539,065	2,555,248	2,570,417	2,584,550	2,597,648	2,609,710	2,620,736	2,630,726	2,639,681	2,647,599	2,654,482	2,660,329
	LCFS	747.102	755,220	763.010	770.469	777.599	784.399	790.870	797.011	802,823	808.305	813.457	818,280	822,780	826.950	830,790	834.301	837.482	840.333	842.854	845.046	846,908
	Natural Gas Sale HSW Tipping Fee	328,475 370,840	335,503 370,840	342,531 370,840	349,559 370,840	356,587 370,840	363,615 370,840	370,643 370,840	377,671 370,840	384,699 370,840	391,727 370,840	398,755 370,840	405,787 370,840	412,818 370,840	419,850 370,840	426,881 342,280	433,913 276,419	440,944 210,558	447,975 144,697	455,007 78,836	462,038 12,975	469,070
	Total benefits	(3,793,243)	(3,833,891)	(3,873,174)	(3,911,092)	(3,947,645)	(3,982,833)	(4,016,656)	(4,049,115)	(4,080,208)	(4,109,937)	(4,138,300)	(4,165,324)	(4,190,988)	(4,215,288)	(4,209,661)	(4,165,368)	(4,119,710)	(4,072,685)	(4,024,296)	(3,974,541)	(3,976,306)
Annual Running Costs:	Engine O&M	240,000	240,900	241,800	242,700	243,600	244,500	245,400	246,300	247,200	248,100	249,000	249,900	250,800	251,700	252,600	253,500	254,400	255,300	256,200	257,100	258,000
	SCR O&M Biogas/GCS Upgrading O&M	240,000 207,470	240,900 210,046	241,800 212,621	242,700 215,196	243,600 217,771	244,500 220,347	245,400 222,922	246,300 225,497	247,200 228,073	248,100 230,648	249,000 233,223	249,900 235,800	250,800 238,376	251,700 240,953	252,600 239,790	253,500 233,744	254,400 227,698	255,300 221,652	256,200 215,606	257,100 209,560	258,000 210,438
	Natural Gas Purchased - Dryer	186.835	186,836	186.837	186.838	186.839	186.840	186.841	186.842	186.843	186.844	186.845	186,846	186.847	186.848	186.849	186.850	186.851	186.852	186.853	186.854	186.855
	Natural Gas Purchased - Engine HSW Facility O&M	195,775 100.000	197,614 100.001	199,454 100.002	201,294 100.003	203,133 100.004	204,973 100.005	206,812	208,652	210,491 100.008	212,331 100.009	214,170 100.010	216,010 100.011	217,849 100.012	219,689 100.013	234,181 100.014	265,198 100.015	296,215 100.016	327,232 100.017	358,249 100,018	389,266 100.019	396,853 100,020
	Dig 1 & 5 O&M Dewatering Polymer	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 7,456	600,000 6,882	600,000 5,558	600,000 4,233	600,000 2,909	600,000	600,000	600,000
	Dewatering Power Class B Hauling	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	10,374 323,901	9,575 298,956	7,733 241,431	5,890 183,906	4,048 126,382	2,205	363 11,332	0
	Total running costs	2,111,812	2,118,029	2,124,245	2,130,462	2,136,679	2,142,896	2,149,113	2,155,329	2,161,546	2,167,763	2,173,980	2,180,198	2,186,416	2,192,634	2,181,447	2,147,529	2,113,610		2,045,774	2,011,855	2,010,166
Net Benefit/(cost)		29,018,568	(1,715,863)	(1,748,929)	(1,780,630)	(1,810,966)	(1,839,937)	(1,867,544)	(1,893,785)	(1,918,662)	(1,942,174)	(1,964,320)	(1,985,126)	(2,004,572)	(2,022,654)	(2,028,214)	(2,017,839)	(2,006,099)	(1,992,993)	(1,978,522)	(1,962,685)	(1,966,140)
Expressed in escalated dollar	s with sensitivity adjustments																					
Capital Outlays		01 000 000																				
Capital Outlays	BUS 1200 scfm + Interconnection Oxicat	1,000,000	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
Capital Outlays			0 0 0	-	0 0 0 0	0 0 0 0	0 0 0 0		0 0 0	0 0 0 0	0 0 0	0 0 0 0		0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Capital Outlays Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs)	1,000,000 5,500,000 30,700,000	0	0	0 0 0 0	0	0	0 0 0	0	0 0 0 0	0	0	0	0	0 0 0 0	0 0 0 0	0 0 0 0	0	0	0	0	0 0 0 0
	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs	1,000,000 5,500,000 30,700,000 2,346,827 0 0	0 2,419,774 0	0 0 2,493,624 0	0 0 0 2,568,361 0	0 0 2,643,969 0	0 0 2,720,432 0	0 0 0 2,797,729 0	0 0 2,875,841 0	0 0 0 2,954,745 0	0 0 3,034,417 0	0 0 3,114,833 0	0 0 3,195,990 0	0 0 3,277,835 0	0 0 0 3,360,335 0	0 0 0 3,443,457 0	0 0 0 3,527,166 0	0 3,611,423 0	0 0 3,696,190 0	0 3,781,424 0	0 3,867,079 0	0 0 0 3,953,109 0
	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale	1,000,000 5,500,000 30,700,000 2,346,827 0 0 0 747,102 328,475	0 2,419,774 0 770,325 342,213	0 0 2,493,624 0 793,835 356,369	0 817,628 370,955	0 0 2,643,969 0 841,698 385,981	0 0 2,720,432 0 866,040 401,460	0 0 0 2,797,729 0 890,648 417,404	0 0 2,875,841 0 915,515 433,826	0 940,635 450,737	3,034,417 0 965,999 468,150	0 0 3,114,833 0 991,599 486,081	0 0 3,195,990 0 1,017,428 504,545	0 0 3,277,835 0 1,043,483 523,553	0 1,069,748 543,120	0 1,096,210 563,261	0 1,122,859 583,989	0 3,611,423 0 1,149,683 605,322	0 0 3,696,190 0 1,176,669 627,274	0 3,781,424 0 1,203,803 649,862	0 3,867,079 0 1,231,072 673,103	0 0 0 3.953,109 0 1.258,460 697,013
	Oxicat Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits	1,000,000 5,500,000 30,700,000 0 0 747,102 328,475 370,840 (3,793,243)	0 2,419,774 0 770,325 342,213 378,257 (3,910,569)	0 0 2,493,624 0 793,835 356,369 385,822 (4,029,650)	0 817,628 370,955 393,538 (4,150,482)	0 0 2,643,969 0 841,698 385,981 401,409 (4,273,058)	2,720,432 0 866,040 401,460 409,437 (4,397,370)	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407)	0 0 2,875,841 0 915,515 433,826 425,979 (4,651,160)	0 940,635 450,737 434,498 (4,780,614)	3,034,417 0 965,999 468,150 443,188 (4,911,755)	0 0 3,114,833 0 991,599 486,081 452,052 (5,044,565)	0 0 3,195,990 0 1,017,428 504,545 461,093 (5,179,056)	0 0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187)	0 1,069,748 543,120 479,721 (5,452,924)	0 1,096,210 563,261 451,631 (5,554,558)	0 1,122,859 583,989 372,023 (5,606,037)	0 3,611,423 0 1,149,683 605,322 289,051 (5,655,478)	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743)	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686)	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155)	0 1,258,460 697,013 0 (5,908,582)
Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee	1,000,000 5,500,000 30,700,000 0 2,346,827 0 0 747,102 328,475 370,840	0 2,419,774 0 770,325 342,213 378,257	0 0 2,493,624 0 793,835 356,369 385,822	0 817,628 370,955 393,538	0 0 0 2,643,969 0 841,698 385,981 401,409	0 0 2,720,432 0 866,040 401,460 409,437	0 0 0 2,797,729 0 890,648 417,404 417,626	0 0 2,875,841 0 915,515 433,826 425,979	0 940,635 450,737 434,498	3,034,417 0 965,999 468,150 443,188	0 3,114,833 0 991,599 486,081 452,052	0 0 3,195,990 0 1,017,428 504,545 461,093	0 0 3,277,835 0 1,043,483 523,553 470,315	0 1,069,748 543,120 479,721	0 1,096,210 563,261 451,631	0 1,122,859 583,989 372,023	0 3,611,423 0 1,149,683 605,322 289,051	0 0 3,696,190 0 1,176,669 627,274 202,610	0 3,781,424 0 1,203,803 649,862 112,597	0 3,867,079 0 1,231,072 673,103 18,902	0 1,258,460 697,013 0
	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M	1,000,000 5,500,000 30,700,000 2,346,827 0 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000	0 2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189) (3,815,189) 245,718	0 2,493,624 0 793,835 356,389 385,822 (4,022,650) (3,835,479) 251,569	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555	2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680	2,720,432 0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360	0 0 2,875,841 0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634	0 0 3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502	0 3,114,833 0 991,599 466,081 452,052 (5,044,565) (3,940,806) 303,530	0 3,195,990 0 1,017,428 504,545 461,093 (5,179,056) (3,947,191) 310,719	0 0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178	0 3,611,423 0 1,149,683 605,322 289,051 (5,655,478) (3,809,671) 349,237	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,886) (3,685,220) 365,917	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374
Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$)	1,000,000 5,500,000 30,700,000 0 0 747,102 328,475 370,840 (3,793,243) (3,793,243)	0 2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189)	0 0 2,493,624 0 793,835 356,369 385,822 (4,029,650) (3,835,479)	0 817,628 370,955 393,538 (4,150,482) (3,854,135)	0 0 2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180)	0 0 2,720,432 0 866,040 401,460 409,437 (4,397,370) (3,886,634)	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520)	0 2,875,841 0 915,515 433,826 425,979 (4,651,160) (3,912,859)	0 940,635 450,737 434,498 (4,780,614) (3,923,673)	0 0 3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981)	0 3,114,833 0 991,599 486,081 452,052 (5,044,565) (3,940,806)	0 3,195,990 0 1,017,428 504,545 461,093 (5,179,056) (3,947,191)	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138)	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662)	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112)	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775)	0 3,611,423 0 1,149,683 605,322 289,051 (5,655,478) (3,809,671)	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814)	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686) (3,685,220)	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903)	0 1,258,460 697,013 0 (5,908,582) (3,605,836)
Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer	1,000,000 5,500,000 30,700,000 2,346,827 0 0 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 240,000 207,470 0 0 0 186,835	2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,718 245,718 214,246 0 0 190,573	0 0 2,493,624 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 251,569 251,569 251,569 0 194,385	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 227,555 228,368 0 198,274	0 0 2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 263,680 203,723 0 0 202,241	2,720,432 0 866,040 401,460 (4,397,370) (3,886,634) 269,948 269,948 269,948 269,948 0 206,287	0 0 0 2,797,729 0 890,648 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 251,046 0 0 210,413	0 0 0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 282,921 282,921 269,025 0 214,623	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 267,223 0 0 218,917	0 0 3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 296,502 275,645 0 223,296	0 3,114,833 0 991,599 466,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 284,298 0 227,763	0 3,195,990 0 1,017,428 504,545 (5,179,056) (3,947,191) 310,719 310,719 310,719 0 0 232,320	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 302,319 0 236,967	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 311,698 0 241,708	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 333,300 336,398 0 246,543	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 314,589 0 251,476	0 3,611,423 0 0 1,149,683 605,322 289,057 (5,655,478) (3,809,671) 349,237 349,237 312,581 0 0 256,507	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482 357,482 0 0 261,638	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 365,917 307,939 0 266,872	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 305,290 0 272,211	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374 383,374 383,374 0 0 277,657
Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine	1,000,000 5,500,000 30,700,000 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 240,000 207,470 0 0 0 186,835 195,775	0 2,419,774 0 770,325 342,213 378,257 (3,910,569 (3,815,189) 245,718 245,71	0 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 251,569 221,211 0 194,385 207,512	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555 257,555 228,368 0 198,274 213,614	0 0 2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 263,680 263,680 235,723 0 202,241 219,878	2,720,432 0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948 269,948 243,281 0 206,287 226,306	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 276,360 276,360 0 210,413 232,904	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 267,223 0 218,917 246,624	0 0 3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 296,502 296,502 275,645 0 223,296 253,755	0 3,114,833 0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 203,530 203,530 227,763 261,072	0 3,195,990 0 1,017,428 504,545 (3,947,191) 310,719 310,719 203,187 0 232,320 268,581	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 318,075 302,319 0 236,967 276,285	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 325,601 325,601 0 241,708 0 241,708 284,191	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 333,300 333,300 333,300 316,398 0 246,543 308,997	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 314,589 0 251,476 356,921	0 3,611,423 0 1,149,683 605,322 289,051 (5,655,478 (3,809,671) 349,237 349,237 349,237 312,581 0 256,507 406,639	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482 357,482 310,366 0 261,638 458,204	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,866) (3,685,220) 365,917 365,917 365,917 307,939 0 266,872 511,667	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 374,546 374,546 0 0 272,211 567,087	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374
Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer	1,000,000 5,500,000 30,700,000 2,346,827 0 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 240,000 240,000 207,470 0 0 835 195,775 195,775 0,7456	0 2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,7	0 0 2,493,624 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 221,211 0 194,385 207,512 624,240 7,757	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555 257,555 228,368 0 198,274 213,614 213,614 636,725 7,913	0 0 2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 263,680 263,680 202,241 219,878 649,459 8,071	2,720,432 0 866,040 401,460 (4,397,370) (3,886,634) 269,948 269,948 243,281 0 206,287 226,306 662,448 8,232	0 0 0 2,797,729 0 890,648 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 251,046 0 210,413 232,904 675,697 8,387	0 2,875,841 0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 282,921 282,921 282,922 0 214,623 239,675 689,211 8,565	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 267,223 0 218,917 246,624 702,996 8,736	0 0 3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 275,645 0 223,296 225,755 717,056 8,911	0 3,114,833 0 991,599 486,081 482,052 (5,044,565) (3,940,806) 303,530 303,530 303,530 284,298 0 227,763 261,072 731,397 9,089	0 3,195,990 0 1,017,428 504,545 (3,947,191) 310,719 310,719 310,719 310,719 203,187 0 232,320 268,581 746,025 9,271	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 318,075 318,075 326,967 226,967 276,285 760,945 9,456	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 327,601 324,708 284,191 776,164 9,645	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 336,398 0 246,543 308,997 791,687 9,081	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 314,589 0 251,476 356,921 807,521 7,480	0 3,611,423 0 1,149,683 605,322 289,051 (3,809,671) 349,237 340,237 340,257 340,257 340,257 340,257 340,257 340,257 340,257 340,257	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 367,482 367,482 367,482 37,4	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 307,939 0 266,872 511,667 511,667 856,948 2,264	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 305,290 0 272,211 567,087 874,087 380	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374 383,374 312,700 0 277,657
Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M SCR 0&M Biogas/GCS Upgrading 0&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M	1,000,000 5,500,000 30,700,000 2,346,827 0 0 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 240,000 240,000 0 0 186,835 195,775 600,000	0 2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,71825,718 245,71825,718 245,718 245,718 245,71825,718 245,718 245,71825,718 245,	0 0 2,493,624 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 251,569 221,211 0 194,385 207,512 624,240	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 227,555 228,388 0 0 198,274 213,614 636,725	0 0 2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 263,680 263,680 202,241 219,878 649,459	2,720,432 0 866,040 409,437 (4,397,370) (3,886,634) 269,948 269,948 269,948 243,281 0 0 206,287 226,306 662,448	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 251,046 0 210,413 232,904 675,697	0 0 2,875,841 0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 282,921 282,921 259,025 0 214,623 239,675 689,211	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 267,223 0 218,917 246,624 702,996	0 0 3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 296,502 275,645 0 223,296 223,296 717,056	0 3,114,833 0 991,599 466,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 284,298 0 227,763 261,072 731,387	0 3,195,990 0 1,017,428 504,545 (3,947,191) 310,719 310,719 310,719 293,187 0 0 232,320 268,581 746,025	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 302,319 0 0 236,967 276,285 760,945	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 311,698 0 241,708 284,191 776,164	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 333,300 316,398 0 0 246,543 308,997 791,687	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 314,589 0 251,476 356,921 807,521	0 3,611,423 0 0 1,149,683 605,322 289,067 (3,809,671) 349,237 340,239 340,	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482 357,482 310,366 0 261,638 458,204 840,145 4,074 5,668	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 365,917 307,939 0 266,872 511,667 856,948	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 305,290 0 0 272,211 567,087 874,087	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374
Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	1,000,000 5,500,000 30,700,000 2,346,827 0 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 207,470 0 0 240,000 207,470 0 0 0 0 240,000 207,470 0 0 0 0 240,000 2	0 2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,7	0 0 2,493,624 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 251,569 221,211 0 194,385 207,512 624,240 7,757 10,793 336,987 2,106,023	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 2267,555 228,368 0 198,274 213,614 343,726 (363,725 7,913 11,009 343,726	0 2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 235,723 0 202,241 219,878 649,459 8,071 11,229 350,601 2,204,563	2,720,432 0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948 243,281 0 0 206,287 226,306 662,448 8,232 11,454 357,613 2,255,517	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 251,046 0 270,413 2210,413 232,904 675,697 8,397 11,683 364,765 2,307,627	0 0 0 0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 29,925 11,917 372,061 2,360,919	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 267,223 0 218,917 246,624 702,996 8,736 12,155 379,502 2,415,421	0 3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 275,645 0 223,296 223,296 253,755 717,056 8,911 12,398 387,092 2,471,157	0 3,114,833 0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 303,530 284,298 0 227,763 261,072 9,089 12,646 394,834 2,528,158	0 3,195,990 0 1,017,428 504,545 (5,179,056) (3,947,191) 310,719 310,719 310,719 203,187 0 232,320 268,581 746,025 9,271 12,899 402,730 2,586,451	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 302,319 0 236,967 2762,85 9,456 9,456 9,456 13,157 410,785 2,646,065	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 325,601 325,601 325,601 325,601 0 241,708 0 241,708 776,164 9,645 13,420 419,001 2,707,028	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 333,300 333,300 316,398 0 246,543 308,997 791,687 9,081 12,634 394,466 2,746,407	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 341,178 0 251,476 356,921 7,480 10,407 324,934 2,755,684	0 3,611,423 0 1,149,683 605,322 289,05,322 289,054 (5,655,478) (3,809,671) 349,237 349,257 349,257 349,257 349,257 349,257	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482 357,482 310,366 0 261,638 458,204 840,145 4,074 5,668 176,965 2,772,023	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 365,917 307,939 0 266,872 511,667 856,948 2,264 3,150 98,345 2,779,018	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 305,290 0 272,211 567,087 874,087 380 529 16,509 2,785,185	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,377 393,377 394,377 394,3
Benefits:	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	1,000,000 5,500,000 30,700,000 2,346,827 0 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 207,470 0 0 240,000 207,470 0 0 0 0 240,000 207,470 0 0 0 0 240,000 2	0 2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,7	0 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 221,211 0 194,385 207,512 624,240 7,757 10,793 336,987 2,106,023 2,004,543	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555 228,368 0 198,274 213,614 	0 0 2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 263,680 263,680 263,680 202,241 219,878 649,459 8,071 11,229 350,601	2,720,432 0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948 243,281 0 206,287 226,948 243,281 0 206,287 226,306 8,232 11,454 357,613	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 251,046 0 210,413 232,904 675,697 8,397 11,683 364,765 2,307,627 1,989,859	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 289,634 267,223 0 218,917 246,624 702,996 8,736 12,155 379,502	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 3,114,833 0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 303,530 303,530 284,298 0 227,763 261,072 731,397 9,089 12,646 394,834	0 3,195,990 0 1,017,428 504,545 (3,947,191) 310,719 310,719 310,719 203,187 0 232,320 268,581 746,025 9,271 12,899 402,730 2,586,451 1,971,250	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 318,075 326,967 276,285 760,945 9,456 13,157 410,785	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 325,601 325,601 325,601 0 241,708 0 241,708 776,164 9,645 13,420 419,001	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 334,588 0 1,598 1,598 1,598 1,598 1,598 1,598 1,598 1,298 1,598 1,298	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 341,178 0 251,476 0 251,476 356,921 7,480 10,407 324,934	0 3,611,423 0 1,149,683 605,322 289,051 (3,809,671) 349,237 340,237 340,2577 340,2577 340,2577 340,25777 340,25777 340,257777 340,25777777777777777777777777777777777777	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 368 377,87 368 377,87 377,965 377,965 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,785 37,775	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,866) (3,685,220) 365,917 365,914 856,948 2,264 3,150 98,345 98,34	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 374,546 374,546 0 272,211 567,087 0 272,211 567,087 380 529 16,509	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 393,374 394,595 395,595 395,595 395,595 395,595 395,595 395,595 395,5
Benefits: Annual Running Costs: Net escalated benefit/(cost)	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	1,000,000 5,500,000 30,700,000 0 747,102 328,475 370,840 (3,793,243) (3,793,243) (3,793,243) 240,000 207,470 0 0 186,835 195,775 0 600,000 7,456 10,374 323,901 2,456 10,374 323,901 2,011,812 5,011,812	0 2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,718 245,718 244,748 244,246 0 190,573 201,567 10,582 330,379 2,058,388 2,008,184 0 0	0 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 221,211 0 194,385 207,512 624,240 7,757 10,793 336,987 2,106,023 2,004,543	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555 228,368 0 198,274 213,614 213,614 636,725 7,913 11,009 343,726 2,154,740 2,000,890	2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 263,680 263,680 263,680 263,680 202,241 219,878 649,459 8,071 11,229 350,601 2,204,563 1,997,225	2,720,432 0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948 243,281 0 206,287 226,948 243,281 0 206,287 226,306 8,232 11,454 357,613 2,255,517 1,993,548	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 276,360 276,360 251,046 0 210,413 232,904 675,697 8,397 11,683 364,765 2,307,627 1,989,859	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 267,223 0 218,917 246,624 702,996 8,736 12,155 379,502 2,415,421 1,982,448	3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 296,502 275,645 0 223,296 253,755 717,056 8,911 12,398 387,092 2,471,157 1,978,726	0 3,114,833 0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 284,288 0 227,763 261,072 731,397 731,397 79,089 12,646 334,834 2,528,158 1,974,993	0 3,195,990 0 1,017,428 504,545 (3,947,191) 310,719 310,719 310,719 203,187 0 232,320 268,581 746,025 9,271 12,899 402,730 2,586,451 1,971,250	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 318,075 302,319 0 236,967 276,285 760,945 9,456 13,157 410,785 2,646,065 1,967,497	0 1,069,748 543,120 479,721 (5,452,924) (3,985,662) 325,601 325,601 325,601 325,601 325,601 0 241,708 0 241,708 776,164 9,645 13,420 419,001 2,707,028 1,963,733	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 334,598 0 246,543 308,997 9,081 12,634 394,466 2,746,407 1,943,707	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 341,178 0 251,476 0 251,476 356,921 7,480 10,407 324,934 2,755,684 1,902,705	0 3,611,423 0 1,149,683 605,322 289,051 (3,809,671) 349,237 349,237 349,237 349,237 349,237 349,237 349,237 15,812 8,086 256,807 406,639 4	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 368 377,87 368 377,87 377,965 377,965 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,782 37,785 37,775	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 365,917 365,917 307,939 0 266,872 511,667 511,667 511,667 3,150 98,345 2,264 3,150 98,345 2,779,018 1,781,812	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 374,546 305,290 0 0 272,211 567,087 380 529 16,509 16,509 2,785,185 1,742,210	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 0 277,657 589,703 891,568 0 0 0 2,838,377 1,732,179
Benefits: Annual Running Costs: Net escalated benefit/(cost) Life cycle cost analysis	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	1,000,000 5,500,000 30,700,000 0 2,346,827 0 0 747,102 328,475 370,840 (3,793,243) (3,793,243) (3,793,243) 240,000 200,0000 200,000 200,00000000	0 2,419,774 0 770,325 342,213 378,257 (3,815,189) 245,718	0 0 2,493,624 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 251,569 221,211 0 194,385 207,512 	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555 258,368 0 198,274 213,614 213,726 214,726 21	2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 263,680 263,680 202,241 219,878 649,459 8,071 11,229 350,661 2,204,563 1,997,225 (2,068,495)	2,720,432 0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948 269,948 243,281 0 206,287 226,306 662,448 8,232 11,454 357,613 2,255,517 1,993,548 (2,141,853)	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 276,360 251,046 0 210,413 232,904 232,904 232,904 232,904 233,904 233,904 24,307,627 1,989,859 (2,215,781)	0 0 2,875,841 0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 282,921 282,921 282,921 259,025 0 214,623 239,675 11,917 372,061 2,360,919 1,986,159 (2,290,241)	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 267,223 0 218,917 246,624 702,996 8,736 12,155 379,502 2,415,421 1,982,448 (2,365,193)	0 3.034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 296,502 296,502 275,645 0 223,755 717,056 8,911 12,398 387,092 2,471,157 1,978,726 (2,440,597)	0 3,114,833 0 991,599 466,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 284,298 0 227,763 261,072 731,397 9,089 12,646 334,834 2,528,158 1,974,993 1,974,993	0 3,195,990 0 1,017,428 504,545 (3,947,191) 310,719 310,719 310,719 293,187 0 0 232,320 268,581 746,025 9,271 12,899 402,730 2,566,451 1,971,250 (2,592,605)	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 302,319 0 236,967 276,285 760,945 9,456 13,157 410,785 2,646,065 1,967,497 (2,669,122)	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 325,601 325,601 311,698 0 241,708 284,191 276,164 9,645 13,420 419,001 2,707,028 1,963,733 (2,745,896)	0 1,096,210 563,261 451,631 (3,931,112) 333,300 336,398 0 246,543 308,997 791,687 9,081 12,634 394,466 2,746,407 1,943,707 (2,808,151)	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 341,178 341,178 0 251,476 356,921 7,480 10,407 324,934 2,755,684 1,902,705 (2,850,353)	0 3,611,423 0 1,149,683 605,322 289,051 (5,555,478) (3,809,671) 349,237 406,639 252,464 2,564,264 2,764,234 1,862,057 (2,891,245) (2,891,245)	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482 357,482 357,482 357,482 357,482 310,366 0 261,638 458,204 	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 365,917 307,939 0 266,872 511,667 855,948 2,264 3,150 98,345 2,779,018 1,781,812 (2,968,667)	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 305,290 0 0 272,211 567,087 874,087 380 529 16,509 16,509 2,785,185 1,742,210 (3,004,971)	0 1,258,460 697,013 0 (5,906,52) (3,605,836) 383,374 383,374 383,374 383,374 383,374 0 277,657 589,703 891,568 0 0 0 2,838,377 1,732,179 (3,070,205)
Benefits: Annual Running Costs: Net escalated benefit/(cost)	Oxicat Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs Discounted Running Costs (in 2020\$)	1,000,000 5,500,000 30,700,000 0 747,102 328,475 370,840 (3,793,243) (3,793,243) (3,793,243) 240,000 207,470 0 0 186,835 195,775 0 600,000 7,456 10,374 323,901 2,456 10,374 323,901 2,011,812 5,011,812	0 2,419,774 0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,718 245,718 244,748 244,748 244,246 0 190,573 201,567 10,582 30,379 2,058,388 2,008,184 0 0	0 0 2,493,624 0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 251,569 221,211 0 194,385 207,512 	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555 228,368 0 198,274 213,614 213,614 636,725 7,913 11,009 343,726 2,154,740 2,000,890	2,643,969 0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 263,680 235,723 0 202,241 219,878 649,459 8,071 11,229 350,601 2,204,563 1,997,225	2,720,432 0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948 243,281 0 206,287 226,948 243,281 0 206,287 226,306 8,232 11,454 357,613 2,255,517 1,993,548	0 0 0 2,797,729 0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 276,360 276,360 251,046 0 210,413 232,904 675,697 8,397 11,683 364,765 2,307,627 1,989,859	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 267,223 0 218,917 246,624 702,996 8,736 12,155 379,502 2,415,421 1,982,448	3,034,417 0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 296,502 275,645 0 223,296 253,755 717,056 8,911 12,398 387,092 2,471,157 1,978,726	0 3,114,833 0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 284,288 0 227,763 261,072 731,397 731,397 79,089 12,646 334,834 2,528,158 1,974,993	0 3,195,990 0 1,017,428 504,545 (3,947,191) 310,719 310,719 310,719 203,187 0 232,320 268,581 746,025 9,271 12,899 402,730 2,586,451 1,971,250	0 3,277,835 0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 318,075 302,319 0 236,967 276,285 760,945 9,456 13,157 410,785 2,646,065 1,967,497	0 1,069,748 543,120 479,721 (5,452,924) (3,985,662) 325,601 325,601 325,601 325,601 325,601 0 241,708 0 241,708 776,164 9,645 13,420 419,001 2,707,028 1,963,733	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 334,598 0 246,543 308,997 9,081 12,634 394,466 2,746,407 1,943,707	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 341,178 0 251,476 0 251,476 356,921 7,480 10,407 324,934 2,755,684 1,902,705	0 3,611,423 0 1,149,683 605,322 289,051 (3,809,671) 349,237 349,237 349,237 349,237 349,237 349,237 349,237 15,812 8,086 256,807 406,639 4	0 3,696,190 0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482 357,482 357,482 357,482 30,366 0 281,638 458,204 	0 3,781,424 0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 365,917 365,917 307,939 0 266,872 511,667 511,667 511,667 3,150 98,345 2,264 3,150 98,345 2,779,018 1,781,812	0 3,867,079 0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 374,546 305,290 0 0 272,211 567,087 380 529 16,509 16,509 2,785,185 1,742,210	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 383,374 0 277,657 589,703 891,568 0 0 0 2,838,377 1,732,179

ALTERNATIVE 2.75

	Year of analysi Escalation rat Discount rat	is 2020 te 2.00%	sk adjustments (+/- pe	rcent): Benefits Capital costs Running costs	0% 0% 0%										HSW	Alternative Study Alternative ernative Cost Ana	lysis (\$)					
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	Year 2035	2036	2037	2038	2039	2040
Expressed in 2020 dollars, un	escalated dollars																					
Capital Outlays	BUS 1200 scfm + Interconnection	21 200 000																				
	Oxicat + SCR	4,900,000																				
	HSW Receiving Facility Dig 1&3 Improvements	5,500,000																				
	Total capital outlays	34,600,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:	D3 RINs	2,346,827	2,372,328	2,396,794	0.400.004	0.440.640	2.463.979	2,484,303	2,503,592	2,521,846	2,539,065	2,555,248	2,570,417	2,584,550	2,597,648	2,609,710	2,620,736	2,630,726	2,639,681	2,647,599	0.054.400	2,660,329
					2,420,224	2,442,619															2,654,482	
	LCFS Natural Gas Sale	747,102 328,475	755,220 335,503	763,010 342,531	770,469 349,559	777,599 356,587	784,399 363,615	790,870 370,643	797,011 377,671	802,823 384,699	808,305 391,727	813,457 398,755	818,280 405,787	822,780 412,818	826,950 419,850	830,790 426,881	834,301 433,913	837,482 440,944	840,333 447,975	842,854 455,007	845,046 462,038	846,908 469,070
	HSW Tipping Fee Total benefits	370,840	370,840 (3.833.891)	370,840	370,840	370,840 (3.947,645)	370,840 (3.982,833)	370,840 (4.016.656)	370,840	370,840 (4.080,208)	370,840	370,840 (4,138,300)	370,840 (4.165.324)	370,840 (4.190,988)	370,840	342,280 (4.209.661)	276,419 (4.165.368)	210,558	144,697 (4.072.685)	78,836 (4.024,296)	12,975	0
	l otal benefits	(3,793,243)	(3,833,891)	(3,873,174)	(3,911,092)	(3,947,645)	(3,982,833)	(4,016,656)	(4,049,115)	(4,080,208)	(4,109,937)	(4,138,300)	(4,165,324)	(4,190,988)	(4,215,288)	(4,209,661)	(4,165,368)	(4,119,710)	(4,072,685)	(4,024,296)	(3,974,541)	(3,976,306)
Annual Running Costs:	Engine O&M	240,000	240,900	241,800	242,700	243,600	244,500	245,400	246,300	247,200	248,100	249,000	249,900	250,800	251,700	252,600	253,500	254,400	255,300	256,200	257,100	258,000
	SCR O&M	240,000	240,900	241,800	242,700	243,600	244,500	245,400	246,300	247,200	248,100	249,000	249,900	250,800	251,700	252,600	253,500	254,400	255,300	256,200	257,100	258,000
	Biogas/GCS Upgrading O&M	207,470	210,046	212,621	215,196	217,771	220,347	222,922	225,497	228,073	230,648	233,223	235,800	238,376	240,953	239,790	233,744	227,698	221,652	215,606	209,560	210,438
	Natural Gas Purchased - Dryer	186,835	186,836	186,837	186,838	186,839	186,840	186,841	186,842	186,843	186,844	186,845	186,846	186,847	186,848	186,849	186,850	186,851	186,852	186,853	186,854	186,855
	Natural Gas Purchased - Engine HSW Facility O&M	195,775 100,000	197,614 100,001	199,454 100,002	201,294 100,003	203,133 100,004	204,973 100,005	206,812	208,652 100,007	210,491 100,008	212,331 100,009	214,170 100,010	216,010 100,011	217,849 100,012	219,689 100,013	234,181 100,014	265,198 100,015	296,215 100,016	327,232 100,017	358,249 100,018	389,266 100,019	396,853 100,020
	Dig 1 & 5 O&M Dewatering Polymer	600,000 7.456	600,000 7,456	600,000 7,456	600,000 7.456	600,000 7,456	600,000 7,456	600,000 7.456	600,000 7.456	600,000 7,456	600,000 7.456	600,000 7,456	600,000 7.456	600,000 7,456	600,000 7,456	600,000 6.882	600,000 5,558	600,000 4,233	600,000 2,909	600,000 1,585	600,000 261	600,000
	Dewatering Power	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	10,374	9,575	7,733	5,890	4,048	2,205	363	0
	Class B Hauling Total running costs	323,901 2,111,812	323,901 2,118,029	323,901 2,124,245	323,901 2,130,462	323,901 2,136,679	323,901 2,142,896	323,901 2,149,113	323,901 2,155,329	323,901 2,161,546	323,901 2,167,763	323,901 2,173,980	323,901 2,180,198	323,901 2,186,416	323,901 2,192,634	298,956 2,181,447	241,431 2,147,529	183,906 2,113,610	126,382 2,079,692	68,857 2,045,774	11,332 2,011,855	2,010,166
	Total raining boots																				÷	
Net Benefit/(cost)		32,918,568	(1,715,863)	(1,748,929)	(1,780,630)	(1,810,966)	(1,839,937)	(1,867,544)	(1,893,785)	(1,918,662)	(1,942,174)	(1,964,320)	(1,985,126)	(2,004,572)	(2,022,654)	(2,028,214)	(2,017,839)	(2,006,099)	(1,992,993)	(1,978,522)	(1,962,685)	(1,966,140)
Expressed in escalated dollar	s with sensitivity adjustments																					
Capital Outlays																						
Capital Outlays	BUS 1200 scfm + Interconnection	21,200,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital Outlays	Oxicat + SCR Dig 1&3 Improvements	4,900,000 5,500,000	0 0 0 0	0	0 0 0 0	0 0 0	0 0 0	0 0 0	0	0	0 0 0	0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0 0	0 0 0	0 0 0	0 0 0 0	0	0 0 0
Capital Outlays	Oxicat + SCR	4,900,000	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Capital Outlays Benefits:	Oxicat + SCR Dig 1&3 Improvements Total capital outlays (Pvs)	4,900,000 5,500,000 34,600,000	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
	Oxicat + SCR Dig 18.3 improvements Total capital outlays (Pvs) D3 RINs	4,900,000 5,500,000 34,600,000 2,346,827 0 0	0 0 0 2,419,774 0	0 0 0 2,493,624 0	0 0 0 2,568,361 0	0 0 0 2,643,969 0	0 0 0 0 2,720,432 0	0 0 0 2,797,729 0	0 0 0 2,875,841 0	0 0 0 0 2,954,745 0	0 0 0 3,034,417 0	0 0 0 3,114,833 0	0 0 0 3,195,990 0	0 0 0 0 3,277,835 0	0 0 0 3,360,335 0	0 0 0 3,443,457 0	0 0 0 3,527,166 0	0 0 0 3,611,423 0	0 0 0 3,696,190 0	0 0 0 3,781,424 0	0 0 0 0 3,867,079 0	0 0 0 3,953,109 0
	Oxicat + SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS	4,900,000 5,500,000 34,600,000	0 770,325	0 0 0 2,493,624 0 793,835 356,369	0 0 0 2.568,361 0 817,628 370,955	0 0 0 2.643,969 0 841,699 385 981	0 0 0 2,720,432 0 866,040 401,460	0 0 0 2,797,729 0 890,648 417.404	0 915,515	0 0 0 2,954,745 940,635 450 737	0 0 0 3.034.417 965.999 468.150	0 0 0 3,114,833 0 991,599 486.081	0 0 0 3.195,990 	0 0 0 3,277,835 0 1,043,483 553 553	0 1,069,748	0 0 0 3.443,457 0 1.096,210 563,261	0 0 0 3,527,166 0 1,122,859 563,989	0 0 0 3,611,423 0 1,149,683 605,322	0 1,176,669	0 0 0 3,781,424 0 1,203,803 649,862	0 1,231,072	0 1,258,460
	Oxicat + SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Toping Fee	4,900,000 5,500,000 34,600,000 0 0 747,102 328,475 370,840	0 770,325 342,213 378,257	0 793,835 356,369 385,822	0 817,628 370,955 393,538	0 841,698 385,981 401,409	0 866,040 401,460 409,437	0 890,648 417,404 417,626	0 915,515 433,826 425,979	0 940,635 450,737 434,498	0 965,999 468,150 443,188	0 991,599 486,081 452,052	0 1,017,428 504,545 461,093	0 1,043,483 523,553 470,315	0 1,069,748 543,120 479,721	0 1,096,210 563,261 451,631	0 1,122,859 583,989 372,023	0 1,149,683 605,322 289,051	0 1,176,669 627,274 202,610	0 1,203,803 649,862 112,597	0 1,231,072 673,103 18,902	0 1,258,460 697,013 0
	Oxicat + SCR Dig 1438 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale	4,900,000 5,500,000 34,600,000 0 2,346,827 0 0 747,102 328,475	0 770,325 342,213	0 793,835 356,369	0 817,628 370,955	0 841,698 385,981	0 866,040 401,460	0 890,648 417,404	0 915,515 433,826	0 940,635 450,737	0 965,999 468,150	0 991,599 486,081	0 1,017,428 504,545	0 1,043,483 523,553	0 1,069,748 543,120	0 1,096,210 563,261	0 1,122,859 583,989	0 1,149,683 605,322	0 1,176,669 627,274	0 1,203,803 649,862	0 1,231,072 673,103	0 1,258,460
Benefits:	Oxicat + SCR Dig 18.38 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HStW Toping Fee Total benefits	4 900,000 5,500,000 34,600,000 0 2,346,827 0 0 747,102 328,475 370,840 (3,793,243)	0 770,325 342,213 378,257 (3,910,569)	0 793,835 356,369 385,822 (4,029,650)	0 817,628 370,955 393,538 (4,150,482)	0 841,698 385,981 401,409 (4,273,058)	0 866,040 401,460 409,437 (4,397,370)	0 890,648 417,404 417,626 (4,523,407)	0 915,515 433,826 425,979 (4,651,160)	0 940,635 450,737 434,498 (4,780,614)	0 965,999 468,150 443,188 (4,911,755)	0 991,599 486,081 452,052 (5,044,565)	0 1,017,428 504,545 461,093 (5,179,056)	0 1,043,483 523,553 470,315 (5,315,187)	0 1,069,748 543,120 479,721 (5,452,924)	0 1,096,210 563,261 451,631 (5,554,558)	0 1,122,859 583,989 372,023 (5,606,037)	0 1,149,683 605,322 289,051 (5,655,478)	0 1,176,669 627,274 202,610 (5,702,743)	0 1,203,803 649,862 112,597 (5,747,686)	0 1,231,072 673,103 18,902 (5,790,155)	0 1,258,460 697,013 0 (5,908,582)
	Oxicat + SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M	4.900.000 5.500.000 34,600,000 2,346,827 0 747,102 370,840 (3,793,243) (3,793,243) 240,000	0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718	0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555	0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680	0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948	0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360	0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634	0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502	0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530	0 1,017,428 504,545 461,093 (5,179,056) (3,947,191) 310,719	0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178	0 1,149,683 605,322 289,051 (5,655,478) (3,809,671) 349,237	0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482	0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917	0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374
Benefits:	Oxicat + SCR Dig 1438 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M	4,900,000 5,500,000 34,600,000 2,346,827 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 240,000	0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,718	0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 251,569	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555	0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680	0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948 269,948	0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360	0 915,515 433,826 425,979 (4,651,160) (3,912,659) 282,921 282,921	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634	0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502	0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530 303,530	0 1,017,428 504,545 461,093 (5,179,056) (3,947,191) 310,719 310,719	0 1.043.483 523.553 470.315 (5.315.187) (3.952.138) 318.075 318.075	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662)	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 333,300	1,122,659 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178	0 1.149,683 605,322 289,051 (5,655,478) (3,809,671) 349,237 349,237	0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482	0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917	0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374
Benefits:	Oxicat + SCR Dig 1838 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas/GCS Upgrading O&M	4.900,000 5.500,000 34,600,000 2.346,827 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 240,000 240,000 0 0 0 0	0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,718 245,718 245,718 214,246 0	0 793,835 356,369 335,822 (4,023,660) (3,835,479) 251,569 251,569 251,569 221,211 0	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555 226,555 228,368 0	0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 235,723 0	269,948 269,948 269,948 269,948 269,948 269,948 269,948 269,948 269,948 269,948 269,948 269,948 269,948 269,948	0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 251,046 0	0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 282,921 282,921 269,025 0	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 267,223 0	0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 275,645 0	0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530 303,530 284,298 0	0 1.017,428 504,545 461,093 (5,179,056) (3,947,191) 310,719 310,719 293,187 0	0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 302,319 0	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 311,698 0	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 333,300 316,398 0	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 0	0 1,149,683 605,322 289,051 (5,655,478) (3,809,671) 349,237 349,237 349,237 342,251 0	0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482 357,482 310,366 0	0 1,203,803 649,862 112,597 (5,747,686) (3,685,20) 365,917 365,917 365,917 0 0	0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 0,272,90 0	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374 383,374 312,700 0
Benefits:	Oxicat + SCR Dig 1438 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M	4,900,000 5,500,000 34,600,000 2,346,827 0 747,102 328,475 370,840 (3,793,243) (3,793,243) 240,000 240,000	0 770,325 342,213 378,257 (3,910,569) (3,815,189) 245,718 245,718	0 793,835 356,369 385,822 (4,029,650) (3,835,479) 251,569 251,569	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555	0 841,698 385,981 401,409 (4,273,058) (3,871,180) 263,680 263,680	0 866,040 401,460 409,437 (4,397,370) (3,886,634) 269,948 269,948	0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360	0 915,515 433,826 425,979 (4,651,160) (3,912,659) 282,921 282,921	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634	0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502	0 991,599 486,081 452,052 (5,044,565) (3,940,806) 303,530 303,530	0 1,017,428 504,545 461,093 (5,179,056) (3,947,191) 310,719 310,719	0 1.043.483 523.553 470.315 (5.315.187) (3.952.138) 318.075 318.075	0 1.069.748 543.120 479.721 (5.452.924) (3.965.662) 325.601 325.601	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 333,300	1,122,659 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178	0 1.149,683 605,322 289,051 (5,655,478) (3,809,671) 349,237 349,237	0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482	0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917	0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546	0 1,258,460 697,013 0 (5,908,582) (3,605,836) 383,374 383,374
Benefits:	Oxicat + SCR Dig 18.38 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR 0&M Biogas/CCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine	4.900.000 5.500.000 34.600.000 2.346.827 0 747.102 328.475 3770.440 (3,783.243) (3,783.243) 240.000 240.000 240.000 0 0 0 0 0 0 0 0 0 0 0 0	0 770.325 342.213 378.257 (3,910.569) (3,816,189) 245.718 245.718 214.246 0 190.573 201.567	0 793,835 356,369 385,822 (4,022,850) (3,835,479) 251,569 261,569 221,211 0 194,385 207,512	0 817,528 370,955 393,538 (4,150,482) (3,854,135) 257,555 257,555 228,368 0 198,274 213,614	0 841,698 335,981 401,409 (4,273,058) (3,871,180) 263,680 263,680 265,680 235,723 0 0 202,241	0 866.00 401.460 409.437 (4.397.370) (3.866.634) 269.948 269.948 243.281 0 206.287 226.306	0 890,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 251,046 0 210,413 232,904	0 915,515 433,826 425,979 (4,651,160) (3,912,869) 282,921 282,921 282,921 282,921 259,025 0 214,623 239,675	0 940.635 450,737 434,498 (4,780.614) 289,634 289,634 267,223 0 218,917 246,624	0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 275,645 0 0 223,296 223,296	0 991,599 486,081 452,052 (3,940,806) 303,530 303,530 303,530 284,298 0 227,763	0 1,017,428 504,545 461,093 (5,179,056) (3,947,191) 310,719 310,719 293,187 0 223,230	0 1,043,483 523,553 470,315 (3,952,138) 318,075 318,075 318,075 302,319 0 236,967	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 325,601 311,698 0 241,708 284,191	0 1,096,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 333,300 336,398 0 0 246,543	0 1,122,859 583,969 372,023 (5,666,637) (3,870,775) 341,178 341,178 341,178 314,589 0 251,476	0 1,149,683 605,322 289,051 (3,809,671) 349,237 349,237 349,237 349,237 349,237 0 0 266,507	0 1.176.669 627.274 202.610 (5,702,743) (3,747,814) 357.482 357.482 357.482 310,366 0 261.638	0 1,203,803 649,862 112,597 (5,747,866) (3,685,220) 365,917 365,917 307,939 0 266,872	0 1,231,072 673,103 18,902 (5,790,155) (3,621,903) 374,546 374,546 374,546 305,290 0 272,211	0 1,258,460 697,013 0 (5,908,522) (3,605,836) 383,374 383,374 383,374 312,700 0 277,657 589,703
Benefits:	Oxicat + SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas(CSV bgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Devatering Polymer	4.900.000 5.500.000 34,600.000 2,346.827 0 747.102 338.475 370.840 (3,793.243) (3,793.243) 240.000 240.000 240.000 240.000 0 0 0 0 0 0 195.775 600.000 7.456	0 0 0 770.325 342.213 378.257 (3.915.659) (3.815.189) 245.718 245.718 245.718 245.718 245.72 0 190.573 201.567 612.000 7.605	0 798.835 356.360 385.822 (4.022.650) (3.835.479) 251.569 221.569 221.51 0 194.385 207.512 624.240 7.757	0 817,628 370,955 393,538 (4,150,452) (3,864,135) 257,555 257,555 257,555 252,868 0 198,274 213,614 636,725 7,913	0 841,698 365,981 401,409 (4,273,059) (3,871,180) 263,680 263,680 263,680 263,680 263,680 263,680 263,671 80 202,241 219,878 649,459 649,459 8,071	0 866.00 401.460 409.437 (4.397.370) (3,886.634) 269.948 243.281 0 206.287 226.306 662.448 8,232	0 800,648 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 251,046 0 210,413 232,904 675,697 8,397	0 915,515 423,826 425,979 (4,651,160) (3,912,859) (3,9	0 940.635 450.737 434.498 (4,780.614) (3,923.673) 289.634 289.634 289.634 287.223 0 218.917 246.624 702.996 8,736	0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 275,645 0 0 223,296 233,755 717,056 8,911	0 991599 486.081 452.052 (5,044.565) (3,940.806) 303.530 284.288 0 227.763 281.072 731.397 9.089	0 1.017.428 504.545 461.093 (5.179.056) (3.947.191) 310,719 310,719 310,719 203,187 0 228,581 746,025 9,271	0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 302,319 0 236,967 276,285 760,945 9,466	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,601 311,698 0 241,708 284,191 776,164 9,645	0 1.006.210 563.261 451.631 (5,554.558) (3.931,112) 333.300 316.398 0 2.46.543 308.997 791.687 9.081	0 1,122,859 583,980 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 341,459 0 251,476 356,921 807,521 807,521 7,480	0 1.149.683 605.322 289.051 (5.655.478) (3.809.671) 349.237 349.237 349.237 349.237 0 256.507 406.639 823.671 5.812	0 1.176.669 627.274 202.610 (5.702.743) (3.747,814) 357.482 357.482 357.482 357.482 0 0 261.638 458.204 840.145 840.145	0 1.203.803 649.862 112.597 (5.747.686) (3.685.220) 365.917 365.917 365.917 0 266.672 511.667 511.667 856.948 2.264	0 1,231072 673,103 (6,790,155) (3,621,903) 374,546 374,546 374,546 374,546 374,546 374,546 0 0 0 272,211 567,087 874,087 380	0 1,258,460 697,013 0 (5,908,52) (3,605,836) 383,374 383,374 383,374 312,700 0 277,657
Benefits:	Oxicat + SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas/ICCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M	4.900.000 5.500.000 34,600,000 2.346,827 0 747,102 328,475 370,840 (3,793,243) 240,000 240,000 240,000 0 0 186,835 195,775 0 0 0 0 600,000	0 770.325 342.213 378.257 (3,810,669) (3,815,189) 245,718 245,718 245,718 245,718 214,246 0 190.573 201.567 612,000 7.605 10.582	0 793.835 356.369 385.622 (4,023,650) (3,835,479) 251.569 221.211 0 194.385 207.512 624.240	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 227,555 227,555 228,368 0 0 198,274 213,614 638,725	0 841.698 385.981 401,409 (4,273,058) (3,871,180) 263,680 264,680 264,690 264,690 264,680 264,690 264,680 264,680 264,680 264,690264,690 264,690 264,690 264,690 264,690264,690 264,690 264,690 264,690 264,690 264,690 264,690 264,690 264,690 264,690 264,690264,690 264,	0 866.040 401.460 409.437 (3.886.634) 269.948 269.948 269.948 269.948 243.281 0 0 206.287 226.306 662.448 8.232 11.454	0 800.648 417,404 417,626 (4,523,447) (3,900,520) 276,360 276,360 276,360 276,360 276,447 0 210,413 232,904 675,697	0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 262,921 262,921 262,921 262,921 262,925 214,623 239,675 689,211 8,565 11,917	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 267,223 0 218,917 246,624 702,996	0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 296,502 275,645 0 223,296 253,755 717,056	0 991599 486.081 452.052 (5,044,565) 303.530 303.530 284.298 0 227.763 261.072 731.397	0 1.017.428 504.545 461.093 (5.179.056) (3.947.191) 310.719 310.719 293.187 0 232.320 268.581 746.025	0 1.043.483 523.553 470.315 (5,315,167) (3,962,138) 318.075 318.075 318.075 302.319 0 236.967 276.285 760.945	0 1.069.748 543.120 479.721 (5,452.924) (3,955.662) 325.601 325.601 325.601 311.698 0 241.708 244.191 776.184	0 1,006,210 563,261 451,631 (5,554,558) (3,931,112) 333,300 336,398 0 246,543 308,997 791,687	0 1,122,85 583,980 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 807,521	0 1,149,683 605,322 289,051 (5,655,478) (3,809,671) 349,237 349,237 349,237 349,237 349,237 0 0 256,507 406,639 823,671	0 1.176.669 627.274 202.610 (5,702,743) (3,747,814) 357.482 357.482 357.482 357.482 357.482 0 261.638 458.204 840.145	0 1.203.803 649.862 112.597 (5,747,666) (3,685,5270) 365.917 365.917 365.917 307.939 0 266.872 511.667	0 1.231072 673.103 18.902 (5.790,155) (3.621,903) 374.546 374.546 374.546 305.290 0 272.211 567.087 874.087	0 1,258,460 697,013 0 (5,908,522) (3,605,836) 383,374 383,374 383,374 312,700 0 277,657 589,703
Benefits:	Oxicat + SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas/ICCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	4.900.000 5.500.000 34,600,000 2.346,827 0	0 0 0 770.325 342.213 378.257 (3.915.659) (3.815.189) 245.718 245.718 245.718 245.718 245.72 0 190.573 201.567 612.000 7.605	0 798.835 356.369 385.622 (4,023,650) (3,835,479) 251.569 221.211 0 194.385 207.512 624.240 7.757 10.793	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 227,555 227,555 227,555 228,368 0 0 198,274 213,614 	0 841 698 385 981 401 409 (4,273 568) (3,877,180) 263 680 263 680 203 677,180 202,241 219,878 649,459 8,071 11,229	0 866.00 401.460 409.437 (4.397.370) (3,886.634) 269.948 243.281 0 206.287 226.306 662.448 8,232	0 800,648 417,404 417,626 (4,523,467) (3,900,520) 276,360 276,360 276,360 210,413 222,064 	0 915,515 423,826 425,979 (4,651,160) (3,912,859) (3,9	0 940,635 450,737 434,498 (4,780,614) (3,923,673) 289,634 289,634 289,634 267,223 0 0 218,917 246,624 702,996 8,736 12,155	0 965,999 468,150 443,188 (4,911,755) (3,932,981) 296,502 275,645 0 0 223,296 253,755 717,056 8,911 12,398	0 991599 486.081 452.052 (5,044,565) 303.530 303.530 284.298 0 227.763 261.072 731.397 9.089 12.646	0 1.017.428 504.545 461.093 (5.179.056) (3.947.191) 310.719 310.719 293.187 0 232.320 268.581 746.025 9.271 12.899	0 1.043.483 523.553 470.315 (5,315,187) (3,952,138) 318.075 318.075 302.319 0 236.967 276.285 760.945 9.456 13.157	0 1.069.748 543.120 479.721 (5,452.924) (3,955.662) 325.601 325.601 325.601 311.698 244.101 776.164 9.645 13.420	0 1.006210 563.261 (5,554,558) (3,931,112) 333.300 336.398 0 246,543 306.997 791,687 9.081 12,634	0 1,122,859 583,980 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 341,178 341,089 341,178 341,089 341,178 341,089 341,178 341,089 341,097	0 1,149,683 605,322 289,051 (5,655,478) (3,809,671) 349,237 349,237 349,237 0 2565,077 406,639 823,671 5,812 8,066	0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 310,366 0 261,638 465,204 	0 1.203.803 649.862 112.597 (5,747,666) (3,685,5270) 365.917 365.917 307.939 0 0 266.872 511.667 	0 1,231,072 673,103 18,902 (5,790,156) 3,521,903 374,546 376,576 380 529 380 380 380 380 380 380 380 380	0 1,258,460 697,013 0 (5,908,522) (3,605,836) 383,374 383,374 383,374 312,700 0 277,657 589,703
Benefits:	Oxicat + SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer	4.900.000 5.500.000 34,600.000 2.346.827 0 2.346.827 0 747.102 370.840 (3,783.243) 240.000 240.000 240.000 240.000 240.000 0 0 0 0 0 0 0 0 0 195.775	0 770.325 342.213 378.257 (3,810,669) (3,815,189) 245,718 245,718 245,718 245,718 245,718 245,718 214,246 0 0 0 0 0 0 0 0 0 0 0 0 0	0 798.835 356.360 386.822 (4.023,650) (3.835,479) 251.569 221.211 0 194.385 207,512 624.240 7.757 10.793 336.987	0 817,628 370,965 393,538 (4,150,482) (3,854,135) 257,555 226,358 228,388 0 0 198,274 213,614 636,725 7,913 11,009 343,726	0 841 698 385 981 401 409 (4,273 568) (3,877,180) 263 680 235,723 0 0 202,241 219,878 649,459 8,071 11,229 350,601	0 866.040 401.460 409.437 (4.397.370) (3.886.634) 269.948 269.948 269.948 269.948 269.948 269.948 269.948 269.263 0 0 206.287 226.306 662.448 8.232 11.454 357.613	0 800,648 417,404 417,626 (4,523,467) (3,900,520) 276,360 276,360 276,360 210,413 222,064 	0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 262,921 262,921 262,921 262,921 262,921 262,921 262,921 262,921 262,921 262,921 689,211 8,565 11,917 372,061	0 940,635 450,737 434,498 (4,760,614) (3,923,673) 289,634 289,634 289,634 267,223 0 218,917 246,624 702,996 8,736 12,155 379,502	0 965,999 468,150 443,188 (4,911,758) 398,502 296,502 275,645 0 223,296 253,755 717,056 8,911 12,398 387,092	0 991599 486.081 452.052 (5,044,565) 303.530 303.530 303.530 284.298 0 227.763 261.072 731.397 9.089 12.646 394.834	0 1.017.428 504.545 461.093 (5.179.056) (3.947.191) 310.719 310.719 293.187 0 232.320 268.581 746.025 9.271 1.2.899 402.730	0 1.043.483 523.553 470.315 (5,315,187) (3,952,138) 318.075 318.075 302.319 0 236.967 276.285 760.945 9.456 13.157 410,785	0 1.069.748 543.120 479.721 (5,452.924) (3,955.662) 325.601 325.601 325.601 311.698 244.191 776.164 9.645 13.420 419.001	0 1.006210 563.261 (5,54,558) (3,931,112) 333.300 316.398 0 0 246,543 306,997 791,687 9.081 12,634 394,486	0 1,122,859 583,980 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 372,023 341,178	0 1,149,683 605,322 289,051 (5,655,478) (3,809,671) 349,237 349,237 349,237 349,237 349,237 0 0 256,507 406,639 823,671 5,812 8,086 252,464	0 1,176,669 627,274 202,670 (3,702,743) (3,747,814) 357,482 310,366 0 261,638 465,204 	0 1.203.803 649.862 112.597 (5,747.866) (3,685.220) 365.917 365.917 307.939 0 266.872 511.667 	0 1,231,072 1,231,072 18,902 18,902 (5,790,158) 3,74,546 3,	0 1.258.460 697.013 (5,908,582) (3,605,836) 383,374 383,374 383,374 312,700 0 277,657 569,703
Benefits:	Oxicat + SCR Dig 18.38 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4.900.000 5.500.000 34,600.000 2.346.827 0 2.346.827 0 747.102 370.840 (3,793.243) (3,793.243) 240.000 240.000 240.000 240.000 240.000 0 0 0 0 0 0 0 0 0 195.775 195.7	0 0 770.325 342.213 378.257 (3.916.569) (3.815,189) 245.718 245.718 245.718 214.246 0 190.573 201.567 612.000 7.605 10.582 330.379 2,058,388	0 798.835 356.369 385.822 (4.029.650) (3.835.479) 251.569 251.569 251.569 251.569 251.569 221.211 0 194.385 207.512 624.240 7.757 10.793 336.987 2.106.023	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 257,555 267,555 267,555 267,555 262,368 0 198,274 213,614 3638,725 7,913 11,009 343,726 2,154,740	0 841,698 365,981 401,409 (4,273,058) (3,877,180) 263,680 265,773 0 202,241 219,878 649,459 8,071 11,229 8,071 11,229 8,071	0 866.040 401.460 409.437 (4.397.370) (3,886.634) 269.948 243.261 0 206.267 226.306 662.448 8.232 11.454 8.232 11.454 337.613	0 800,048 417,404 417,826 (4,523,407) (3,900,520) 276,360 276,360 276,360 276,360 276,360 210,413 222,904 675,697 675,697 11,683 364,765 2,307,627	0 915,515 433,826 425,979 (4,651,160) (3,912,859) 282,921 282,921 282,921 282,925 0 0 214,623 239,675 689,211 8,565 11,917 372,061 2,360,919	0 940.635 450.737 434.498 (4,760.614) (3,923.673) 269.634 269.634 267.223 0 218.917 246.624 702.996 8.736 12.155 379.502 2,415.421	0 965.999 468.150 (4.911,755) (3.932,981) 286.502 275.645 0 223.296 223.756 717.056 8.911 1.2.398 387.092 2.471,157	0 991599 486,081 452,052 (5,044,565) (3,940,806) 303,530 284,298 0 227,763 261,072 731,397 9,089 12,546 394,834 2,528,158	0 1.017.428 504.545 461.093 (5.179.056) (3.947.191) 310.719 310.719 203.187 0 223.230 2268.581 746.025 9.271 12.899 402.730	0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 302,319 0 236,967 276,285 760,945 9,456 13,157 410,785 2,646,065	0 1.069.748 543.120 479.721 (5.452.924) (3.955.662) 325.601 325.601 325.601 325.601 311.698 0 241.708 264.191 776.164 9.645 13.420 419.001	0 1.066210 563261 (5.554,558) (3.333,300 333,300 335,300 336,308 0 246,543 308,997 791,687 9,081 12,634 334,466 2,746,407	0 1,122,859 583,989 372,023 (5,666,037) (3,870,775) 341,178 341,178 341,178 341,178 341,289 0 2,51,476 366,921 7,480 10,407 324,934 2,755,884	0 1.149.683 605.322 289.051 (5,655.478) 3.49.237 3.49.237 3.49.237 3.42.581 0 2.266.507 4.06.639 8.23.671 5.812 8.086 2.52.464 2.764.234	0 1,176,669 627,274 202,610 (6,702,743) (3,747,814) 357,482 357,482 310,366 0 261,638 465,204 	0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 305,917 307,939 0 266,872 511,667 511,667 856,948 2,264 3,150 98,345 2,779,018	0 1,231072 673.103 (5,790,156) (3,621,903) (3,621,903) 374,546 374,546 374,546 374,546 0 0 0 272,211 567,067 380 529 16,509 2,785,185	0 1.258.460 697.013 0 (5.906,582) (3.605,836) (3.60
Benefits: Annual Running Costs:	Oxicat + SCR Dig 18.38 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4 400,000 5,500,000 34,600,000 2,346,827 0 747,102 328,475 370,840 (3,793,243) 240,000 240,000 240,000 240,000 240,000 240,000 0 186,835 195,775 600,000 7,456 10,374 323,901 9,574 5,074,812 2,011,812 2,011,812 2,011,812	0 770.325 342.213 378.257 (3.910.569) (3.815,189) 245.718 245.718 245.718 214.246 0 190.573 201.567 612.000 7.605 10.582 330.379 2,058,388 2,008,184 0	0 798.835 356.369 (4,029.650) (3,835.479) (3,835.479) 251.569 221.211 0 194.385 207.512 624.240 7.757 10,793 336.987 2,106.023 2,004.643	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 267,555 267,555 262,555 262,555 262,555 262,555 262,555 262,555 262,555 262,555 262,555 262,555 263,555 263,555 27,555 263,555 27,555 263,555 27,555 263,555 27,55	0 841.698 365.981 (4.273.058) (3.871.180) 263.680 263.680 263.773 0 202.241 219.878 649.459 8.071 11.229 350.601 2.204.563 1.997.225	0 866.040 401.460 409.437 (4.397.370) (3.886.634) 268.948 243.261 0 266.267 226.306 662.448 8.232 11.454 8.232 11.454 337.613 22.255.517 1.993.548	0 800,048 417,404 417,826 (4,523,407) (3,900,520) 276,360 276,360 276,360 210,413 222,004 675,697 6,567 6,567 11,683 364,765 2,307,627 1,989,859	0 915.515 433.826 425.979 (4.651.160) (3.912.859) 282.921 285.925 0 0.214.623 239.675 689.211 8.565 11.917 372.061 2.380.919 1.986.159	0 940.635 450.737 434.498 (4,760.614) (3,923.673) 289.634 289.634 289.634 289.634 289.634 289.634 289.634 249.624 702.996 8,736 12,155 379.502 2,415.421 1,982.448	0 965.999 468.150 (4.911,755) (3.932,981) 206.502 275.645 0 223.296 223.296 223.296 223.296 8.011 1.2.398 387.092 2.471.157 1.978,726	0 991599 486,081 452,052 (5,044,565) 303,530 204,298 0 227,763 261,072 731,397 9,089 12,646 334,834 2,528,158 1,974,983	0 1.017.428 504.545 461.093 (5.179.056) (3.947.191) 310.719 293.187 0 232.320 288.581 746.025 9.271 12.899 402.730 2.586.451 1.971.250	0 1,043,483 523,553 470,315 (5,315,187) (3,962,138) 318,075 318,075 318,075 302,319 0 236,967 276,285 760,945 9,466 1,3,157 410,785 2,646,065 1,967,497	0 1.069.748 543.120 479.721 (5.452.924) (3.955.662) 325.601 325.601 311.698 0 241.708 264.191 776.164 9.645 13.420 419.001 2,707.028 1,963,733	0 1.086210 563261 (5.554,558) (3.333,300 333,300 316,398 0 246,543 306,997 791,687 9,081 12,634 334,466 2,746,407 1,943,707	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 341,178 341,689 0 251,476 356,921 7,480 10,407 324,934 2,755,684 1,902,705	0 1.149.683 605.322 289.051 (5,655.478) 349.237 349.237 349.237 312.581 0 266.507 406.639 823.671 5.812 8.086 252.464 2,764.234 1,862.057	0 1,176,669 627,274 202,610 (6,702,743) (3,74,814) 357,482 357,482 357,482 310,366 0 261,638 465,204 840,145 840,145 5,668 176,965 2,772,023 1,821,760	0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 307,539 0 266,672 511,667 856,948 2,264 3,150 98,345 2,779,018 1,781,812	0 1,231072 673.103 (5,790,156) (3,621,903) (3,621,903) 374.546 374.546 374.546 305.290 0 272.211 567.087 874.067 874.067 380 529 1,5.599 1,5.599 1,742,210	0 1.258.460 697.013 0 (5.906.582) (3.605.836) 383.374 383.374 383.374 383.374 383.374 383.77 589.703 891.568 0 0 0 2.838.377 1.732,179
Benefits: Annual Running Costs: Net escalated benefit/(cost)	Oxicat + SCR Dig 18.38 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4 400,000 5,500,000 34,600,000 2,346,827 0 747,102 328,475 370,840 (3,793,243) 240,000 240,000 240,000 240,000 240,000 240,000 0 186,835 195,775 600,000 7,456 10,374 323,901 9,574 5,074,812 2,011,812 2,011,812 2,011,812	0 770.325 342.213 378.257 (3.910.569) (3.815,189) 245.718 245.718 245.718 214.246 0 190.573 201.567 612.000 7.605 10.582 330.379 2,058,388 2,008,184 0	0 793.835 365.869 365.822 (4,023,650) (3,835,479) 251.569 221.569 221.569 221.569 221.211 0 194.385 207.512 624.240 7.757 10.793 336.987 2,106.023 2,004,543 (1,923,627)	0 817,628 370,955 393,538 (4,150,482) (3,854,135) 267,555 267,555 262,555 262,555 262,555 262,555 262,555 262,555 262,555 262,555 262,555 262,555 263,555 263,555 27,555 263,555 27,555 263,555 27,555 263,555 27,55	0 841.698 365.981 (4.273.058) (3.871.180) 263.680 263.680 263.773 0 202.241 219.878 649.459 8.071 11.229 350.601 2.204.563 1.997.225	0 866.040 401.460 409.437 (4.397.370) (3.886.634) 268.948 243.261 0 266.267 226.306 662.448 8.232 11.454 8.232 11.454 337.613 22.255.517 1.993.548	0 800,048 417,404 417,626 (4,523,407) (3,900,520) 276,360 276,360 276,360 210,413 222,004 675,697 6,567 6,567 11,683 364,765 2,307,627 1,989,859	0 915.515 433.826 425.979 (4.651.160) (3.912.859) 282.921 285.925 0 0.214.623 239.675 689.211 8.565 11.917 372.061 2.380.919 1.986.159	0 940.635 450.737 434.498 (4,760.614) (3,923.673) 289.634 289.634 289.634 289.634 289.634 289.634 289.634 249.624 702.996 8,736 12,155 379.502 2,415.421 1,982.448	0 965.999 468.150 (4.911,755) (3.932,981) 206.502 275.645 0 223.296 223.296 223.296 223.296 8.011 1.2.398 387.092 2.471.157 1.978,726	0 991599 486,081 452,052 (5,044,565) 303,530 204,298 0 227,763 261,072 731,397 9,089 12,646 334,834 2,528,158 1,974,983	0 1.017.428 504.545 461.093 (5.179.056) (3.947.191) 310.719 293.187 0 232.320 288.581 746.025 9.271 12.899 402.730 2.586.451 1.971.250	0 1,043,483 523,553 470,315 (5,315,187) (3,962,138) 318,075 318,075 318,075 302,319 0 236,967 276,285 760,945 9,466 1,3,157 410,785 2,646,065 1,967,497	0 1.069.748 543.120 479.721 (5.452.924) (3.955.662) 325.601 325.601 311.698 0 241.708 264.191 776.164 9.645 13.420 419.001 2,707.028 1,963,733	0 1.086210 563261 (5.554,558) (3.333,300 333,300 316,398 0 246,543 306,997 791,687 9,081 12,634 334,466 2,746,407 1,943,707	0 1,122,859 583,989 372,023 (5,606,037) (3,870,775) 341,178 341,178 341,178 341,178 341,689 0 251,476 356,921 7,480 10,407 324,934 2,755,684 1,902,705	0 1.149.683 605.322 289.051 (5,655.478) 349.237 349.237 349.237 312.581 0 266.507 406.639 823.671 5.812 8.086 252.464 2,764.234 1,862.057	0 1,176,669 627,274 202,610 (6,702,743) (3,74,814) 357,482 357,482 357,482 310,366 0 261,638 465,204 840,145 840,145 5,668 176,965 2,772,023 1,821,760	0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 307,539 0 266,672 511,667 856,948 2,264 3,150 98,345 2,779,018 1,781,812	0 1.231072 673.103 18.002 (5.790,155) (3.521,903) 374.546 374.546 374.546 374.546 374.546 374.546 374.546 374.546 374.546 374.546 374.546 374.546 1.742,210 (3.004,971) (3.004,971) (1.879,693)	0 1.258.460 697.013 0 (5.906.582) (3.605.836) 383.374 383.374 383.374 383.374 383.374 383.77 589.703 891.568 0 0 0 2.838.377 1.732,179
Benefits: Annual Running Costs: Net escalated benefit/(cost) Life cycle cost analysis	Oxicat + SCR Dig 18.38 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Class B Hauling Total running costs	4.900.000 5.500.000 34,600,000 2,346,827 0 747,102 328,475 370,840 (3,793,243) 240,000 240,000 240,000 207,470 0 0 0 0 0 0 0 0 0 0 0 0 0	0 770.325 342.213 378.257 (3.910.589) (3.815.89) 245.718 245.718 245.718 245.718 245.73 201.567 612.000 7.605 10.582 330.379 2,058.386 2,008,184 0 (1.852,181)	0 798.835 356.360 385.822 (4.025.650) (3.833.479) 251.560 221.560 221.560 221.211 0 194.385 207.512 624.240 7.757 10.793 336.967 2.106.023 2.004.643 (1.923.627)	0 817,628 370,955 393,538 (4,150,462) (3,854,135) 257,555 228,368 0 198,274 213,614 636,725 7,913 11,009 343,726 2,154,740 2,000,890 (1,995,743)	0 841,698 365,991 (4,273,058) (3,877,189) 263,680 235,723 0 202,723 0 202,241 219,878 649,459 8,071 11,229 350,601 350,601 350,601 (2,068,495)	0 866.00 401.460 409.437 (4.357.370) (3.866.634) 269.948 269.9	0 80,048 417,404 417,225 (4,523,407) (3,900,520) 276,360 276,360 276,360 276,360 276,360 276,360 210,413 222,904 675,597 11,883 364,765 2,307,627 1,369,859 (2,215,781)	0 915,515 423,826 425,979 (4,651,160) (3,912,859) 282,921 299,925 299,	0 940.635 450.737 434.498 (4,780.614) (3,923.673) 289.634 289.634 289.634 289.634 289.634 289.634 289.634 289.634 289.634 289.634 289.634 289.634 246.624 702.996 8.736 12.155 379.502 2.4415.421 1.982.448 (2,365,193)	0 965.999 468.150 (4.911,755) (3,332,981) 296.502 275.645 0 223,296 263,295 717.056 8.911 12,398 387.092 387.092 387.092 (2,440,597)	0 991599 486.081 452.052 (5,044.565) (3,940.806) 303.530 284.298 0 227.763 281.072 731.397 731.397 12.646 304.834 2,528.158 1,977.4933 (2,516.407)	0 1.017.428 504.545 461.003 (5.179.056) (3.947.191) 310,719 310,719 310,719 203,187 0 228,581 746,025 9,271 12,889 402,730 2,586,451 1,971,250 (2,592,605)	0 1,043,483 523,553 470,315 (5,315,187) (3,952,138) 318,075 318,075 318,075 318,075 302,319 0 236,967 276,285 760,945 9,456 1,3157 410,785 2,664,065 1,967,497 (2,669,122)	0 1,069,748 543,120 479,721 (5,452,924) (3,955,662) 325,601 325,901	0 1.096,210 563,261 (5,554,558) (3,931,112) 333,300 333,300 333,300 333,300 0 246,543 306,997 791,687 9,081 12,634 394,466 394,466 394,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 304,465 306,997 (2,808,151)	0 1,122,859 563,969 372,023 (6,606,0377 (3,870,775) 341,178 341,178 341,178 341,178 341,178 341,178 341,178 341,178 341,178 341,289 0 251,476 356,921 7,480 10,407 324,934 2,755,884 1,902,705 (2,850,353)	0 1.149.683 605.322 289.051 (5.655.478) (3.809.671) 349.237 349.237 349.237 349.237 349.237 0 256.507 406.639 823.671 5.812 8.086 252.464 2,764.234 1,862.057 (2,891,245)	0 1,176,669 627,274 202,610 (5,702,743) (3,747,814) 357,482 357,482 357,482 310,366 0 201,538 458,204 840,145 5,668 176,965 1,6965 1,6968 1,76,965 2,772,023 1,821,760 (2,930,720)	0 1,203,803 649,862 112,597 (5,747,686) (3,685,220) 365,917 365,917 365,917 365,917 307,399 0 266,872 511,667 511,667 2,278,018 2,278,018 1,778,1812 (2,968,667)	0 1,231072 673.103 (8,002 (5,790,155) (3,621,903) 374,546 374,546 374,546 374,546 374,546 374,546 374,546 00 272,211 567,087 874,087 569 16,509 1,742,210 (3,004,971]	0 1.258.460 697.013 0 (5.908.582) (3.605.836) 383.374 383.374 383.374 383.374 383.374 383.374 383.374 0 0 0 0 277.657 589.703 891.568 0 0 0 0 0 2.838.377 1.732.179 (3.070.205)

ALTERNATIVE 3

	Year of analys Escalation ra Discount rai	is 2020 te 2.00%	sk adjustments (+/-	percent): Benefits Capital costs Running costs	0% 0% 0%										HSW	Alternative Study Alternative ernative Cost Ana						
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expressed in 2020 dollars, une	scalated dollars	2020	2021	2022	2020	2024	2020	2020	2027	2020	2020	2000	2001	2002	2000	2004	2000	2000	2001	2000	2000	2040
Capital Outlays																						
	BUS + Interconnection	15,300,000																				
	Oxicat + GCS HSW Receiving Facility	3,000,000																				
	Dig 1&3 Improvements Total capital outlays	5,500,000 29,100,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	rour oup an outago	20,100,000	J. J		•		Ŭ	U	Ū					Ũ	Ŭ	Ŭ	U	•		Ŭ		,
Benefits:	D3 RINs	2,346,827	2,372,328	2,396,794	2,420,224	2,442,619	2,463,979	2,484,303	2,503,592	2,521,846	2,539,065	2,555,248	2,570,417	2,584,550	2,597,648	2,609,710	2,620,736	2,630,726	2,639,681	2,647,599	2,654,482	2,660,329
						777.599			797.011													
	LCFS Natural Gas Sale	747,102 328,475	755,220 335,503	763,010 342,531	770,469 349,559	777,599 356,587	784,399 363.615	790,870 370,643	797,011 377,671	802,823 384,699	808,305 391,727	813,457 398,755	818,280 405,787	822,780 412,818	826,950 419,850	830,790 426,881	834,301 433,913	837,482 440,944	840,333 447,975	842,854 455.007	845,046 462,038	846,908 469,070
	HSW Tipping Fee	817,600	817,600	821,250	825,484	829,718	833,952	838,186	842,420	846,654	850,888	855,122	858,480	862,860	867,094	871,036	874,978	879,212	883,446	887,680	892,060	896,440
	Total benefits	(4,240,003)	(4,280,651)	(4,323,584)	(4,365,736)	(4,406,523)	(4,445,945)	(4,484,002)	(4,520,695)	(4,556,022)	(4,589,985)	(4,622,582)	(4,652,964)	(4,683,008)	(4,711,542)	(4,738,417)	(4,763,927)	(4,788,364)	(4,811,435)	(4,833,140)	(4,853,626)	(4,872,746)
Annual Running Costs:	5	040.000	0.40.000	044,000	010 700	040.000	011 500	045 400	0.40.000	0.17.000		040.000	040.000	050.000	054 700	050.000	050 500	054 400	055.000	050.000	057 (00	050.000
	Engine O&M	240,000	240,900 0	241,800	242,700 0	243,600	244,500 0	245,400 0	246,300	247,200	248,100 0	249,000 0	249,900 0	250,800	251,700 0	252,600 0	253,500 0	254,400 0	255,300 0	256,200 0	257,100 0	258,000 0
	Biogas Upgrading/GCS O&M	265,960	268,535	271,588	274,718	277,848	280,977	284,107	287,236	290,366	293,496	296,625	299,641	302,791	305,922	309,015	312,107	315,238	318,369	321,500	324,650	327,800
	Natural Gas Purchased - Dryer	186,835	186,836	186,837	186,838	186,839	186,840	186,841	186,842	186,843	186,844	186,845	186,846	186,847	186,848	186,849	186,850	186,851	186,852	186,853	186,854	186,855
	Natural Gas Purchased - Engine	150.000	150.001	150.002	150.003	150.004	150.005	150.006	150.007	150.008	150.009	150.010	150.011	150.012	150.013	150.014	150.015	150.016	150.017	150.018	150.019	150,020
	HSW Facility O&M Dig 1 & 5 O&M	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000
	Dewatering Polymer Dewatering Power	16,439 22,872	16,439 22,872	16,512 22,974	16,597 23,093	16,682 23,211	16,767 23,330	16,853 23,448	16,938 23,567	17,023 23,685	17,108 23,804	17,193 23,922	17,261 24,016	17,349 24,139	17,434 24,257	17,513 24,367	17,592 24,478	17,677 24,596	17,763 24,714	17,848 24,833	17,936 24,955	18,024 25,078
	Class B Hauling	714,113	714,113	717,301	720,999	724,697	728,395	732,093	735,791	739,489	743,187	746,885	749,818	753,644	757,342	760,785	764,228	767,926	771,624	775,322	779,148	782,974
	Total running costs	2,196,219	2,199,696	2,207,015	2,214,948	2,222,881	2,230,815	2,238,748	2,246,681	2,254,614	2,262,548	2,270,481	2,277,493	2,285,581	2,293,516	2,301,143	2,308,770	2,316,705	2,324,639	2,332,574	2,340,662	2,348,750
Net Benefit/(cost)		27,056,215	(2,080,955)	(2,116,569)	(2,150,788)	(2,183,642)	(2,215,131)	(2,245,255)	(2,274,014)	(2,301,408)	(2,327,437)	(2,352,101)	(2,375,470)	(2,397,427)	(2,418,026)	(2,437,274)	(2,455,157)	(2,471,659)	(2,486,795)	(2,500,566)	(2,512,964)	(2,523,996)
Expressed in escalated dollars	with sensitivity adjustments																					
Capital Outlays		15 300 000	0		0	0	0	0	0	0	0	0	0	01	0	0	0	0	0	0	0	0
	BUS + Interconnection Oxicat + GCS	15,300,000 5,300,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	BUS + Interconnection Oxicat + GCS Dig 1&3 Improvements	5,300,000 5,500,000	0 0 0	0	0 0 0	0 0 0	0 0 0	0	0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Capital Outlays	BUS + Interconnection Oxicat + GCS	5,300,000	0	0	0	0	0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0	0 0 0 0	0 0 0 0	0	0	0 0 0 0	0	0	0	0	0	0 0 0 0
	BUS + Interconnection Oxicat + GCS Dig 143 Improvements Total capital outlays (Pvs)	5,300,000 5,500,000 29,100,000	0	0	0	0	0	0	0		0 0 0 0 3 034 417	0 0 0 3 114 833	-	0	0	0	0	0	0	0	0	0 0 0 0
Capital Outlays	BUS + Interconnection Oxicat + GCS Dig 183 Improvements Total capital outlays (Pvs) D3 RINs	5,300,000 5,500,000 29,100,000 2,346,827 0 0	0 0 2,419,774 0	0 0 2,493,624 0	0 0 2,568,361 0	0 0 2,643,969 0	0 0 2,720,432 0	0 0 2,797,729 0	0 0 2,875,841 0	2,954,745	3,034,417	3,114,833 0	3,195,990	0 0 3,277,835 0	0 0 3,360,335 0	0 0 3,443,457 0	3,527,166 0	0 0 3,611,423 0	0 0 3,696,190 0	0 0 3,781,424 0	0 0 3,867,079 0	0 0 0 3,953,109 0
Capital Outlays	BUS + Inconnection Oxicat + GCS Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS	5,300,000 5,500,000 29,100,000 2,346,827 0 0 747,102	0 0 2,419,774 0 770,325	0 0 2,493,624 0 793,835	0 0 2,568,361 0 817,628	0 0 2,643,969 0 841,698	0 0 2,720,432 0 866,040	0 0 2,797,729 0 890,648	0 0 2,875,841 0 915,515	2,954,745 0 940,635	3,034,417 0 965,999		-	3,277,835 0 1,043,483	0 0 3,360,335 0 1,069,748	0 0 3,443,457 0 1,096,210	0 0 3,527,166 0 1,122,859	0 0 3,611,423 0 1,149,683	0 0 3,696,190 0 1,176,669	0 0 3,781,424 0 1,203,803	0 0 3,867,079 0 1,231,072	0 1,258,460
Capital Outlays	BUS + Interconnection Oxicat + GCS Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee	5.300.000 5.500.000 29,100,000 2,346.827 0 0 0 747,102 328,475 817,600	0 0 2,419,774 0 770,325 342,213 833,952	0 0 2,493,624 0 793,835 356,369 854,429	0 0 2,568,361 0 817,628 370,955 876,010	0 0 2,643,969 0 841,698 385,981 898,113	0 0 2,720,432 0 866,040 401,460 920,750	0 0 2,797,729 0 890,648 417,404 943,934	0 0 2,875,841 0 915,515 433,826 967,676	2,954,745 0 940,635 450,737 991,990	3,034,417 0 965,999 468,150 1,016,890	3,114,833 0 991,599 486,081 1,042,389	3,195,990 0 1,017,428 504,545 1,067,412	3,277,835 0 1,043,483 523,553 1,094,345	0 0 3,360,335 0 1,069,748 543,120 1,121,679	0 0 3,443,457 0 1,096,210 563,261 1,149,314	3,527,166 0 1,122,859 583,989 1,177,605	0 0 3,611,423 0 1,149,683 605,322 1,206,970	0 0 3,696,190 0 1,176,669 627,274 1,237,038	0 0 3,781,424 0 1,203,803 649,862 1,267,826	0 3,867,079 0 1,231,072 673,103 1,299,563	0 1,258,460 697,013 1,332,063
Capital Outlays	BUS + Interconnection Oxicat + GCS Dig 18.3 improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits	5.300.000 5.500.000 29,100,000 0 0 747,102 2328,475	0 0 2,419,774 0 770,325 342,213	0 0 793,835 356,369 854,429 (4,498,257)	0 0 2,568,361 0 817,628 370,955	0 0 0 841.698 385.981 898.113 (4,769.762)	0 0 2,720,432 0 866,040 401,460	0 0 2,797,729 0 890,648 417,404	0 0 2,875,841 0 915,515 433,826	2,954,745 0 940,635 450,737	3,034,417 0 965,999 468,150	3,114,833 0 991,599 486,081	3,195,990 0 1,017,428 504,545	3,277,835 0 1,043,483 523,553	0 0 3,360,335 0 1,069,748 543,120	0 0 3,443,457 0 1,096,210 563,261	0 0 3,527,166 0 1,122,859 583,989	0 0 3,611,423 0 1,149,683 605,322	0 0 3,696,190 0 1,176,669 627,274	0 0 3,781,424 0 1,203,803 649,862	0 0 3,867,079 0 1,231,072 673,103	0 1,258,460 697,013 1,332,063 (7,240,645)
Capital Outlays Benefits:	BUS + Interconnection Oxicat + GCS Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee	5,300,000 5,500,000 29,100,000 2,346,827 0 0 747,102 328,475 817,600 (4,240,003)	0 0 2,419,774 0 770,325 342,213 833,952 (4,366,264)	0 0 793,835 356,369 854,429 (4,498,257)	0 0 2,568,361 0 817,628 370,955 876,010 (4,632,954)	0 0 2,643,969 0 841,698 385,981 898,113	0 0 2,720,432 0 866,040 401,460 920,750 (4,908,683)	0 0 0 890,648 417,404 943,934 (5,049,715)	0 0 915,515 433,826 967,676 (5,192,857)	2,954,745 0 940,635 450,737 991,990 (5,338,106)	3,034,417 0 965,999 468,150 1,016,890 (5,485,456)	3,114,833 0 991,599 486,081 1,042,389 (5,634,902)	3,195,990 0 1,017,428 504,545 1,067,412 (5,785,375)	0 0 0 1,043,483 523,553 1,094,315 (5,339,187)	0 0 0 1,069,748 543,120 1,121,679 (6,094,881)	0 0 0 1,096,210 563,261 1,149,314 (6,252,241)	0 0 3,527,166 0 1,122,859 583,989 1,177,605 (6,411,619)	0 0 3,611,423 0 1,149,683 605,322 1,206,970 (6,573,397)	0 0 3,696,190 0 1,176,669 627,274 1,237,038 (6,737,170)	0 0 3,781,424 0 1,203,803 649,862 1,267,826 (6,902,914)	0 0 3,867,079 0 1,231,072 673,103 1,299,563 (7,070,817)	0 1,258,460 697,013 1,332,063
Capital Outlays	BUS + Interconnection Oxicat + GCS Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$)	5,300,000 5,500,000 29,100,000 2,346,827 0 747,102 328,475 617,600 (4,240,003) (4,240,003)	0 2,419,774 0 770,325 342,213 833,952 (4,366,264) (4,259,770)	0 0 2,493,624 0 0 793,835 366,369 854,429 (4,48,257) (4,281,506)	0 0 0 817,628 370,955 876,010 (4,302,158)	0 0 2,643,969 0 841,698 385,991 898,113 (4,769,762) (4,321,169)	0 0 2,720,432 0 866,040 401,460 920,750 (4,308,633) (4,338,560)	0 0 2,797,729 0 890,648 417,404 943,934 (5,049,715) (4,354,353)	0 0 2,875,841 0 915,515 433,826 967,676 (5,192,857) (4,368,670)	2,954,745 0 940,635 450,737 991,990 (5,338,106) (4,381,232)	3,034,417 0 965,999 468,150 1,016,890 (5,485,456) (4,392,361)	3.114.833 0 991,599 486,081 1.042,389 (5,634,902) (4,401,976)	3,195,990 0 1,017,428 504,545 1,067,412 (5,785,375) (4,409,294)	0 0 3.277,835 0 0 1.043,483 5.23,553 1.094,315 (5,939,187) (4,416,117)	0 0 3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351)	0 0 3,443,457 0 1,096,210 563,261 1,149,314 (6,252,241) (4,424,881)	0 0 1,122,859 583,989 1,177,805 (6,411,619) (4,427,002)	0 3.611.423 0 1.149.683 605.322 1.206.970 (6.573.397) (4.428,004)	0 3,696,190 0 1,176,669 627,274 1,237,038 (6,737,170) (4,427,635)	0 0 3,761.424 0 1.203.803 649.862 1.267.826 (6,902,914) (4,425,913)	0 3.867.079 0 1.231.072 673.103 1.299.563 (4.422,992)	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755)
Capital Outlays Benefits:	BUS + Interconnection Oxicat + GCS Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M	5,300,000 5,500,000 29,100,000 0 0 0 747,102 328,475 817,600 (4,240,003) (4,240,003) (4,240,003) 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,419,774 0 770,325 342,213 833,952 (4,366,264) (4,259,770) 245,718 0 0	0 0 2,493,624 0 793,835 366,369 8654,229 (4,498,257) (4,281,506) 251,569 0 0	0 0 0 817,628 370,955 876,010 (4,502,954) (4,302,158) 257,555 0	0 0 2,643,969 0 0 441,698 385,981 898,113 (4,769,762) (4,321,169) 263,680 0	0 0 2,720,432 0 866,040 401,460 920,750 (4,398,633) (4,338,560) 269,948 0	0 0 2,797,729 0 890,648 417,404 943,934 (5,049,716) (4,354,353) 276,360 0 0	0 0 2,875,841 0 915,515 433,826 967,676 (5,192,867) (4,368,570) 282,921 0	2,954,745 0 940,635 450,737 991,990 (4,381,06) (4,381,232) 289,634 0	3,034,417 0 965,999 468,150 1,016,890 (5,485,456) (4,392,361) 296,502 0	3.114.833 0 991.599 486.081 1.042.389 (5.53.4902) (4.401.976) 303.530 0	3,195,990 0 1,017,428 504,545 1,067,412 (5,785,375) (4,409,294) 310,719	0 0 3.277,835 0 1,043,483 5.23,553 1,094,315 (5,939,187) (4,416,117) (4,416,117) 0	0 0 3,360,335 0,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 0	0 0 3,443,457 0 1,096,210 563,261 1,149,314 (6,252,241) (4,424,881) 333,300 0	0 3.527,166 0 1.122,859 563,989 1.177,605 (6,411,619) (4,427,002) 341,178 0	0 3.611,423 0 1.149,683 605,322 1.206,970 (6,573,397) (4,428,004) 349,237 0	0 3,696,190 0,1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) 357,482 0	0 3.781.424 0 1.203.803 649.862 1.275.826 (6,902,914) (4,425,913) 365.917 0	0 3.867.079 0 1.231.072 673.103 1.299.563 (4.422.992) 374.546 0	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755) 383,374 0
Capital Outlays Benefits:	BUS + Interconnection Oxicat + GCS Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$)	5.300.000 5.500.000 29,100,000 29,100,000 0 0 747,102 328.475 817.600 (4,240,003) (4,240,003) (4,240,003) 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,419,774 0 770,325 342,213 833,9524 (4,356,524 (4,259,770) 245,718 0 273,906 0 0 0 0 0 0 0 0 0	0 0 2,493,624 0 793,835 366,369 864,429 (4,489,257) (4,281,566) 0 282,561 0 0 0 0 0	0 0 2.568,361 0 817,628 370,955 876,010 (4.532,954) (4.302,159) 257,555 0 291,533 0 0	0 2,643,969 0 841,698 385,091 385,091 (4,769,762) (4,321,169) 263,680 0 300,751 0	0 2,720,432 0 866,040 401,460 920,750 (4,908,683) (4,338,550) 269,948 0 310,221 0	0 0 2.797.729 0 890.648 417.404 943.3934 (5.049,715) (4.354,353) 276.360 0 319.950 0 0	0 2.875,841 915,515 433,826 967,676 (5,192,857) (4,368,570) 282,921 0 329,944 0 0	2,954,745 0 940,635 450,737 991,990 (5,338,106) (4,381,232) 289,634 0 340,210 0	3.034,417 0 965,999 468,150 1,016,890 (5,485,456) (4,392,361) 296,502 0 350,754 0 0	3,114,833 0 991,599 466,081 1,042,389 (6,634,902) (4,401,976) 303,530 0 361,584 0 0	3,195,990 0 1,017,428 504,545 1,067,412 (5,785,376) (4,409,294) 310,719 0 372,566 0	0 0 3.277,835 0 1.043,483 523,553 1.064,315 (5,939,187) (4,416,117) 318,075 0 384,012 0 0	0 3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 0 395,743 0	0 0 0 1,098,210 563,261 1,149,314 (6,252,241) (4,424,881) 333,300 0 0 0 0 0 0	0 3.527,166 0 1.122,859 563,989 1.177,605 (6.411,619) (4.427,002) 341,178 0 420,055 0 0	0 3.611.423 0 1.149.683 605.322 1.206.970 (6.573.397) (4.428.04) 349.237 0 432.754 0	0 0 3,696,190 0 1,176,660 627,274 1,237,038 (6,737,710) (4,427,635) 357,482 0 445,733 0 0	0 0 3.761,424 0 1.203,803 649,862 1.267,826 (6,902,914) (4,425,913) 365,917 0 459,181 0	0 3.867.079 1.231.072 673.103 1.299.563 (7.070.817) (4.422,992) 374.546 0 472.953 0	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755) 383,374 0 487,093 0
Capital Outlays Benefits:	BUS + Interconnection Oxical + GCS Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M Biogas Upgrading/GCS O&M Natural Gas Purchased - Dryer	5,300,000 5,500,000 29,100,000 0 0 0 747,102 328,475 817,600 (4,240,003) (4,240,003) (4,240,003) 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,419,774 0 770,325 342,213 833,952 (4,366,264) (4,259,770) 245,718 0 0	0 0 2,493,624 0 793,835 366,369 864,429 (4,489,257) (4,281,566) 0 282,561 0 0 0 0 0	0 0 0 817,628 370,955 876,010 (4,502,954) (4,302,158) 257,555 0	0 0 2,643,969 0 0 441,698 385,981 898,113 (4,769,762) (4,321,169) 263,680 0	0 0 2,720,432 0 866,040 401,460 920,750 (4,398,633) (4,338,560) 269,948 0	0 0 2,797,729 0 890,648 417,404 943,934 (5,049,715) (4,354,353) 276,360 0 0	0 0 2,875,841 0 915,515 433,826 967,676 (5,192,867) (4,368,570) 282,921 0	2,954,745 0 940,635 450,737 991,990 (4,381,06) (4,381,232) 289,634 0	3,034,417 0 965,999 468,150 1,016,890 (5,485,456) (4,392,361) 296,502 0	3.114.833 0 991.599 486.081 1.042.389 (5.534.902) (4.401.976) 303.530 0	3,195,990 0 1,017,428 504,545 1,067,412 (5,785,375) (4,409,294) 310,719	0 0 3.277,835 0 1,043,483 5.23,553 1,094,315 (5,939,187) (4,416,117) (4,416,117) 0	0 0 3,360,335 0,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 0	0 0 3,443,457 0 1,096,210 563,261 1,149,314 (6,252,241) (4,424,881) 333,300 0	0 3.527,166 0 1.122,859 563,989 1.177,605 (6,411,619) (4,427,002) 341,178 0	0 3.611,423 0 1.149,683 605,322 1.206,970 (6,573,397) (4,428,004) 349,237 0	0 3,696,190 0,1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) 357,482 0	0 3.781.424 0 1.203.803 649.862 1.275.826 (6,902,914) (4,425,913) 365.917 0	0 3.867.079 0 1.231.072 673.103 1.299.563 (4.422.992) 374.546 0	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755) 383,374 0
Capital Outlays Benefits:	BUS + Interconnection Oxical + GCS Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M Biogas Upgrading/GCS O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine	5.300.000 5.500.000 29,100,000 29,100,000 0 0 747,102 328,475 617,600 (4,240,003) 0 265,960 0 0 265,960 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,493,524 0 793,835 356,369 854,429 (4,498,257) (4,281,506) 251,569 0 282,561 0 194,385 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2.643.969 0 841.98 385.981 385.981 385.981 (4,769,762) (4,321,169) 263.680 0 0 300,751 0 202.241 0	0 2,720,432 0 886,040 401,460 920,750 (4,308,683) (4,338,560) 266,948 0 310,221 0 206,287 0	0 2,797,729 0 800,648 417,404 943,934 (5,049,715) (4,354,353) 276,360 0 319,950 0 210,413 0	0 0 2,875,841 0 915,515 433,826 967,676 (5,192,857) (4,368,670) 282,921 0 0 329,944 0 214,623 0 0	2.954,745 0 940,635 450,737 991,980 (5,338,106) (4,381,232) 289,634 0 340,210 0 218,917 0	3.034.417 0 965.999 468.150 1.016.800 (6,485,456) (4,392,361) 296.502 0 350.754 0 223.296 0 0 0 0 0 0 0 0 0 0 0 0 0	3.114.833 0 961.599 486.081 1.042.389 (6.543.4902) (4.401.976) 303.530 0 303.530 0 361.584 0 227.763 0	3,195,990 0 1,017,428 504,545 1,067,412 (5,785,375) (4,409,294) 310,719 0 372,566 0 232,320 0	0 0 3.277,835 0 1.043,483 523,553 1.094,315 (5,939,187) (4,416,117) 318,075 0 0 384,012 0 236,967 0	0 0 3.360,335 0 1.069,748 543,120 (6,094,881) (4,421,351) 325,601 0 325,601 0 325,743 0 0 241,708 0	0 0 0 3,443,457 0 1,096,210 563,261 1,149,314 (4,424,881) 333,300 0 407,738 0 407,738 0 246,543 0 0	0 3.527.166 0 1.122.859 583.989 1.177.605 (6.411.619) (4.427,002) 341.178 0 420.055 0 0 251.476 0	0 3,611,423 0 1,149,683 605,322 1,206,970 (6,573,397) (4,428,004) 349,237 0 432,754 0 256,507 0	0 0 0 1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) (4,427,635) 0 445,793 0 261,633 0 0	0 3,781,424 0 1,203,803 649,862 (6,902,914) (4,425,913) 365,917 0 459,181 0 266,872 0	0 3,867,079 0 1,221,072 673,103 1,299,563 (7,070,817) (4,422,992) 374,546 0 4422,553 0 272,211 0 0	0 1.258.460 697.013 1.332.063 (7,240.645) (4,418,755) 383.374 0 487.093 0 0 277.657 0
Capital Outlays Benefits:	BUS + Interconnection Oxicat + GCS Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M Biogas Upgrading/GCS O&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M	5.300.000 5.500.000 9.5500.000 29,100,000 29,100,000 29,100,000 0 747,102 328,475 817,600 (4,240,003) (4,240,003) 0 265,960 0 265,960 0 186,836 0 0	0 0 2,419,774 0 770,325 342,213 833,952 (4,366,264) (4,259,770) 245,718 0 273,906 0 190,573 0 190,573 0 0 612,000 612,000	0 2,493,624 0 793,835 366,369 854,429 (4,498,257) (4,281,506] 251,569 0 282,561 0 194,385 0 0 0 624,240	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2.643,969 0 841,656 365,961 365,861 (4,769,762) (4,321,169) 263,680 0 300,751 0 202,241 0 0 649,459	0 2,720,432 866,040 401,460 920,750 (4,308,683) (4,338,560) 266,948 0 310,221 0 206,287 0 0 0 0 0 0	0 0 2,797,729 0 800,648 417,404 943,934 (5,049,715) (4,354,353) 276,360 0 319,950 0 210,413 0 675,697	0 2.875,841 915,515 433,826 967,676 (6,192,867) (4,366,570) 282,521 0 329,944 0 214,623 0 0 0 0 0 0 0 0 0 0 0 0 0	2,954,745 0 940,635 460,737 991,990 (5,338,106) (4,381,232) 289,534 0 340,210 0 218,917 0 702,996	3,034,417 0 965,989 468,150 1,016,880 (4,485,456) (4,352,361) 296,502 0 350,754 0 222,296 0 222,296 0 222,296 0 717,056	3,114,833 0 991,590 466,061 1,042,380 (6,634,902) (4,401,976) 303,530 0 301,584 0 227,763 0 731,397	3.195.990 0 1.017.428 504.545 1.067.412 (5.785.375) (4.409.294) 310.719 0 372.566 0 232.320 0 746.025	0 0 0 3.277.835 0 1.043.483 623.553 1.004.315 (5.939.187) (4.416,117) 318.075 0 384.012 0 236.967 0 760.945	0 0 3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 0 395,743 0 241,706 0 241,706 0 776,164	0 0 0 3.443.457 0 1.096.210 563.261 1.140.314 (6.252.241) (4.424.881) 333.300 0 0 407.738 0 246.543 0 791.687	3,527,166 0 1,122,859 583,989 1,177,805 (6,411,619) (4,427,002) 341,178 0 420,055 0 251,476 0 0 251,476 0 0	0 3.611.423 0 1.149.63 605.322 1.206.970 (6,573,397) (4,426,004) 349.237 0 432.754 0 256.507 0 256.507 0 823.671	0 3,696,190 0 1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) 357,482 0 357,482 0 445,793 261,638 0 0 261,638 0 0 0 0 0 0 0 0 0 0 0 0 0	0 3,781,424 0 1,203,803 649,862 1,267,826 (6,902,914) (4,425,913) 3865,917 0 459,181 0 266,872 0 0 8565,948	0 3.867.079 0 1.231.072 673.103 1.299.563 (7,070.817) (4,422.992) 374.546 0 472.953 0 272.211 0 0 874.087	0 1.258.460 697.013 1,332,063 (7,240,645) (4,418,755) 383,374 0 487,093 0 277,657 0 891,568
Capital Outlays Benefits:	BUS + Interconnection Oxicat + GCS Dig 13.3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M Biogas Upgrading/GCS O&M Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer	5.300,000 5.500,000 9.5500,000 29,100,000 29,100,000 29,100,000 0 747,102 328,475 617,600 (4,240,003) (4,240,003) 0 265,960 0 0 186,635 0 0 600,000 164,393 22,872	0 0 2,419,774 0 770,325 342,213 833,952 (4,356,264) (4,259,770) 245,718 0 0 733,906 0 0 190,573 0 0 612,000 612,000 16,767 23,330	0 2,493,624 0 793,835 366,389 864,429 (4,488,257) (4,281,506) 251,569 0 282,561 0 194,385 0 0 624,240 17,179 23,903	0 0 2,568,361 0 817,628 370,955 876,010 (4,502,158) (4,302,158) 257,555 0 257,555 0 257,555 0 198,274 0 0 198,274 0 0 636,725 17,613 24,506	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,720,432 0 886,040 401,460 920,750 (4,308,683) (4,338,560) 289,948 0 310,221 0 206,287 0 0 662,448 18,513 25,758	0 0 2,797,729 0 800,648 417,404 943,934 (5,049,715) (4,354,353) 276,360 0 319,950 0 210,413 0 675,697 18,979 28,407	0 0 2,875,841 0 915,515 433,826 967,676 (5,192,857) (4,368,570) 282,921 0 329,944 0 0 214,623 0 0 689,211 19,456 27,071	2,964,745 0 940,635 450,737 991,990 (5,338,106) (4,381,232) 289,634 0 340,210 0 218,917 0 702,996 19,945 27,751	3,034,417 0 965,999 468,150 (1,016,800 (5,485,466) (4,392,361) 296,502 0 350,754 0 223,296 0 717,056 20,445 28,447	3,114,833 0 991,599 486,081 1,042,389 (6,634,902) (4,401,976) 303,530 0 303,530 0 361,584 0 227,763 0 731,397 20,958 29,161	3.195.990 0 1.017.428 504.545 1.067.412 (5.785.375) (4.409.294) 310.719 0 372.566 0 232.320 0 746.025 21.461 29.861	0 0 0 3.277,835 0 1.043,483 523,553 1.094,315 (5,939,187) (4.416,117) 318,075 0 348,012 0 0 236,967 0 0 760,945 22,002 30,013	0 0 3,360,335 0 1,069,748 543,120 (6,994,881) (4,421,351) 4(4,421,351) 325,601 0 395,743 0 0 241,708 0 776,164 22,653 31,379	0 0 0 3,443,457 0 1,096,210 563,261 1,149,314 (6,252,241) (4,424,881) 333,300 0 0 407,738 0 0 246,543 0 791,687 23,108 23,152	0 3,527,166 0 1,122,859 563,989 1,177,605 (6,411,619) (4,427,002) 4,427,002 (4,427,002) 0 251,476 0 0 251,476 0 0 251,476 0 0 251,476 0 0 251,476 0 0 25,977 22,944	0 3,611,423 0 1,149,633 605,322 1,206,970 (6,573,397) (4,428,004) 349,237 0 432,754 0 256,507 0 0 823,671 24,267 33,765	0 0 0 1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) 357,482 0 357,482 0 357,482 0 357,482 0 357,482 0 357,482 0 357,482 0 357,482 0 357,482 0 34,47,659 0 34,606 840,145 24,872 34,606	0 3,781,424 0 1,203,803 649,862 1,267,826 (6,902,914) (4,425,913) (4,425,913) 385,917 0 455,917 0 266,872 0 266,872 0 266,948 25,491 35,667	0 3.867.079 0 1.231.072 673.103 1.299.563 (7.070.817) (4,422.992) 374.546 0 472.953 0 272.211 0 272.211 0 0 874.087 28.129 36.355	0 1.258.460 697.013 1.332.063 (7,240,645) (4,418,755) 383,374 0 487,093 0 277,657 0 0 891,568 26,783 37,264
Capital Outlays Benefits:	BUS + Interconnection Oxical + GCS Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M Biogas Upgrading/GCS 0&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Devatering Polymer	5.300.000 5.500.000 29,100.000 29,100.000 0 1747.102 328.475 617.600 (4,240.003) (4,240.003) 0 265.960 0	0 0 2,419,774 0 0 770,325 342,213 833,952 (4,366,264) (4,259,770) 245,716 0 0 273,906 0 0 190,573 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,493,624 0 793,835 366,389 864,429 (4,488,257) (4,281,506) 251,569 0 282,561 0 194,385 0 0 624,240 17,179 23,903	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,720,432 0 866,040 401,460 920,750 (4,308,683) (4,338,560) 269,948 0 310,221 0 206,287 0 662,448 18,513	0 2.797.729 0 880.648 417.404 943.3934 (6.049.715) (4.354.353) 276.360 0 319.950 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 9 (15,515 433,826 9 (7,676 (5,192,857) (4,368,570) 2 (2,921 2 (2,921 0 0 2 (4,623 0 0 2 (4,623 0 0 2 (4,623 0 0 0 2 (4,623 0 0 0 1 (4,66) 0	2,954,745 0 940,635 450,737 991,980 (6,338,106) (4,381,232) 289,634 0 340,210 0 248,917 0 702,996 19,945	3.034.417 0 965.999 468.150 (4.392,361) 296.502 0 350.754 0 223.266 0 223.266 0 717.056 20.446	3,114,833 0 991,599 466,081 1,042,389 (5,534,902) (4,401,976) 303,530 0 301,584 0 0 227,763 0 731,397 20,958	3.195.990 0 1.017.428 504.545 1.067.412 (5,785.375) (4,409.294) 310,719 0 372.566 0 232.200 0 746.025 21.461	0 0 0 3.277.835 0 1.443.483 523.553 1.094.315 (5.339,187) (4.416,117) 318.075 0 384.012 0 2.28.667 0 760.945 2.2.002	3,360,335 0 1,069,748 543,120 (6,094,881) (4,421,351) 325,601 325,601 0 395,743 0 241,708 0 0 70,164 775,164	0 0 0 3.443.457 0 1.096.210 563.261 1.149.314 (6.252.241) (4.424.881) 333.300 0 407.738 0 246.543 0 791.687 791.687 723.108	0 3.527,166 0 1,122,859 583,989 1,177,805 (6,441,619) (4,427,002) 341,178 0 420,055 0 251,476 0 0 251,476 0 0 251,476	0 0 3.611,423 0 1,149,683 605,322 1,206,970 (6,573,397) (4,428,094) 349,237 0 432,754 0 2432,754 0 0 265,607 0 823,671 24,267	0 3,696,190 0 1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) 0 445,793 0 0 445,793 0 0 261,638 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1,203,803 649,862 1,207,826 (6,902,914) (4,425,913) 365,917 0 459,181 0 0 266,872 0 856,948 25,491	0 3.867.079 0 1.231.072 673.103 1.299.653 (7.070.817) (4.422.992) 374.546 0 472.953 0 272.211 0 74.087 28.129	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755) 383,374 0 383,374 0 383,374 0 0 277,657 0 0 277,657 0 891,568 891,568
Capital Outlays Benefits:	BUS + Interconnection Oxical + GCS Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M Biogas Upgrading/GCS 0&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	5.300.000 5.500.000 29,100,000 29,100,000 29,100,000 29,100,000 0 747,102 328,475 817,600 (4,240,003) (4,240,003) (4,240,003) 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,493,624 0 793,835 366,369 854,429 (4,498,257) (4,281,506) 2251,569 2251,569 0 0 282,561 0 0 194,385 0 624,240 17,179 23,903 746,280 746,280 2,140,116	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2.643,969 0 0 844,598 385,981 385,981 385,981 385,981 (4,769,762) (4,321,169) 263,680 0 0 202,241 0 649,459 18,058 25,125 784,435 2243,749	0 2,720,432 0 866,040 401,460 920,750 (4,308,683) (4,338,560) 269,948 0 310,221 0 206,287 0 206,287 0 662,448 18,513 25,758 804,207 2,297,382	0 2.797.729 0 8890.648 417.404 943.394 (5.049,715) (4.354,353) 276.360 276.360 0 319.950 0 210.413 0 675.697 18.979 26.407 824.456 2,352.262	0 0 2.875,841 0 915,515 433,826 967,676 (5,192,887) (4,368,570) 282,921 282,921 0 329,944 0 214,623 0 689,211 19,456 27,071 845,193 2408,419	2,954,745 0 940,635 450,737 991,980 (5,338,106) (4,381,232) 289,634 0 340,210 0 218,917 0 702,996 19,945 27,751 866,429 2,465,882	3.034,417 0 965,999 468,160 1.016,890 (6,485,456) (4,392,361) 206,502 0 0 350,754 0 0 223,296 0 0 717,056 20,446 28,447 88,178 88,178	3,114,833 0 991,599 466,081 1,042,389 (6,534,902) (4,401,976) 303,530 0 304,584 301,584 0 0 227,763 0 731,397 20,958 22,161 910,449 910,449 2,584,842	3.195,990 0 1.017,428 504,545 1.067,412 (5,785,375) (4,409,294) 310,719 310,719 0 372,566 0 232,320 0 746,025 21,461 29,861 932,305 2,464,257	0 0 0 3.277,835 0 1.043,483 523,553 1.094,315 (5,939,187) (4,416,117) 318,075 0 384,012 384,012 0 236,967 0 760,945 22,002 30,613 955,803 2768,418	3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 325,601 325,601 0 0 241,708 0 776,164 22,553 31,379 979,703 2,772,856	0 0 0 3.443.457 0 1.096.210 563.261 1.149.314 (6.252.241) (4.424.881) 333.300 0 0 407.738 0 0 246.543 0 791.667 791.667 791.687 2.108.840 2.838,369	0 0 3.527,166 0 1,122,859 583,989 1,177,605 (6,411,619) (4,427,902) 341,178 0 420,055 0 0 251,476 0 807,521 23,677 32,944 1,022,550 2,905,400	0 3.611,423 0 1.149,683 605,322 1.206,970 (6,573,397) (4,428,004) 349,237 (4,428,004) 349,237 0 0 256,507 0 256,507 0 823,671 24,267 33,765 1.054,199 2,974,399	0 0 0 0 0 0 0 0 1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) 0 0 445,783 0 0 261,638 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 261,638 0 0 261,638 0 0 261,638 0 0 261,638 0 0 261,638 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 0 261,638 0 0 0 0 261,638 0 0 0 0 0 0 261,638 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 3.781.424 0 1.203.803 649.862 1.267.826 (6,902.914) (4.425,913) 365.917 0 266.872 0 266.872 0 856.948 25.491 35.467 1.107.351 1.17.227	0 3.867.079 1.231.072 673.103 1.299.653 (7.070.817) (4.422.992) 374.546 0 472.953 0 0 272.211 0 874.087 26.129 36.355 1.135.071	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755) 383,374 0 487,093 0 277,657 0 277,657 0 891,568 26,783 37,264 1,163,457 3,267,197
Capital Outlays Benefits: Annual Running Costs:	BUG + Interconnection Oxicat + GCS Dig 13.3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M Biogas Upgrading/GCS O&M Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	5.300.000 5.500.000 29,100.000 29,100.000 0 0 24,246,827 0 747.102 817.600 (4,240,003) 0 0 0 0 0 0 0 0 0 0 0 0 0	2,419,774 0 770,325 342,213 833,952 (4,365,264) (4,259,770) 245,718 0 273,906 190,573 0 0 612,000 16,767 2,23,300 728,395 2,099,689 2,099,689 2,099,689 0	0 0 2.493.624 0 793.835 366.369 865.429 (4.498.257) (4.281.506) 215.699 0 2282.561 0 0 2282.561 0 0 624.240 17,179 23.903 746.280 2,140,116 2,036,993	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2.643,969 0 0 844,698 385,991 385,991 385,991 (4,769,762) (4,321,169) 263,880 0 203,241 0 0 202,241 0 649,459 18,058 25,125 784,435 784,435 2,243,749 2,032,726	0 2,720,432 0 866,040 401,460 920,750 (4,308,683) (4,338,560) 2269,948 0 310,221 0 0 206,287 0 662,448 18,513 25,758 804,207 2,227,382 2,030,551	0 2.797.729 0 880.648 417.404 943.394 (5.049.715) (4.354.353) 276.360 0 319.950 0 210.413 0 675.697 18.979 26.407 824.456 2.352.262 2.028.349	0 0 2.875,841 0 915,515 433,826 967,676 (5,192,887) (4,388,570) 282,921 0 282,921 0 244,623 0 244,623 0 689,211 19,456 27,071 19,456 27,071 19,456 27,071 19,456 27,071 19,456 27,071 24,08,419 2,026,120	2,954,745 0 940,635 450,737 961,980 (5,338,106) (4,381,232) 289,634 0 289,634 0 248,917 0 702,996 19,945 27,751 866,429 2,465,882 2,465,882 2,023,864	3,034,417 0 965,999 468,160 1,016,890 (6,485,456) (4,392,361) 296,502 0 0 0 223,296 0 0 223,296 0 0 717,056 717,056 20,446 28,447 888,178 888,178	3,114,833 0 991,599 466,081 1,042,389 (6,534,902) (4,401,976) 303,530 0 301,584 301,584 0 0 731,397 20,965 22,161 910,449 910,449 2,584,842 2,019,274	3.195,990 0 1.017,428 504,545 1.067,412 (5,785,375) (4,409,294) 310,719 0 372,566 0 0 232,320 0 746,025 21,461 29,861 932,305 2,645,257 2,016,069	0 0 0 3.277,835 0 0 1.043,483 523,553 1.094,315 (5,339,187) (4,416,117) 318,075 0 384,012 384,012 0 0 760,945 226,967 0 760,945 22,002 30,613 955,803 2,708,418 2,013,860	3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 325,601 335,743 0 0 241,708 0 776,164 2,2,553 31,379 379,703 2,772,850 2,011,482	0 0 0 3.443.457 0 1.096.210 563.261 1.149.314 (6.252.241) (4.424.881) 333.300 0 407.738 0 0 246.543 0 791.687 791.687 791.687 791.687 23.106 32.152 2.008.791	0 0 3.527.166 0 1.122.859 583.989 1.177.605 (6.411.619) (4.427.002) 341.178 0 420.055 420.055 0 0 807.521 23.677 32.944 1.022.550 2.905.400 2.006.079	0 0 3.611,423 0 1.149,683 605,322 1.206,970 (6,573,397) (4,428,004) 349,237 0 432,754 432,754 432,754 0 256,507 0 823,671 24,267 33,765 1.054,198 2,974,399 2,003,630	0 0 0 0 0 0 0 0 1,176,69 627,274 1,237,038 (6,737,170) (4,427,635) 0 445,733 0 0 261,638 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 0 261,638 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 3.781.424 0 1.203.803 649.862 1.267.825 (6,902,914) (4,425,913) 365.917 0 459.181 459.181 0 0 266,872 0 856.947 0 266,872 0 856.949 25,491 35,467 1,107.351 3,117.227 1,998,660	0 3,867,079 1,231,072 673,103 1,299,663 (7,070,817) (4,422,992) 374,546 0 472,953 0 0 272,211 0 874,087 2,61,129 3,6355 1,135,071 3,191,353 1,995,280	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755) 383,374 0 487,093 0 0,277,657 0 3891,568 26,783 37,264 1,163,457 1,163,457
Capital Outlays Benefits:	BUS + Interconnection Oxical + GCS Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M Biogas Upgrading/GCS 0&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	5.300.000 5.500.000 29,100,000 29,100,000 29,100,000 29,100,000 0 747,102 328,475 817,600 (4,240,003) (4,240,003) (4,240,003) 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2.493.624 0 793.835 366.369 865.429 (4.498.257) (4.281.506) 215.699 0 2282.561 0 0 2282.561 0 0 624.240 17,179 23.903 746.280 2,140,116 2,036,993	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2.643,969 0 0 844,598 385,981 385,981 385,981 385,981 (4,769,762) (4,321,169) 263,680 0 0 202,241 0 649,459 18,058 25,125 784,435 2243,749	0 2,720,432 0 866,040 401,460 920,750 (4,308,683) (4,338,560) 269,948 0 310,221 0 206,287 0 206,287 0 662,448 18,513 25,758 804,207 2,297,382	0 2.797.729 0 8890.648 417.404 943.394 (5.049,715) (4.354,353) 276.360 276.360 0 319.950 0 210.413 0 675.697 18.979 26.407 824.456 2,352.262	0 0 2.875,841 0 915,515 433,826 967,676 (5,192,887) (4,368,570) 282,921 282,921 0 329,944 0 214,623 0 689,211 19,456 27,071 845,193 2408,419	2,954,745 0 940,635 450,737 991,980 (5,338,106) (4,381,232) 289,634 0 340,210 0 218,917 0 702,996 19,945 27,751 866,429 2,465,882	3.034,417 0 965,999 468,160 1.016,890 (6,485,456) (4,392,361) 206,502 0 0 350,754 0 0 223,296 0 0 717,056 20,446 28,447 88,178 88,178	3,114,833 0 991,599 466,081 1,042,389 (6,534,902) (4,401,976) 303,530 0 304,584 301,584 0 0 227,763 0 731,397 20,958 22,161 910,449 910,449 2,584,842	3.195,990 0 1.017,428 504,545 1.067,412 (5,785,375) (4,409,294) 310,719 310,719 0 372,566 0 232,320 0 746,025 21,461 29,861 932,305 2,464,257	0 0 0 3.277,835 0 1.043,483 523,553 1.094,315 (5,939,187) (4,416,117) 318,075 0 384,012 384,012 0 236,967 0 760,945 22,002 30,613 955,803 2768,418	3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 325,601 325,601 0 0 241,708 0 776,164 22,553 31,379 979,703 2,772,856	0 0 0 3.443.457 0 1.096.210 563.261 1.149.314 (6.252.241) (4.424.881) 333.300 0 0 407.738 0 0 246.543 0 791.667 791.667 791.687 2.108.840 2.838,369	0 0 3.527.166 0 1.122.859 583.989 1.177.605 (6.411.619) (4.427.002) 341.178 0 420.055 420.055 0 0 807.521 23.677 32.944 1.022.550 2.905.400 2.006.079	0 3.611,423 0 1.149,683 605,322 1.206,970 (6,573,397) (4,428,004) 349,237 (4,428,004) 349,237 0 0 256,507 0 256,507 0 823,671 24,267 33,765 1.054,199 2,974,399	0 0 0 0 0 0 0 0 1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) 0 0 445,783 0 0 261,638 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 261,638 0 0 261,638 0 0 261,638 0 0 261,638 0 0 261,638 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 0 261,638 0 0 0 0 261,638 0 0 0 0 0 0 261,638 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 3.781.424 0 1.203.803 649.862 1.267.826 (6,902.914) (4.425,913) 365.917 0 266.872 0 266.872 0 856.948 25.491 35.467 1.107.351 1.17.227	0 3.867.079 1.231.072 673.103 1.299.653 (7.070.817) (4.422.992) 374.546 0 472.953 0 0 272.211 0 874.087 26.129 36.355 1.135.071	0 1.258.460 697.013 1.332.063 (7.240.645) (4.418.755) (4.418.755) (4.418.755) 0 487.093 0 277.657 0 277.657 0 277.657 0 2891.568 26.783 37.264 1.163.457 3.267.197
Capital Outlays Benefits: Annual Running Costs:	BUS + Interconnection Oxical + GCS Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M Biogas Upgrading/GCS 0&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	5.300.000 5.500.000 29,100.000 29,100.000 0 0 24,246,827 0 747.102 817.600 (4,240,003) 0 0 0 0 0 0 0 0 0 0 0 0 0	2,419,774 0 770,325 342,213 833,952 (4,365,264) (4,259,770) 245,718 0 273,906 190,573 0 0 612,000 16,767 2,23,300 728,395 2,099,689 2,099,689 2,099,689 0	0 0 2.493.624 0 793.835 366.369 865.429 (4.498.257) (4.281.506) 215.699 0 2282.561 0 0 2282.561 0 0 624.240 17,179 23.903 746.280 2,140,116 2,036,993	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2.643,969 0 0 844,698 385,991 385,991 385,991 (4,769,762) (4,321,169) 263,880 0 203,241 0 0 202,241 0 649,459 18,058 25,125 784,435 784,435 2,243,749 2,032,726	0 2,720,432 0 866,040 401,460 920,750 (4,308,683) (4,338,560) 2269,948 0 310,221 0 0 206,287 0 662,448 18,513 25,758 804,207 2,227,382 2,030,551	0 2.797.729 0 880.648 417.404 943.394 (5.049.715) (4.354.353) 276.360 0 319.950 0 210.413 0 675.697 18.979 26.407 824.456 2.352.262 2.028.349	0 0 2.875,841 0 915,515 433,826 967,676 (5,192,887) (4,388,570) 282,921 0 282,921 0 244,623 0 244,623 0 689,211 19,456 27,071 19,456 27,071 19,456 27,071 19,456 27,071 19,456 27,071 24,08,419 2,026,120	2,954,745 0 940,635 450,737 961,980 (5,338,106) (4,381,232) 289,634 0 289,634 0 248,917 0 702,996 19,945 27,751 866,429 2,465,882 2,023,864	3,034,417 0 965,999 468,160 1,016,890 (6,485,456) (4,392,361) 296,502 0 0 0 223,296 0 0 223,296 0 0 717,056 717,056 20,446 28,447 888,178 888,178	3,114,833 0 991,599 466,081 1,042,389 (6,534,902) (4,401,976) 303,530 0 301,584 301,584 0 0 731,397 20,965 22,161 910,449 910,449 2,584,842 2,019,274	3.195,990 0 1.017,428 504,545 1.067,412 (5,785,375) (4,409,294) 310,719 0 372,566 0 0 232,320 0 746,025 21,461 29,861 932,305 2,645,257 2,016,069	0 0 0 3.277,835 0 0 1.043,483 523,553 1.094,315 (5,339,187) (4,416,117) 318,075 0 384,012 384,012 0 0 760,945 226,967 0 760,945 22,002 30,613 955,803 2,708,418 2,013,860	3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 325,601 335,743 0 0 241,708 0 776,164 2,2,553 31,379 379,703 2,772,850 2,011,482	0 0 0 3.443.457 0 1.096.210 563.261 1.149.314 (6.252.241) (4.424.881) 333.300 0 407.738 0 0 246.543 0 791.687 791.687 791.687 791.687 23.106 32.152 2.008.791	0 0 3.527.166 0 1.122.859 583.989 1.177.605 (6.411.619) (4.427.002) 341.178 0 420.055 420.055 0 0 807.521 23.677 32.944 1.022.550 2.905.400 2.006.079	0 0 3.611,423 0 1.149,683 605,322 1.206,970 (6,573,397) (4,428,004) 349,237 0 432,754 432,754 432,754 0 256,507 0 823,671 24,267 33,765 1.054,198 2,974,399 2,003,630	0 0 0 0 0 0 0 0 1,176,69 627,274 1,237,038 (6,737,170) (4,427,635) 0 445,733 0 0 261,638 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 0 261,638 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 3.781.424 0 1.203.803 649.862 1.267.825 (6,902,914) (4,425,913) 365.917 0 459.181 459.181 0 0 266,872 0 856.947 0 266,872 0 856.947 1.35.467 1.107.351 3.117.227 1.998,660	0 3,867,079 1,231,072 673,103 1,299,663 (7,070,817) (4,422,992) 374,546 0 472,953 0 0 272,211 0 874,087 2,61,129 3,6355 1,135,071 3,191,353 1,995,280	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755) 383,374 0 487,093 0 0,277,657 0 3891,568 26,783 37,264 1,163,457 1,163,457
Capital Outlays Benefits: Annual Running Costs: Net escalated benefit/(cost)	BUS + Interconnection Oxical + GCS Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M Biogas Upgrading/GCS 0&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	5.300.000 5.500.000 29,100.000 29,100.000 0 0 24,246,827 0 747.102 817.600 (4,240,003) 0 0 0 0 0 0 0 0 0 0 0 0 0	2,419,774 0 770,325 342,213 833,952 (4,365,264) (4,259,770) 245,718 0 273,906 190,573 0 0 612,000 16,767 2,23,300 728,395 2,099,689 2,099,689 2,099,689 0	0 2.493,624 0 793,835 366,399 854,429 (4,498,257) (4,281,596) 251,569 251,569 0 282,561 0 104,385 0 114,385 0 114,385 0 17,179 23,903 746,280 2,140,116 2,036,993 (2,358,141)	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2.643,969 0 0 844,698 385,991 385,991 385,991 (4,769,762) (4,321,169) 263,880 0 203,241 0 0 202,241 0 649,459 18,058 25,125 784,435 784,435 2,243,749 2,032,726	0 2,720,432 0 866,040 401,460 920,750 (4,308,683) (4,338,560) 2269,948 0 310,221 0 0 206,287 0 662,448 18,513 25,758 804,207 2,227,382 2,030,551	0 2.797.729 0 880.648 417.404 943.394 (5.049.715) (4.354.353) 276.360 0 319.950 0 210.413 0 675.697 18.979 26.407 824.456 2.352.262 2.028.349	0 0 2.875,841 0 915,515 433,826 967,676 (5,192,887) (4,388,570) 282,921 0 282,921 0 244,623 0 244,623 0 689,211 19,456 27,071 19,456 27,071 19,456 27,071 19,456 27,071 19,456 27,071 24,08,419 2,026,120	2,954,745 0 940,635 450,737 961,980 (5,338,106) (4,381,232) 289,634 0 289,634 0 248,917 0 702,996 19,945 27,751 866,429 2,465,882 2,023,864	3.034,417 0 965,599 468,150 (4,392,381) 296,502 0 0 205,054 0 717,056 20,446 28,447 888,178 28,447 28,447 28,447 28,447 28,447 28,447 28,447 28,447 28,447 28,447 28,447 2,244,679 2,024,652 (2,960,777)	3,114,833 0 991,599 466,081 1,042,389 (6,534,902) (4,401,976) 303,530 0 301,584 301,584 0 0 731,397 20,965 22,161 910,449 910,449 2,584,842 2,019,274	3.195,990 0 1.017,428 504,545 1.067,412 (5,785,375) (4,409,294) 310,719 0 372,566 0 0 232,320 0 746,025 21,461 29,861 932,305 2,645,257 2,016,069	0 0 0 3.277,835 0 1.443,483 523,553 1.904,315 (5.339,187) (4,416,117) 318,075 0 0 384,012 0 0 226,697 0 760,945 22,002 30,613 955,803 2,2708,418 2,208,448 2,2108,448 2,2108,448 (3,230,768)	3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 0 335,743 0 335,743 0 241,708 0 70,164 22,553 31,379 979,703 979,703 2,772,860 2,011,482 (3,322,032)	0 0 0 3.443.457 0 1.096.210 563.261 1.149.314 (4.424.881) 333.300 0 0 407.738 0 407.738 0 246.543 0 246.543 0 246.543 0 246.543 0 246.543 0 (3.413.872)	0 3.527,166 0 1,122,859 583,989 1,177,805 (6,441,619) (4,427,002) 341,178 0 420,055 0 251,476 0 0 251,476 0 0 251,477 32,944 1,028,550 2,906,400 2,906,400 2,906,218)	0 0 3.611,423 0 1,149,683 605,322 1,206,970 (6,573,397) (4,428,004) 349,237 0 432,754 0 432,754 0 2265,507 0 2265,507 0 2265,507 0 2265,507 0 233,765 1,054,198 2,974,399 2,003,630 (3,598,998)	0 0 3,696,190 0 1,176,669 627,274 1,237,038 (6,737,170) (4,427,635) 357,482 0 0 445,793 0 246,153 0 0 246,153 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1,203,803 649,862 1,207,826 (6,902,914) (4,425,913) 365,917 0 459,181 0 459,181 0 266,872 0 266,872 0 856,948 25,491 35,467 1,107,351 1,192,27 1,998,660 (3,785,687)	0 3.867.079 0 1.231.072 673.103 1.299.663 (7.070.817) (4.422.992) 374.546 374.546 0 0 472.953 0 0 272.211 0 272.211 0 274.087 0 272.6129 36.3501 1.35.071 3.135.071 3.6355 1.956,280 (3.879.463)	0 1,258,460 697,013 1,332,063 (7,240,645) (4,413,755) 383,374 0 487,093 0 277,657 0 277,657 0 277,657 0 277,657 0 37,264 1,163,457 3,267,197 1,933,876 (3,973,447)
Capital Outlays Benefits: Annual Running Costs: Net escalated benefit/(cost) Life cycle cost analysis	BUS + Interconnection Oxical + GCS Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M Biogas Upgrading/GCS 0&M Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	5.300.000 5.500.000 29,100,000 29,100,000 0 0 747,102 328,475 617,600 (4,240,003) (4,240,003) 0 240,000 0 240,000 0 240,272 714,113 2,046,219 2,046,219 2,046,219 2,046,218 26,966,218 2,046,219 2,046,218 2	0 0 2,419,774 0 770,325 342,213 833,952 (4,366,264) (4,259,770) 245,718 245,718 245,718 0 0 273,906 0 0 190,673 0 190,673 0 0 0 0 0 0 0 0 0 0 0 0 0	0 2,493,624 0 793,835 366,369 854,429 (4,498,257) (4,281,596) 251,569 262,561 0 282,561 0 104,385 0 624,240 17,179 23,903 746,280 746,280 2,140,116 2,358,141]	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.643,969 0 841,998 385,981 385,981 385,981 (4,769,762) (4,321,169) 263,680 0 0 0 0 202,241 0 203,0751 0 0 202,241 0 0 202,241 0 449,459 2649,459 180,588 25,125 784,435 264,3749 2,2032,726 (2,526,013)	0 2,720,432 0 866,040 401,460 920,750 (4,308,683) (4,338,560) 269,948 0 310,221 0 206,287 0 206,287 0 662,448 18,513 25,758 804,207 2,297,382 2,030,551 (2,611,301)	0 2.797.729 0 880.648 417.404 943.394 (6,049.715) (4.354.353) 276.360 276.360 0 210.413 0 210.413 0 20.407 824.456 2.352.262 2.028.349 (2.697.453)	0 0 2.875.841 0 9 15.515 433.826 967.676 (5.192.857) (4.368.570) 282.921 0 282.921 0 214.623 0 214.623 0 214.623 0 214.623 0 214.623 0 27.071 19.456 27.071 19.456 27.071 19.456 27.071 24.08.419 2.026.120 (2.784.438)	2,954,745 0 940,635 450,737 951,990 (6,338,106) (4,381,232) 289,634 0 340,210 0 248,917 0 702,996 702,996 702,996 19,945 27,751 866,429 2,465,882 2,023,864 (2,872,224)	3,034,417 0 965,999 468,160 1,016,890 (6,485,456) (4,392,361) 296,502 0 0 0 223,296 0 0 223,296 0 0 717,056 717,056 20,446 28,447 888,178 888,178	3,114,833 0 991,599 466,081 1,042,389 (6,534,902) (4,401,976) 303,530 0 301,584 0 0 227,763 0 731,397 731,397 731,397 720,958 22,161 910,449 2,654,842 2,019,274 (3,050,060)	3.195.990 0 1.017.428 504.545 504.545 (6,785.375) (4,409.294) 310,719 0 372,566 0 0 2322,320 746.025 21,461 29,861 932,305 2,645.257 2,016,069 (3,140,118)	0 0 0 3.277,835 0 1.043,483 523,553 1.094,315 (5,339,187) (4,416,117) 318,075 0 384,012 384,012 0 0 760,945 226,967 0 760,945 22,002 30,613 955,803 2,708,418 2,013,860	3,360,335 0 1,069,748 543,120 1,121,679 (6,094,881) (4,421,351) 325,601 325,601 335,743 0 0 241,708 0 776,164 2,2,553 31,379 379,703 2,772,850 2,011,482	0 0 0 3.443.457 0 1.096.210 563.261 1.149.314 (6.252.241) (4.424.881) 333.300 0 407.738 0 0 246.543 0 791.687 791.687 791.687 791.687 23.106 32.152 2.008.791	0 3.527,166 0 1,122,859 563,989 1,177,805 (6,411,619) (4,427,002) 341,178 0 420,055 0 251,476 0 0 251,476 0 0 251,476 0 0 2,507,721 32,944 1,028,550 2,906,079 (3,506,218)	0 0 3.611,423 0 1.149,683 605,322 1.206,970 (6,573,397) (4,428,004) 349,237 0 432,754 432,754 432,754 0 256,507 0 823,671 24,267 33,765 1.054,198 2,974,399 2,003,630	0 0 0 0 0 0 0 0 1,176,69 627,274 1,237,038 (6,737,170) (4,427,635) 0 445,733 0 0 261,638 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 261,638 0 0 0 0 261,638 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 1,203,803 649,862 1,207,826 (6,902,914) (4,425,913) 365,917 0 459,181 0 459,181 0 266,872 0 266,872 0 856,948 25,491 35,467 1,107,351 1,192,27 1,998,660 (3,785,687)	0 3,867,079 1,231,072 673,103 1,299,663 (7,070,817) (4,422,992) 374,546 0 472,953 0 0 272,211 0 874,087 2,61,129 3,6355 1,135,071 3,191,353 1,995,280	0 1,258,460 697,013 1,332,063 (7,240,645) (4,418,755) 383,374 0 487,093 0 0,277,657 0 3891,568 26,783 37,264 1,163,457 1,163,457

ALTERNATIVE 4

	Year of analysi Escalation rat Discount rat	te 2.00%	isk adjustments (+/- ı	percent): Benefits Capital costs Running costs	0% 0% 0%										HSW	Alternative Study Alternative ernative Cost Analy						
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expressed in 2020 dollars, un	escalated dollars																					
Capital Outlays	BUS + Interconnection	24.000.000																				
	SCR	4,000,000																				
	HSW Receiving Facility Dig 1&3 Improvements	5,500,000																				
	Total capital outlays	39,500,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																						
	D3 RINs D5 RINs	2,346,827 157,772	2,372,328 156,145	2,396,794 154,519	2,420,224 152,892	2,442,619 151,266	2,463,979 149,639	2,484,303 148,013	2,503,592 146,386	2,521,846 144,760	2,539,065 143,133	2,555,248 141,507	2,570,417 139,880	2,584,550 138,254	2,597,648 136,627	2,609,710 124,604	2,620,736 99,415	2,630,726 74,804	2,639,681 50,772	2,647,599 27,316	2,654,482	2,660,329
	LCFS Natural Gas Sale	1,287,788 566,196	1,290,332 573,224	1,292,547 580,252	1,294,433 587,280	1,295,988 594,308	1,297,215 601,336	1,298,111 608.364	1,298,678 615,392	1,298,916 622,420	1,298,824 629,448	1,298,402 636,476	1,297,657 643.508	1,296,583 650,539	1,295,172 657,571	1,273,585 654,398	1,226,510 637,898	1,180,215 621,398	1,134,694 604,899	1,089,947 588,399	1,045,974 571,899	1,036,888 574,295
	HSW Tipping Fee	370,840	370,840	370,840	370,840	370,840	370,840	370,840	370,840	370,840	370,840	370,840	370,840	370,840	370,840	342,280	276,419	210,558	144,697	78,836	12,975	0
	Total benefits	(4,729,422)	(4,762,869)	(4,794,952)	(4,825,669)	(4,855,021)	(4,883,009)	(4,909,631)	(4,934,889)	(4,958,782)	(4,981,310)	(5,002,473)	(5,022,302)	(5,040,767)	(5,057,858)	(5,004,576)	(4,860,978)	(4,717,702)	(4,574,742)	(4,432,097)	(4,285,330)	(4,271,512)
Annual Running Costs:																						
	Engine O&M SCR O&M	240,000 240,000	240,900 240,900		242,700 242,700	243,600 243,600	244,500 244,500	245,400 245,400	246,300 246,300	247,200 247,200	248,100 248,100	249,000 249,000	249,900 249,900	250,800 250,800	251,700 251,700	252,600 252,600	253,500 253,500	254,400 254,400	255,300 255,300	256,200 256,200	257,100 257,100	258,000 258,000
	Biogas Upgrading O&M NC Demand	207,470	210,046	212,621	215,196	217,771	220,347	222,922	225,497	228,073	230,648	233,223	235,800	238,376	240,953	239,790	233,744	227,698	221,652	215,606	209,560	210,438
	Natural Gas Purchased - Dryer	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835	186,835
	Natural Gas Purchased - Engine HSW Facility O&M	490,537 100.000	492,376	494,216	496,055 100.000	497,895	499,734 100.000	501,574	503,413 100.000	505,253 100.000	507,092 100.000	508,932 100.000	510,771 100.000	512,611 100,000	514,450 100.000	516,290 100,000	518,130 100.000	519,969 100.000	521,809 100,000	523,648 100,000	525,488 100.000	527,327 100.000
	Dig 1 & 5 O&M	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000	600,000
	Dewatering Polymer Dewatering Power	7,456 10,374	7,456 10,374	7,456	7,456 10,374	7,456 10,374	7,456 10,374	7,456 10,374	7,456 10,374	7,456 10,374	7,456 10,374	7,456 10,374	7,456 10,374	7,456 10,374	7,456 10,374	6,882 9,575	5,558 7,733	4,233 5,890	2,909 4,048	1,585 2,205	261 363	0
	Class B Hauling	323,901	323,901	323,901	323,901	323,901	323,901	323,901	323,901	323,901	323,901	323,901	323,901	323,901	323,901	298,956	241,431	183,906	126,382	68,857	11,332	2,140,600
	Total running costs	2,406,574	2,412,789	2,419,003	2,425,218	2,431,433	2,437,648	2,443,862	2,450,077	2,456,292	2,462,507	2,468,722	2,474,938	2,481,154	2,487,370	2,463,528	2,400,430	2,337,333	2,274,235	2,211,137	2,148,039	
Net Benefit/(cost)		37,177,152	(2,350,081)	(2,375,948)	(2,400,451)	(2,423,588)	(2,445,361)	(2,465,769)	(2,484,812)	(2,502,490)	(2,518,803)	(2,533,751)	(2,547,365)	(2,559,613)	(2,570,489)	(2,541,048)	(2,460,548)	(2,380,369)	(2,300,507)	(2,220,960)	(2,137,290)	(2,130,912)
Expressed in escalated dollar	s with sensitivity adjustments																					
Capital Outlays																						
Capital Outlays	BUS + Interconnection	24,000,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital Outlays	SCR Dig 1&3 Improvements	4,000,000 5,500,000	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Capital Outlays	SCR	4.000.000	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Capital Outlays Benefits:	SCR Dig 1&3 Improvements Total capital outlays (Pvs)	4,000,000 5,500,000 39,500,000	0 0 0 0	0 0 0	0 0 0 0				, i i i i i i i i i i i i i i i i i i i	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	, i i i i i i i i i i i i i i i i i i i	0 0 0	0 0 0 0
	SCR Dig 1&3 Improvements	4,000,000 5,500,000 39,500,000 2,346,827 157,772	0 0 0 2,419,774 159,268	0 0 0 2,493,624 160,761	0 0 0 2.568.361 162.251	2,643,969 163,735	2,720,432	2,797,729	2,875,841 168,152	0 0 0 2,954.745 169.609	0 0 0 3,034,417 171,058	0 0 0 3,114,833 172,496	0 0 0 3,195,990 173,924	0 0 0 3,277,835 175,339	0 0 0 3,360,335 176,742	0 0 0 3,443,457 164,412	0 0 0 3,527,166 133,800	0 0 0 3,611,423 102,691	0 0 0 3,696,190 71,092	3,781,424 39,014	0 0 0 3,867,079 0	0 0 0 3,953,109 0
	SCR Dig 1&3 improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788	159,268 1,316,139	160,761 1,344,766	162,251 1,373,662	2,643,969 163,735 1,402,820	2,720,432 165,214 1,432,230	2,797,729 166,687 1,461,884	2,875,841 168,152 1,491,773	169,609 1,521,887	171,058 1,552,215	172,496 1,582,745	173,924 1,613,474	175,339 1,644,381	176,742 1,675,444	164,412 1,680,469	133,800 1,650,721	102,691 1,620,183	71,092 1,588,846	3,781,424 39,014 1,556,713	0 1,523,786	0 1,540,761
	SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,840	159,268 1,316,139 584,688 378,257	160,761 1,344,766 603,694 385,822	162,251 1,373,662 623,226 393,538	2,643,969 163,735 1,402,820 643,298 401,409	2,720,432 165,214 1,432,230 663,924 409,437	2,797,729 166,687 1,461,884 685,117 417,626	2,875,841 168,152 1,491,773 706,892 425,979	169,609 1,521,887 729,264 434,498	171,058 1,552,215 752,249 443,188	172,496 1,582,745 775,861 452,052	173,924 1,613,474 800,121 461,093	175,339 1,644,381 825,041 470,315	176,742 1,675,444 850,638 479,721	164,412 1,680,469 863,464 451,631	133,800 1,650,721 858,527 372,023	102,691 1,620,183 853,047 289,051	71,092 1,588,846 847,004 202,610	3,781,424 39,014 1,556,713 840,378 112,597	0 1,523,786 833,149 18,902	0 1,540,761 853,372 0
	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422)	159,268 1,316,139 584,688 378,257 (4,858,127)	160,761 1,344,766 603,694 385,822 (4,988,668)	162,251 1,373,662 623,226 393,538 (5,121,038)	2,643,969 163,735 1,402,820 643,298 401,409 (5,255,231)	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236)	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042)	2,875,841 168,152 1,491,773 706,892 425,979 (5,668,636)	169,609 1,521,887 729,264 434,498 (5,810,003)	171,058 1,552,215 752,249 443,188 (5,953,126)	172,496 1,582,745 775,861 452,052 (6,097,986)	173,924 1,613,474 800,121 461,093 (6,244,602)	175,339 1,644,381 825,041 470,315 (6,392,911)	176,742 1,675,444 850,638 479,721 (6,542,879)	164,412 1,680,469 863,464 451,631 (6,603,432)	133,800 1,650,721 858,527 372,023 (6,542,236)	102,691 1,620,183 853,047 289,051 (6,476,394)	71,092 1,588,846 847,004 202,610 (6,405,743)	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126)	0 1,523,786 833,149 18,902 (6,242,916)	0 1,540,761 853,372 0 (6,347,242)
Benefits:	SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,840	159,268 1,316,139 584,688 378,257	160,761 1,344,766 603,694 385,822 (4,988,668)	162,251 1,373,662 623,226 393,538	2,643,969 163,735 1,402,820 643,298 401,409	2,720,432 165,214 1,432,230 663,924 409,437	2,797,729 166,687 1,461,884 685,117 417,626	2,875,841 168,152 1,491,773 706,892 425,979	169,609 1,521,887 729,264 434,498	171,058 1,552,215 752,249 443,188	172,496 1,582,745 775,861 452,052	173,924 1,613,474 800,121 461,093	175,339 1,644,381 825,041 470,315	176,742 1,675,444 850,638 479,721	164,412 1,680,469 863,464 451,631	133,800 1,650,721 858,527 372,023	102,691 1,620,183 853,047 289,051	71,092 1,588,846 847,004 202,610	3,781,424 39,014 1,556,713 840,378 112,597	0 1,523,786 833,149 18,902	0 1,540,761 853,372 0
	SCR Dig 183 Improvements Total capital outlays (Pvs) DS RINs DS RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$)	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422)	159,268 1,316,139 584,688 378,257 (4,858,127) (4,739,636)	160,761 1,344,766 603,694 385,822 (4,988,668) (4,748,286)	162,251 1,373,662 623,226 393,538 (5,121,038) (4,755,393)	2,643,969 163,735 1,402,820 643,298 401,409 (5,255,231)	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067)	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676)	2,875,841 168,152 1,491,773 706,892 425,979 (5,668,636) (4,768,827)	169,609 1,521,887 729,264 434,498 (5,810,003) (4,768,540)	171,058 1,552,215 752,249 443,188 (5,953,126) (4,766,837)	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737)	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291)	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487)	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338)	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428)	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189)	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660)	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823)	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661)	0 1,523,786 833,149 18,902 (6,242,916)	0 1,540,761 853,372 0 (6,347,242) (3,873,537)
Benefits:	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 240,000	159,268 1,316,139 584,688 378,257 (4,858,127) (4,739,636) 245,718	160.761 1.344.766 603.694 385.622 (4,988,668) (4,748,286) 251,569 251,569	162,251 1,373,662 623,226 393,538 (5,121,038) (4,755,393) 257,555 257,555	2,643,969 163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,960) 263,680 263,680	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360	2.875.841 168.152 1.491.773 706.692 425.979 (5.668.636) (4,768.639) 282.921 282.921	169,609 1,521,887 729,264 434,498 (5,810,003) (4,768,540) 289,634 289,634	171,058 1,552,215 752,249 443,188 (5,953,126) (4,766,837) 296,502	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291) 310,719	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546	0 1,540,761 853,372 0 (6,347,242) (3,873,537) 383,374 383,374
Benefits:	SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 240,000 207,470 0 0	159.268 1,316,139 584,688 378.257 (4,858,127) (4,739,636) 245,718 245,718 245,718 214,246 0	160.761 1,344.766 603.694 385.822 (4,988.669) (4,748,286) 251.569 251.569 221.211 0 0	162,251 1,373,662 623,226 393,538 (5,121,038) (4,755,393) 257,555 257,555 257,555 228,368 0	2,643,969 163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 269,948 269,948 243,281 0	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 276,360 0	2.875.841 168.152 1.491.773 706.892 425.979 (5.656.656) (4.768.827) 282.921 282.921 282.921 285.925 0	169,609 1,521,887 729,264 434,498 (5,810,003) (4,768,540) 289,634 289,634 289,634 267,223 0	171,058 1,552,215 752,249 443,188 (5,953,126) (4,766,837) 296,502 296,502 296,502 275,645 0	172,496 1,582,745 775,861 452,052 (6,097,966) (4,763,737) 303,530 303,530 284,298 0	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291) 310,719 310,719 310,719 0	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 333,300 336,398 0	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 314,589 0	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237 349,237 312,681 0	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 310,366 0	3,781,424 39,014 1,556,713 840,378 112,997 (6,330,126) (4,058,661) 365,917 365,917 365,917 307,939 0	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546 374,546 305,290 0	0 1,540,761 853,372 0 (6,347,242) (3,873,537) 383,374 383,374 383,374 312,700 0
Benefits:	SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale H5W Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Dryer	4,000,000 5,500,000 33,500,000 2,346,827 157,772 1,287,788 566,196 370,240 (4,723,422) (4,723,422) (4,723,422) 240,000 240,000 240,000 207,470 0 186,835	159.268 1,316,139 584,688 378.257 (4,858,127) (4,739,636) 245,718 245,718 245,718 214,246 0 190,572	160.761 1,344,766 603,604 385,822 (4,988,688) (4,748,286) 251,569 251,569 221,211 0 194,383	162.251 1,373.662 623.226 393.538 (5,121.038) (4,755.393) 257.555 257.555 228,368 0 198.271	2,643,969 163,735 43,298 401,409 (6,285,231) (4,760,980) 263,680 263,680 235,723 0 202,236	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 269,948 269,948 243,281 0 200,621	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 251,046 0 210,407	2,875,841 168,152 1,491,773 706,892 425,879 (5,668,639) (4,768,827) 282,921 282,921 282,921 282,921 282,921 0 0 214,615	169.609 1.521.887 729.264 434.498 (5,810.003) (4,768,540) 289.634 289.634 289.634 267.223 0 218.907	171.058 1,552.215 752.249 443.188 (4,766,837) 296.502 296.502 275.645 0 223.285	172.496 1,582,745 775.861 452,052 (6,097,986) (4,763,737) 303,530 303,530 203,530 284,298 0 227,751	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291) 310,719 310,719 293,187 0 223,206	175,339 1,644,381 825,041 470,315 (6,332,911) (4,753,487) 318,075 318,075 318,075 318,075 302,319 0 236,952	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0 241,691	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 333,300 333,300 233,300 246,525	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 314,589 0 251,455	102.691 1,620.183 853.047 289.051 (4,362,560) 349.237 349.237 349.237 312.581 0 255,485	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 310,366 0 281,614	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 307,939 0 206,647	0 1,523,766 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546 374,546 305,290 0 272,184	0 1,540,761 853,372 0 (6,547,742) (3,873,537) 383,374 383,374 383,374 383,374 383,374
Benefits:	SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,240 (4,729,422) (4,729,422) 240,000 24	159.268 1.316.139 584.688 378.257 (4.858,127) (4.739,636) 245,718 245,718 245,718 214.246 0 190.572 502,224	160.761 1.344.766 603.604 365.822 (4,988,669) (4,748,286) (4,748,286) 251.569 251.569 221.211 0 194.383 514,182	162,251 1,373,662 623,226 303,538 (5,121,038) (4,755,383) 257,555 257,555 257,555 257,555 262,388 0 198,271 526,418	2,643,969 163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 263,680 263,680 235,723 0 202,236 538,937	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 269,948 243,281 0 209,6281 551,747	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 251,046 0 210,407 564,854	2,875,841 168,152 1,491,773 706,892 425,879 (5,668,639) (4,768,827) 282,921 282,921 282,921 282,921 282,921 282,921 282,921 259,025 0 214,615 578,264	169.609 1.521.887 729.264 434.498 (5.810.003) (4,768,540) 289.634 289.634 289.634 267.223 0 218.907 591.984	171.058 1,552.215 752.249 443.188 (5,953.126) (4,766,837) 296.502 296.502 275,645 0 233.285 606.022	172.496 1,582,745 175.861 452,052 (6,097,986) (4,763,737) 303,530 303,530 203,530 203,530 203,530 0 227,751 620,385	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,291) 310,719 310,719 293,187 0 223,366 635,080	175,339 1,644,381 825,041 470,315 (6,392,941) (4,753,487) 318,075 318,075 318,075 318,075 302,319 0 236,952 650,115	176,742 1,675,444 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0 241,691 665,497	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 333,300 333,300 336,398 0 246,525 681,234	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 314,589 0 251,455 697,334	102.691 1,620.183 853.047 289.051 (6,476,534) (4,362,660) 349.237 349.237 349.237 312.581 0 256.485 713.806	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 357,482 310,366 0 281,614 730,658	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 365,917 307,939 0 266,647 747,898	0 1,523,766 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546 374,546 305,290 0 272,184 765,536	0 1,540,761 853,372 0 (6,547,242) (3,873,537) 383,374 383,374 383,374 383,374 312,700 0 0 277,627 783,580
Benefits:	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M	4,000,000 5,500,000 33,500,000 2,346,827 157,772 1,287,788 566,196 370,240 (4,723,422) (4,723,422) (4,723,422) 240,000 240,000 240,000 207,470 0 186,835	159.268 1.316.139 584.688 378.257 (4,858,127) (4,739,636) 245.718 245.718 245.718 214.246 0 190.572 502.224 612.000	160.761 1,344,766 603,604 385,822 (4,988,688) (4,748,286) 251,569 251,569 221,211 0 194,383	162,261 1,373,662 623,226 393,538 (5,221,038) (4,755,383) 257,555 257,555 257,555 257,555 267,555 267,555 268,725 198,271 526,418 526,418 526,418	2,643,969 163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 263,680 263,680 263,680 263,680 202,235 538,937 649,459	2.720.432 165.214 1.432.230 663.924 609.457 (6.391.236) (4.765.067) 269.948 269.948 269.948 269.948 206.281 0 206.281 551.747	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 276,360 276,360 0 210,407 564,854 675,697	2,875,841 168,152 1,491,773 706,892 425,979 (5,668,636) (4,768,627) 282,921 282,921 282,921 282,921 282,921 282,921 0 214,615 578,264 689,211	169,609 1,521,887 729,264 434,496 (5,810,003) (4,768,540) 289,634 289,634 289,634 267,223 0 0 218,907 591,984 702,996	171.058 1.552215 752.249 443.188 (5.953,126) (4.766,837) 296.502 296.502 296.502 296.502 275,645 0 0 223.285 606.022 717.056	172,496 1,582,745 775,861 452,052 (6,097,966) (4,763,737) 303,530 303,530 303,530 303,530 284,298 0 227,751 620,385 731,397	173,924 1,613,474 800,121 461,093 (6,244,602) (4,759,281) 310,719 310,719 310,719 293,187 0 232,306 635,080 746,025	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 302,319 0 236,952 660,115 760,945	176,742 1.675,744 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 311,698 0 241,691 665,497 776,184	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 336,398 	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 314,589 0 251,455	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237 349,237 349,237 349,237 312,581 0 256,485 713,806 	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 310,386 0 0 261,614 730,558 840,145	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) (4,058,661) 3865,917 3865,917 3865,917 307,939 0 0 286,847 747,898 855,948	0 1,523,766 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546 374,546 305,290 0 272,184	0 1,540,761 853,372 0 (6,547,742) (3,873,537) 383,374 383,374 383,374 383,374 383,374
Benefits:	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 240,000 207,470 0 186,835 490,537 	159,268 1,316,139 584,688 378,257 (4,858,127) (4,739,636) 245,71824,718 245,718 245,718 245,71824,718 245,71825,718 245,718 245,71825,718	160.761 1.344.766 603.694 385.822 (4,988,668) (4,748,286) 251.569 221.211 0 194.383 514.182 624.240 7.757 10.793	162,261 1.373,662 623,226 393,538 (5,121,038) (4,755,383) 257,555 227,555 227,555 228,368 0 198,271 526,418 636,725 7,913 11,099	2,643,969 163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 26	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 276,360 276,360 0 210,407 564,854 675,697 8,397 11,683	2,875,841 168,152 1,491,773 706,892 425,979 (6,668,636) (4,768,827) 282,921 282,921 282,921 282,921 282,921 282,921 269,025 0 214,615 576,264 689,211 8,565 11,917	169.600 1.521.887 729.264 4.34.496 (5.840.003) (4.768,540) 289.634 289.634 289.634 289.634 287.223 0.218.907 591.964 702.996 8.738 2.735	171.058 1.552.215 752.249 443,188 (5,953,128) (4,766,837) 296,502 296,502 296,502 275,645 0 223,285 606,022 717,056 8,911 12,388	172.496 1,582.745 775.861 452.052 (6,077.866) (4,763.737) 303.530 303.530 303.530 284.298 0 0 227.751 620.385 731.397 9.089 12.646	173.924 1.613.474 800.121 461.003 (6,244,602) (4,759.281) 310,719 310,719 310,719 310,719 293.187 0 232.306 655.060 746.025 9.271 12.899	175,339 1,644,381 825,041 470,315 (6,382,911) (4,753,487) 318,075 318,075 318,075 302,319 0 28,6952 650,115 760,945 9,456 13,157	176,742 1,675,544 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 325,601 0 241,691 665,497 776,164 9,645 13,420	164,412 1,680,469 863,464 451,631 (4,673,428) (4,673,428) 333,300 336,300 316,398 0 246,525 661,234 791,687 9,081 12,634	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,459 0 251,455 697,334 807,521 7,480 10,407	102,691 1,620,183 853,047 289,051 (6,476,384) (4,362,660) 349,237 349,237 312,581 0 256,485 713,806 823,671 5,812 8,066	71,092 1,588,846 847,004 202,610 (6,465,743) (4,209,823) 357,482 357,482 357,482 357,482 310,366 0 261,614 730,658 840,145 4,074 5,668	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 365,917 365,917 307,939 0 2266,847 747,898 856,948 2,264 3,150	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546 374,546 305,290 0 0 272,184 765,536 	0 1,540,761 853,372 0 (6,547,242) (3,873,537) 383,374 383,374 383,374 312,700 0 277,627 783,580
Benefits:	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	4,000,000 5,500,000 39,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 240,000 207,470 0 186,835 490,537 	159288 1.316139 594688 378257 (4,858,127) (4,739,836) 245,718 245,718 245,718 245,718 245,718 245,718 245,718 245,712 502,224 612,000 7,865 10,582 330,379	160.761 1.344.766 603.694 305.622 (4,988,668) (4,748,286) 251.569 251.569 221.211 0.194.383 514.182 624.240 7.757 10.793 336.987	162,261 1.373,662 623,226 393,538 (5,121,038) (4,755,383) 257,555 226,368 0 0 198,271 526,418 636,725 7,913 11,009 343,726	2,643,060 163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,990) 263,680 263,680 263,680 263,680 202,236 538,937 549,459 8,071 11,229 350,601	2.720.432 165.214 1.432.230 663.924 409.437 (5.391.236) (4.765.067) 269.948 269.948 269.948 243.281 0 206.281 551.747 551.747 562.448 8.232 11.454 357.613	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 276,360 276,360 0 210,407 564,854 675,697 8,397 11,683 364,765	2,875,841 168,152 1,491,773 706,892 425,979 (6,666,636) (4,768,827) 282,921 282,921 282,921 282,921 282,921 282,921 282,921 0 214,615 578,264 669,211 8,565 11,917 372,061	169,609 1,521,887 729,264 434,496 (5,840,003) (4,768,540) 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 299,634 200,635 20	171.058 1.552215 752.249 443,188 (5,953,126) (4,766,837) 296,502 296,502 296,502 296,502 275,645 0 0 223,285 606,022 717,056 8,911 12,398 387,092	172,496 1,582,745 1,582,745 1,582,745 1,582,745 452,052 (6,097,946) (4,763,737) 303,530 303,530 303,530 303,530 284,298 0 0 227,751 620,385 731,397 9,089 12,646 394,834	173.924 1.613.474 800.121 461.003 (6,244,602) (4,759.281) 310,719 310,719 310,719 293.187 0 232.306 635.080 746.025 9.271 12.899 402,730	175,339 1,644,381 825,041 470,315 (6,382,911) (4,753,487) 318,075 318,075 318,075 302,319 0 286,952 650,115 760,945 9,456 13,157 410,785	176,742 1,675,844 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 325,601 325,601 325,601 0 241,691 665,497 776,164 9,645 13,420 419,001	164,412 1,680,469 863,464 451,631 (4,673,428) (4,673,428) 333,300 336,338 0 246,525 681,234 791,687 9,081 12,634 394,466	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 0 0 251,455 697,334 807,521 7,480 10,407 324,934	102,691 1620,183 853,047 289,051 (6,476,384) (4,362,660) 349,237 349,237 349,237 312,581 0 256,485 713,806 	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 310,366 0 0 261,614 730,658 840,145 4,074 5,668 176,965	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,918365,918 365,918 365,918 365,91836,918 365,918 365,	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546 374,546 305,290 0 272,184 765,536 	0 1.540,761 853,372 0 (6,347,242) (3,873,537) 383,374 394,580 0 0 0 0 0 0 0 0 0 0 0 0 0
Benefits:	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer	4,000,000 5,500,000 33,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) (4,729,422) 240,000	159,268 1,316,139 584,688 378,257 (4,858,127) (4,739,636) 245,71824,718 245,718 245,718 245,71824,718 245,718 245,71825,718 245,71825,718 245,718	160.761 1.344.766 603.694 385.822 (4,988,668) (4,748,286) 251.569 221.211 0 194.383 514.182 624.240 7.757 10.793	162,261 1.373,662 623,226 393,538 (5,121,038) (4,755,383) 257,555 227,555 227,555 228,368 0 198,271 526,418 636,725 7,913 11,099	2,643,969 163,735 1,402,820 643,298 401,409 (5,255,231) (4,760,980) 263,680 26	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 276,360 276,360 0 210,407 564,854 675,697 8,397 11,683	2,875,841 168,152 1,491,773 706,892 425,979 (6,668,636) (4,768,827) 282,921 282,921 282,921 282,921 282,921 282,921 269,025 0 214,615 576,264 689,211 8,565 11,917	169.600 1.521.887 729.264 4.34.496 (5.840.003) (4.768,540) 289.634 289.634 289.634 289.634 287.223 0.218.907 591.964 702.996 8.738 2.735	171.058 1.552.215 752.249 443,188 (5,953,128) (4,766,837) 296,502 296,502 296,502 275,645 0 223,285 606,022 717,056 8,911 12,388	172.496 1,582.745 775.861 452.052 (6,077.866) (4,763.737) 303.530 303.530 303.530 284.298 0 0 227.751 620.385 731.397 9.089 12.646	173.924 1.613.474 800.121 461.003 (6,244,602) (4,759,281) 310,719 310,719 310,719 310,719 293,187 0 232,306 655,060 746,025 9,271 12,899	175,339 1,644,381 825,041 470,315 (6,382,911) (4,753,487) 318,075 318,075 318,075 302,319 0 28,6952 650,115 760,945 9,456 13,157	176,742 1,675,544 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 325,601 0 241,691 665,497 776,164 9,645 13,420	164,412 1,680,469 863,464 451,631 (4,673,428) (4,673,428) 333,300 336,300 316,398 0 246,525 661,234 791,687 9,081 12,634	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,459 0 251,455 697,334 807,521 7,480 10,407	102,691 1,620,183 853,047 289,051 (6,476,384) (4,362,660) 349,237 349,237 312,581 0 256,485 713,806 823,671 5,812 8,066	71,092 1,588,846 847,004 202,610 (6,465,743) (4,209,823) 357,482 357,482 357,482 357,482 310,366 0 261,614 730,658 840,145 4,074 5,668	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 365,917 365,917 365,917 307,939 0 0 2266,847 747,898 856,948 2,264 3,150	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546 374,546 305,290 0 0 272,184 765,536 	0 1,540,761 853,372 0 (6,547,242) (3,873,537) 383,374 383,374 383,374 383,374 312,700 0 0 277,627 783,580
Benefits:	SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (In 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauing	4,000,000 5,500,000 33,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) (4,729,422) 240,000	159.268 1.316.139 584.688 378.257 (4.858.127) (4.739.636) 245.718 245.718 245.718 245.718 245.718 0190.572 502.224 612.000 7.605 10.582 330.379 2.359.044	160.761 1.344.766 603.694 365.822 (4.988.663) (4.748.286) 251.569 221.569 221.569 221.211 0 194.383 514.182 624.240 7.757 10.793 333.997 2.412.691 2.295,434	162,251 1.373,662 623,226 623,226 163,538 (5,121,038) (4,755,393) (4,755,393) (4,755,393) (4,755,393) (4,755,393) (5,121,038) (4,755,393) (5,121,038	2,643,969 163,735 443,298 441,409 (5,255,231) (4,760,380) 263,880 263,880 263,880 263,880 202,236 538,637 649,459 8,071 11,229 8,071 11,229 13,500 14,59 15,507 11,229 15,507 15	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 2269,948 2269,948 2269,948 243,281 0 0 206,281 551,747 662,448 8,232 11,454 8,232 11,454 357,613 2,580,952	2,797,729 166,687 1,661,884 685,117 417,626 (5,529,042) (4,767,676) 276,380 276,380 276,380 276,380 0 0 210,407 564,854 675,697 8,397 11,683 364,765 2,539,570	2,875,841 168,152 1,491,773 706,892 425,979 (5,668,536) (4,768,827) 282,921 282,921 282,921 282,921 282,921 282,921 282,921 0 0 214,615 578,284 689,211 8,565 11,917 372,061 2,699,500	169.609 1.521.887 729.264 434.499 (6.840.033) (4.768,540) 289.634 289.634 289.634 289.634 287.723 0 219.607 501.984 702.986 8.735 12.155 379.502 2,760,772	171.058 1.552.215 752.249 4.43.188 (5.953.126) (4.766,837) 2.96,502 2.96,502 2.95,545 0.023,245 6.06,022 717.056 8.911 12,388 3.87,092 2.83,344	172,496 1,582,745 775,861 452,052 (6,097,936) (4,763,737) 303,530 303,530 303,530 284,298 0 0 227,751 620,385 731,397 9,089 12,646 394,834 2,887,458	173.924 1613.474 800.121 461.093 (6.244.602) (4.759.291) 310.719 330.719 283.187 0 222.306 635.080 746.025 9.271 12.899 402.730 2.952.937	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 302,319 0 226,952 650,115 760,945 9,456 13,157 410,785 3,019,879	176,742 1,875,844 850,638 479,721 (6,542,879) (4,746,338) 225,601 325,601 311,698 0 241,691 665,497 776,164 9,645 13,420 419,001 3,088,317	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 336,398 0 246,525 661,234 791,687 9,081 12,634 394,466 3,118,625	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,272 341,394 34	102,691 1,620,183 853,047 289,051 (6,476,334) (4,362,660) 349,237 349,237 342,2561 0 256,485 713,806 13,806 713,806 252,464 5,812 8,086 252,464 3,071,378	71,082 1,588,846 847,004 847,004 847,004 (6,405,743) (6,405,743) (4,209,823) 357,482 357,482 357,482 357,482 301,386 0 0 261,614 730,658 40,744 5,668 176,965 3,044,454	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 365,917 365,917 307,399 0 0 266,847 747,998 856,948 2,264 3,315,223	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) (3,905,117) (3,905,117) 0 0 0 2,12,184 765,536 722,184 765,536 72,184 765,538 74,087 874,097 874,097 87	0 1.540.761 853.372 0 (6,347,242) (3,873,537) 3883,374 3883,374 383.374 312.700 0 277.627 783,580 891,568 0 0 0 0 0 0 0 0 0 0 0 0 0
Benefits: Annual Running Costs:	SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (In 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauing	4,000,000 5,500,000 33,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 24	159.268 1.316.139 584.688 378.257 (4.858.127) (4.739.636) 245.718 24	160.761 1.344.766 603.694 365.822 (4.988.663) (4.748.286) 251.569 221.569 221.569 221.211 0 194.383 514.182 624.240 7.757 10.793 333.997 2.412.691 2.295,434	162,251 1.373,662 623,226 623,226 393,538 (5,121,038) (4,755,393) (4,755,393) (4,755,393) (4,755,393) (5,121,038) (4,755,393) (5,121,038	2,643,969 163,735 443,298 401,409 (5,255,231) (4,760,380) 263,880 263,880 263,880 263,880 202,236 538,837 0 0 202,236 538,837 649,459 8,071 11,229 8,071 11,229 350,601 2,523,618 2,286,273	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 269,948 269,948 269,948 269,948 206,281 551,747 662,448 8,232 11,454 8,232 11,454 357,613 2,580,952 2,281,185	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,380 276,380 276,380 276,380 276,380 276,380 276,380 276,380 276,380 276,380 276,380 276,380 10,687 64,654 675,697 8,397 11,683 364,765 2,639,570 2,276,093	2,875,841 168,152 1,491,773 706,862 425,979 (5,668,536) (4,768,827) 282,921 282,921 282,921 282,921 282,921 282,921 282,921 0 0 214,615 578,264 0 0 214,615 578,264 0 2,565 11,917 372,061 2,599,500 2,270,996	169.609 1.521.887 729.264 434.499 (6.840.033) (4.768.540) 289.634 289.634 289.634 289.634 287.723 0 219.607 501.984 702.986 8.735 12.155 379.502 2.760,772 2.265,894	171.058 1.552.215 752.249 443.188 (5.953.126) (4.766,837) (4.766,837) 2.96,502 2.95,565 0.02 2.75,645 0.023,285 6.06,022 717.056 8.911 12.388 387,092 397,092	172,466 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 303,530 264,268 0 0 227,751 620,385 731,397 9,089 12,646 334,834 2,887,458 2,255,678	173.924 1613.474 800.121 461.093 (6.244.602) (4.759.291) 310.719 330.719 293.187 0 223.206 635.080 746.025 9.271 12.899 402.730 2.955.937 2.250,565	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 302,319 0 0,286,952 650,115 760,945 9,456 13,157 410,785 3,019,879 2,245,449	176,742 1,875,444 850,638 479,721 (6,542,879) (4,746,338) 225,601 325,601 311,698 0 241,691 665,497 776,164 9,645 13,420 419,001 3,088,317 2,240,328	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 336,398 0 246,525 681,234 791,687 79,081 12,634 334,466 3,118,625 2,207,136	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 341,178 341,178 0,251,455 697,334 807,521 7,480 10,407 324,934 3,096,076 2,137,734	102,691 1,620,183 853,047 289,051 (6,476,334) (4,362,660) 349,237 349,237 349,237 312,2861 0 0 256,485 713,806 1 823,671 5,812 8,086 557 2,068,957 2,066,957	71,082 1,588,846 847,004 847,004 847,004 (6,405,743) (6,405,743) (4,209,823) 357,482 357,482 357,482 357,482 301,386 0 0 261,614 730,658 176,965 3,044,454 2,000,800	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,918 3,516 98,345 3,515	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) (3,905,117) (3,905,117) 0 0 0 272,184 765,536 74,087 874,077 874,077 87	0 1.540.761 853.372 0 (6,347,242) (3,873,537) 383.374 383.374 383.374 312.700 0 277,627 783,580 0 0 0 0 0 0 0 0 0 0 0 0 0
Benefits: Annual Running Costs: Net escalated benefit/(cost) Life cycle cost analysis	SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (In 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauing	4.000.000 5.500.000 39,500,000 2.346,827 157.772 1.287.788 566,196 370,240 (4,729,422) 240.0000 240.0000 240.000 240.0000 240.0000 240.0000 240.0000	159,268 1,316,139 544,688 378,257 (4,858,127) (4,739,636) 245,718 245,944 2,30,307 0 (2,499,082) 245,944 245,945 245	160.761 1.344.766 603.604 965.822 (4,985.866) (4,745,286) 251.569 221.211 0.194.383 514.182 624.240 7.757 10.793 336.967 2,412.691 2,296.434 (2,575.977)	162,251 1.373,662 623,226 303,538 (6,121,038) (4,755,333) (4,755,333) 257,555 257,555 257,555 257,555 252,388 0 198,271 526,418 636,725 7,913 11,009 343,726 2,467,540 2,231,366 (2,653,488)	2,643,969 163,735 1,402,820 643,298 401,409 (6,285,231) (4,760,980) 263,680 263,680 263,680 263,680 202,236 538,937 449,459 8,071 11,229 8,071 11,229 8,071 11,229 8,071 11,229 8,071 11,229 (2,731,613)	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 249,948 249,948 249,248 0 0 206,281 551,747 662,448 8,232 11,454 8,232 11,454 357,613 2,280,952 2,281,885 (2,810,284)	2,797,729 166,637 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,360 276,360 276,360 276,360 251,046 0 210,407 564,854 675,697 11,683 364,765 2,263,9570 2,276,093 (2,889,473)	2,875,841 168,152 1,491,773 706,892 425,979 (5,668,636) (4,768,827) 282,921 282,921 282,921 282,921 282,921 282,921 259,025 0 214,615 578,264 689,221 689,221 8,565 11,917 372,061 372,061 2,269,900 2,270,996 (2,969,136)	169.609 1.521.887 729.264 434.499 (5,810.003) (4,768,540) 229.634 229.634 229.634 229.634 229.634 229.534 267.223 0 21.9.907 702.999 87.39 12.155 379.502 2,760,772 2,266,544 (3,049,232)	171.058 1.552.215 752.249 443.188 (5,953.126) (4,766.837) 296.502 296.502 296.502 296.502 275.645 0 223.285 606.022 717.056 8.911 12.398 387.092 2.823.414 2.260.788 (3,129,712)	172,496 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 303,530 303,530 284,298 0 227,751 620,385 731,397 731,397 731,397 12,646 304,834 2,887,458 2,285,678 (3,210,528)	173.924 1613.474 800.121 461.093 (6.244.602) (4.759.291) 310.719 310.719 310.719 310.719 293.187 0 223.06 635.080 746.025 9.271 12.899 402.730 2.952.937 2.250.565 (3.291.665)	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 3318,075 332,319 0 236,952 650,115 760,945 9,456 13,157 410,785 3,019,879 2,245,449 (3,373,032)	176,742 1,875,844 850,638 479,721 (6,542,879) (4,746,338) 325,601 325,601 325,601 325,601 325,601 325,601 341,698 0 241,691 665,497 776,164 9,945 13,420 419,001 3,068,317 2,240,328 (3,454,562)	164,412 1,660,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 333,300 333,300 336,380 0 246,525 681,234 791,687 9,061 12,634 394,466 3,118,625 2,207,136 (3,484,807)	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 0 251,455 697,334 807,521 7,480 10,407 10,407 3,096,076 2,137,734 (3,446,160)	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237 349,237 349,237 312,581 0 256,485 713,806 823,671 5,812 8,086 252,464 252,464 (3,405,016)	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) (4,209,823) (4,209,823) (4,209,823) (4,209,823) (4,209,823) (3,361,428 357,482 364,484 3,044,484 3,364,289 (3,361,289)	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,918 365,917 365,918 3,315,923 (3,314,903) (3,314,903)	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) 374,546 374,546 374,546 374,546 305,290 0 272,184 765,538 874,087 380 529 1,66,528 (3,259,310) (3,259,310)	0 1.540.761 853.372 0 (6.347.243) (3.873.537) 383.374 383.374 383.374 383.374 383.374 383.374 383.374 383.374 0 0 0 277.627 783.580 891.568 991.568 0 0 0 0 (3.315,017) (3.315,017)
Benefits: Annual Running Costs: Net escalated benefit/(cost)	SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total bendfts Discounted Benefits (In 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	4,000,000 5,500,000 33,500,000 2,346,827 157,772 1,287,788 566,196 370,840 (4,729,422) (4,729,422) 240,000 24	159.268 1.316.139 584.688 378.257 (4.858.127) (4.739.636) 245.718 24	160.761 1.344.766 603.604 965.822 (4,985.866) (4,745,286) 251.569 221.211 0.194.383 514.182 624.240 7.757 10.793 336.967 2,412.691 2,296.434 (2,575.977)	162,251 1.373,662 623,226 623,226 393,538 (5,121,038) (4,755,393) (4,755,393) (4,755,393) (4,755,393) (5,121,038) (4,755,393) (5,121,038	2,643,969 163,735 443,298 401,409 (5,255,231) (4,760,380) 263,880 263,880 263,880 263,880 202,236 538,837 0 0 202,236 538,837 649,459 8,071 11,229 8,071 11,229 350,601 2,523,618 2,286,273	2,720,432 165,214 1,432,230 663,924 409,437 (5,391,236) (4,765,067) 269,948 269,948 269,948 269,948 269,948 206,281 551,747 662,448 8,232 11,454 8,232 11,454 357,613 2,580,952 2,281,185	2,797,729 166,687 1,461,884 685,117 417,626 (5,529,042) (4,767,676) 276,380 276,380 276,380 276,380 276,380 276,380 276,380 276,380 276,380 0 210,407 564,854 675,697 8,397 11,683 364,765 2,639,570 2,276,093	2,875,841 168,152 1,491,773 706,862 425,979 (5,668,536) (4,768,827) 282,921 282,921 282,921 282,921 282,921 282,921 282,921 0 0 214,615 578,264 0 0 214,615 578,264 0 2,565 11,917 372,061 2,599,500 2,270,996	169.609 1.521.887 729.264 434.499 (6.840.033) (4.768.540) 289.634 289.634 289.634 289.634 287.723 0 219.607 501.984 702.986 8.735 12.155 379.502 2.760,772 2.265,894	171.058 1.552.215 752.249 443.188 (5.953.126) (4.766,837) (4.766,837) 2.96,502 2.95,565 0.02 2.75,645 0.023,285 6.06,022 717.056 8.911 12.388 387,092 397,092	172,466 1,582,745 775,861 452,052 (6,097,986) (4,763,737) 303,530 303,530 303,530 264,268 0 0 227,751 620,385 731,397 9,089 12,646 334,834 2,887,458 2,255,678	173.924 1613.474 800.121 461.093 (6.244.602) (4.759.291) 310.719 330.719 293.187 0 223.206 635.080 746.025 9.271 12.899 402.730 2.955.937 2.250,565	175,339 1,644,381 825,041 470,315 (6,392,911) (4,753,487) 318,075 318,075 302,319 0 226,952 650,115 760,945 9,456 13,157 410,785 3,019,879 2,245,449	176,742 1,875,444 850,638 479,721 (6,542,879) (4,746,338) 202,501 322,501 322,501 311,698 0 0 241,691 665,497 776,164 9,645 13,420 419,001 3,088,317 2,240,328	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 336,398 0 246,525 681,234 791,687 79,081 12,634 334,466 3,118,625 2,207,136	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 341,178 0,251,455 697,334 807,521 7,480 10,407 324,934 3,096,076 2,137,734	102,691 1,620,183 853,047 289,051 (6,476,334) (4,362,660) 349,237 349,237 349,237 312,2861 0 0 256,485 713,806 1 823,671 5,812 8,086 557 2,068,957 2,066,957	71,082 1,588,846 847,004 847,004 847,004 (6,405,743) (6,405,743) (4,209,823) 357,482 357,482 357,482 357,482 301,386 0 0 261,614 730,658 176,965 3,044,454 2,000,800	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,918 3,516 98,345 3,515	0 1,523,786 833,149 18,902 (6,242,916) (3,905,117) (3,905,117) (3,905,117) 0 0 0 272,184 765,536 74,087 874,077 874,077 87	0 1.540.761 853.372 0 (6,347,242) (3,873,537) 383.374 383.374 383.374 312.700 0 277,627 783,580 0 0 0 0 0 0 0 0 0 0 0 0 0

ALTERNATIVE 5

	Year of analysi Escalation rat Discount rat	is 2020 te 2.00%	sk adjustments (+/- ı	percent): Benefits Capital costs Running costs	0% 0% 0%										HSW	Alternative Study Alternative ernative Cost Anal	ysis (\$)					
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	Year 2035	2036	2037	2038	2039	2040
Expressed in 2020 dollars, une	escalated dollars	L							I.		ľ	ľ	ľ	ľ								
Capital Outlays																						
	BUS + Interconnection SCR	24,000,000 4,000,000 6,000,000																				
	HSW Receiving Facility Dig 1&3 Improvements	6,000,000 5,500,000																				
	Total capital outlays	39,500,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benefits:																						
	D3 RINs D5 RINs	2,346,827	2,372,328 996,298	2,396,794 985,920	2,420,224 975,542	2,442,619 965,164	2,463,979 954,786	2,484,303 944,407	2,503,592 934,029	2,521,846 923,651	2,539,065 913,273	2,555,248 902,895	2,570,417 892,517	2,584,550 882,139	2,597,648 871 761	2,609,710 124,604	2,620,736 99.415	2,630,726 74,804	2,639,681 50,772	2,647,599	2,654,482	2,660,329
	LCFS	2,909,263	1,290,332	1,292,547	1,294,433	1,295,988	1,297,215	1,298,111	1,298,678	1,298,916	1,298,824	1,298,402	1,297,657	1,296,583	1,295,172	1,273,585	1,226,510	1,180,215	1,134,694	1,089,947	1,045,974	1,036,888
	Natural Gas Sale HSW Tipping Fee	1,279,100 2,366,173	573,224 2,366,173	580,252 2,366,173	587,280 2,366,173	594,308 2,366,173	601,336 2,366,173	608,364 2,366,173	615,392 2,366,173	622,420 2,366,173	629,448 2,366,173	636,476 2,366,173	643,508 2,366,173	650,539 2,366,173	657,571 2,366,173	654,398 342,280	637,898 276,419	621,398 210,558	604,899 144,697	588,399 78,836	571,899 12,975	574,295 0
	Total benefits	(9,908,039)	(7,598,355)	(7,621,686)	(7,643,652)	(7,664,252)	(7,683,488)	(7,701,359)	(7,717,866)	(7,733,007)	(7,746,783)	(7,759,194)	(7,770,272)	(7,779,985)	(7,788,325)	(5,004,576)	(4,860,978)	(4,717,702)	(4,574,742)	(4,432,097)	(4,289,768)	(4,271,512)
Annual Running Costs:																						
	Engine O&M SCR O&M	240,000 240,000	240,900 240,900	241,800 241,800	242,700 242,700	243,600 243 600	244,500 244,500	245,400 245,400	246,300 246,300	247,200 247,200	248,100 248,100	249,000 249,000	249,900 249,900	250,800 250,800	251,700 251,700	252,600 252,600	253,500 253,500	254,400 254,400	255,300 255,300	256,200 256,200	257,100 257,100	258,000 258,000
	Biogas Upgrading O&M	468,699	471,274	473,849	476,424	479,000	481,575	484,150	486,726	489,301	491,876	494,451	497,028	499,604	502,181	239,790	233,744	227,698	221,652	215,606	209,560	210,438
	NC Demand Natural Gas Purchased - Dryer	186,835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835	186.835
	Natural Gas Purchased - Engine	490,537	492,376	494,216	496,055	497,895	499,734	501,574	503,413	505,253	507,092	508,932	510,771	512,611	514,450	516,290	518,130	519,969	521,809	523,648	525,488	527,327 450,000
	HSW Facility O&M Dig 1 & 5 O&M	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000 600,000	450,000
	Dewatering Polymer Dewatering Power	47,574 66,194	47,574 66,194	47,574 66,194	47,574 66,194	47,574 66,194	47,574 66,194	47,574 66,194	47,574 66,194	47,574	47,574 66,194	47,574 66 194	47,574 66,194	47,574 66,194	47,574 66,194	6,882 9,575	5,558 7,733	4,233 5,890	2,909 4,048	1,585 2,205	261 363	0
	Class B Hauling	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	2,066,676	298,956	241,431	183,906	126,382	68,857	11,332	0
	Total running costs	4,856,515	4,862,730	4,868,944	4,875,159	4,881,374	4,887,589	4,893,804	4,900,018	4,906,233	4,912,448	4,918,663	4,924,879	4,931,095	4,937,311	2,813,528	2,750,430	2,687,333	2,624,235	2,561,137	2,498,039	2,490,600
Net Benefit/(cost)		34,448,476	(2,735,626)	(2,752,742)	(2,768,492)	(2,782,879)	(2,795,900)	(2,807,556)	(2,817,847)	(2,826,774)	(2,834,335)	(2,840,532)	(2,845,394)	(2,848,890)	(2,851,014)	(2,191,048)	(2,110,548)	(2,030,369)	(1,950,507)	(1,870,960)	(1,791,729)	(1,780,912)
Expressed in escalated dollars	s with sensitivity adjustments																					
Capital Outlays																						
	BUS + Interconnection	24,000,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SCR Dig 1&3 Improvements	4,000,000 5,500,000	0 0 0	0	0 0 0	0	0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0	0 0 0	0 0 0	0	0 0 0	0 0	0 0 0	0	0 0 0	0 0
	SCR	4.000.000	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
Benefits:	SCR Dig 1&3 Improvements Total capital outlays (Pvs)	4,000,000 5,500,000 39,500,000					0					0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0		0 0 0 0	0 0 0 0
Benefits:	SCR Dig 1&3 Improvements	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676	2,419,774 1,016,224	2,493,624 1,025,751	2,568,361 1,035,253	2,643,969 1,044,724	2,720,432 1,054,160	2,797,729	2,875,841	2,954,745 1,082,205	0 0 0 3,034,417 1,091,446	0 0 0 3,114,833 1,100,624	0 0 0 3,195,990 1,109,733	0 0 0 3.277.835 1.118.765	0 0 0 3,360,335 1,127,715	0 0 0 3,443,457 164,412	0 0 0 3,527,166 133,800	0 0 0 3,611,423 102,691	0 0 0 3,696,190 71,092	3,781,424 39,014	0 0 0 3,867,079 6,466	0 0 0 3,953,109 0
Benefits:	SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263	2,419,774 1,016,224 1,316,139	2,493,624 1,025,751 1,344,766	2,568,361 1,035,253 1,373,662	2,643,969 1,044,724 1,402,820	0 0 2,720,432 1,054,160 1,432,230	2,797,729	2,875,841 1,072,906 1,491,773	2,954,745 1,082,205 1,521,887	1,091,446 1,552,215	1,100,624 1,582,745	1,109,733	1,644,381	1,127,715 1,675,444	164,412 1,680,469	133,800 1,650,721	102,691 1,620,183	71,092 1,588,846	3,781,424 39,014 1,556,713	6,466 1,523,786	0 1,540,761
Benefits:	SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263 1,279,100 2,366,173	2,419,774 1,016,224 1,316,139 584,688 2,413,497	2,493,624 1,025,751 1,344,766 603,694 2,461,767	2,568,361 1,035,253 1,373,662 623,226 2,511,002	2,643,969 1,044,724 1,402,820 643,298 2,561,222	0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447	2,797,729 1,063,556 1,461,884 685,117 2,664,695	2,875,841 1,072,906 1,491,773 706,892 2,717,989	2,954,745 1,082,205 1,521,887 729,264 2,772,349	1,091,446 1,552,215 752,249 2,827,796	1,100,624 1,582,745 775,861 2,884,352	1,109,733 1,613,474 800,121 2,942,039	1,644,381 825,041 3.000.880	1,127,715 1,675,444 850,638 3,060,898	164,412 1,680,469 863,464 451,631	133,800 1,650,721 858,527 372,023	102,691 1,620,183 853,047 289,051	71,092 1,588,846 847,004 202,610	3,781,424 39,014 1,556,713 840,378 112,597	6,466 1,523,786 833,149 18,902	0 1,540,761 853,372 0
Benefits:	SCR Dig 18.3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263 1,279,100 2,366,173 (9,908,039)	2,419,774 1,016,224 1,316,139 584,688 2,413,497 (7,750,322)	2,493,624 1,025,751 1,344,766 603,694 2,461,767 (7,929,602)	2,568,361 1,035,253 1,373,662 623,226 2,511,002 (8,111,504)	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033)	0 0 2.720,432 1,054,160 1,432,230 663,924 2,612,447 (8,483,192)	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982)	2,875,841 1,072,906 1,491,773 706,892 2,717,989 (8,865,402)	2,954,745 1,082,205 1,521,887 729,264 2,772,349 (9,060,450)	1,091,446 1,552,215 752,249 2,827,796 (9,258,123)	1,100,624 1,582,745 775,861 2,884,352 (9,458,415)	1,109,733 1,613,474 800,121 2,942,039 (9,661,357)	1,644,381 825,041 3,000,880 (9,866,902)	1,127,715 1,675,444 850,638 3,060,898 (10,075,029)	164,412 1,680,469 863,464 451,631 (6,603,432)	133,800 1,650,721 858,527 372,023 (6,542,236)	102,691 1,620,183 853,047 289,051 (6,476,394)	71,092 1,588,846 847,004 202,610 (6,405,743)	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126)	6,466 1,523,786 833,149 18,902 (6,249,382)	0 1,540,761 853,372 0 (6,347,242)
	SCR Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263 1,279,100 2,366,173	2,419,774 1,016,224 1,316,139 584,688 2,413,497	2,493,624 1,025,751 1,344,766 603,694 2,461,767	2,568,361 1,035,253 1,373,662 623,226 2,511,002	2,643,969 1,044,724 1,402,820 643,298 2,561,222	0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447	2,797,729 1,063,556 1,461,884 685,117 2,664,695	2,875,841 1,072,906 1,491,773 706,892 2,717,989	2,954,745 1,082,205 1,521,887 729,264 2,772,349	1,091,446 1,552,215 752,249 2,827,796	1,100,624 1,582,745 775,861 2,884,352	1,109,733 1,613,474 800,121 2,942,039	1,644,381 825,041 3.000.880	1,127,715 1,675,444 850,638 3,060,898	164,412 1,680,469 863,464 451,631	133,800 1,650,721 858,527 372,023	102,691 1,620,183 853,047 289,051	71,092 1,588,846 847,004 202,610	3,781,424 39,014 1,556,713 840,378 112,597	6,466 1,523,786 833,149 18,902	0 1,540,761 853,372 0
Benefits: Annual Running Costs:	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$)	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263 1,279,100 2,366,173 (9,908,039)	2,419,774 1,016,224 1,316,139 584,688 2,413,497 (7,750,322) (7,561,290)	2,493,624 1,025,751 1,344,766 603,694 2,461,767 (7,929,602)	2.568.361 1.035,253 1.373,662 623,226 2.511,002 (8,111,504) (7,532,338) 257,555	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033)	0 0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447 (8,483,192) (7,497,906) 269,948	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982)	2.875.841 1,072.906 1,491,773 700.892 2,717.989 (6,865.402) (7,458,154) 282.921	2,954,745 1,082,205 1,521,887 729,264 2,772,349 (9,060,450)	1,091,446 1,552,215 752,249 2,827,796 (9,258,123) (7,413,241)	1,100,624 1,582,745 775,861 2,884,352 (9,458,415)	1,109,733 1,613,474 800,121 2,942,039 (9,661,357) (7,363,353)	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593)	1,127,715 1,675,444 850,638 3,060,898 (10,075,029)	164,412 1,680,469 863,464 451,631 (6,603,432)	133,800 1,650,721 858,527 372,023 (6,542,236)	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660)	71,092 1,588,846 847,004 202,610 (6,405,743)	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126)	6,466 1,523,786 833,149 18,902 (6,249,382)	0 1,540,761 853,372 0 (6,347,242) (3,873,537) 383,374
	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263 1,279,100 2,366,173 (9,906,039) (9,908,039) 240,000 240,000	2,419,774 1,016,224 1,316,139 584,688 2,413,497 (7,750,322) (7,561,290) 245,718 245,718	2,493,624 1,025,751 1,344,766 603,694 2,461,767 (7,929,602) (7,547,509) 251,569	2.568.361 1.035,253 1.373,662 623,226 2.511,002 (8,111,504) (7,532,338) 257,555	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033) (7,515,797) 263,680 263,680	0 0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447 (8,483,192) (7,497,906) 269,948	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982) (7,478,685) 276,360 276,360	2.875.841 1,072.906 1,491,773 700.892 2,717.989 (6,865.402) (7,458,154) 282.921	2,954,745 1,082,205 1,521,887 729,264 2,772,349 (9,060,450) (7,436,333) 289,634 289,634	1,091,446 1,552,215 752,249 2,827,796 (9,258,123) (7,413,241)	1,100,624 1,582,745 775,861 2,884,352 (9,488,415) (7,388,898) 303,530 303,530	1,109,733 1,613,474 800,121 2,942,039 (9,661,357) (7,363,353)	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593) (7,336,593) 318,075 318,075	1,127,715 1,675,444 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,601	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300	133.800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178	102,691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237	71,092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546	0 1,540,761 853,372 0 (6,347,242) (3,873,537) 383,374
	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263 1,279,100 2,366,173 (9,906,039) (9,906,039) 240,000 240,000 240,000 0 0 0 0 0 0 0 0 0 0 0 0	2,419,774 1,016,224 1,316,139 584,688 2,413,497 (7,756,322) (7,561,290) 245,718 245,718 480,699 0	2,493,624 1,025,751 1,344,766 603,594 2,461,767 (7,529,602) (7,547,659) 251,569 251,569 492,993 0	2,560,361 1,035,253 1,373,662 633,226 633,226 (6,111,564) (7,532,336) 257,555 257,555 505,585 0,585 0,585	2,643,969 1,044,724 1,402,820 643,298 (8,296,033) (7,515,797) 283,880 283,880 283,680 518,485 0	0 2,720,432 1,054,160 1,432,230 663,924 2,612,447 (8,483,192) (7,497,996) 269,948 269,948 269,948 0 0	2,797,729 1,063,556 1,4,61,884 685,117 2,664,695 (8,672,982) (7,478,685) 276,360 276,360 276,360 276,360 0	2,875,841 1,072,906 1,491,773 706,892 2,717,989 (8,855,402) (7,458,154) 282,921 282,921 282,921 559,995 0	2,954,745 1,082,205 1,521,887 729,264 2,772,349 (9,060,450) (7,436,333) 289,634 289,634 573,294 0	1,091,446 1,552,215 7,52,249 2,827,796 (9,258,123) (7,413,241) 296,502 296,502 296,502 587,838 0	1,100,624 1,582,745 775,861 2,884,352 (9,458,415) (7,388,898) 303,530 303,530 602,734 0	1,109,733 1,613,474 800,121 2,942,039 (9,661,357) (7,363,353) 310,719 310,719 310,719 0	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593) 318,075 318,075 633,619 0	1,127,715 1,675,444 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,601 649,625 0	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 333,300 331,638 0	133,800 1,650,721 856,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 0	102.691 1,620,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237 349,237 312,581 0	71.092 1,588.846 847.004 202.610 (6,405,743) (4,209,823) 357,482 357,482 310,366 0	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 0,939 0,0	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 374,546 305,290 0	0 1,540,761 853,372 0 (6,347,242) (3,873,637) 383,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 384,374 385,3
	SCR Dig 183 Improvements Total capital outlays (Pvs) DS RINs DS RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR 0&M Biogas Upgrading 0&M NG Demand Natural Gas Purchased - Dryer	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,209,263 1,279,100 2,366,173 (9,308,039) (9,308,039) 240,000 240,000 240,000 468,699 0 186,835	2,419,774 1,016,224 1,316,139 564,688 2,413,497 (7,564,290) 245,718 245,718 245,718 480,699 0 0 190,572	2,493,624 1,025,751 1,344,766 603,694 2,451,767 (7,929,602) (7,547,509) (251,569 2251,569 492,993 0 194,383	2,568,361 1,035,283 1,373,662 2,511,002 (6,111,504) (7,532,338) 257,565 257,565 257,565 505,585 0 198,271	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033) (7,515,797) 263,680 263,680 518,485 0 518,485 0 0,202,236	0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447 (6,483,192) (7,497,906) 269,948 269,948 269,948 0 0 206,281	2,797,729 1,063,556 1,461,884 885,117 2,664,695 (8,672,982) (7,478,685) 276,360 276,360 276,360 240,407	2,875,841 1,072,906 1,491,773 706,892 2,717,989 (8,865,402) (7,458,154) 2,82,921 2,921	2,954,745 1,082,205 1,521,887 729,264 2,772,349 (9,060,450) (7,436,333) (7,436,333) 289,634 289,634 289,634 289,634 289,634 289,634	1,091,446 1,552,215 752,249 2,827,796 (9,258,123) (7,413,241) 296,502 296,502 296,502 296,502 296,502 296,502 296,502 296,502 202,285	1,100,624 1,582,745 775,861 2,884,352 (9,458,445) (7,388,898) 303,530 303,530 602,734 0 227,751	1,109,733 1,613,474 800,121 2,942,039 (9,661,357) (7,363,353) 310,719 310,719 310,719 617,992 0 223,06	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593) 318,075 318,075 633,619 0 236,952	1,127,715 1,675,444 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,601 325,601 649,625 0 241,691	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 333,300 334,638 0 246,625	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 314,589 0 251,455	102.691 1,620.183 853,047 289,051 (6,476,534) (4,362,660) 349,237 349,237 312,581 0 256,485	71,092 1,568,846 847,004 202,610 (6,405,743) (4,209,823) (4,209,823) 357,482 357,482 357,482 310,366 0 261,614	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 307,399 0 206,647	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 374,546 305,290 0 272,184	0 1,540,761 853,372 0 (6,547,742) (3,873,537) 383,374 383,374 383,374 383,374 383,374
	SCR Dig 183 Improvements Total capital outlays (Pvs) DS RINs DS RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR 0&M Biogas Upgrading 0&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine	4.000,000 5.500,000 39,500,000 2,346,827 1.006,676 2,909,263 1,279,100 2,366,173 (9,908,039) (9,908,039) 240,000 240,000 240,000 468,699 0 186,835 490,537	2,419,774 1,016,224 1,316,139 584,688 2,413,478 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,750,322 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,320 7,50,30 7,50,30 7,50,30 7,50,30 7,50,30 7,50,30 7,50,30 7,50,30 7,50,30 7,50,30 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,50 7,	2,493,624 1,025,751 1,344,766 603,694 2,461,767 (7,929,602) (7,547,509) 251,569 251,569 492,993 0 194,383 514,182	2,568,361 1,035,283 1,373,662 623,226 2,511,002 (6,111,504) (7,532,338) 257,555 267,555 267,555 505,585 0 198,271 526,418	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033) (7,515,797) 263,680 263,680 263,680 518,485 0 518,485 0 202,236 538,937	0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447 (8,483,192) (7,497,906) 269,948 269,948 269,948 269,948 0 0 0 206,281 551,747	2,797,729 1,063,556 3,461,884 885,117 2,664,695 (8,672,982) (7,478,685) 276,360 276,360 276,360 276,360 240,407 564,854	2,875,841 1,072,906 1,491,773 706,892 2,717,989 (8,865,402) (7,458,154) 282,921 282,921 282,921 282,921 282,921 282,925 0 0 214,415 578,284	2,954,745 1,052,205 1,521,887 729,264 2,772,349 (9,060,450) (7,436,333) (7,436,333) 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634 289,634	1,091,446 1,552,215 752,249 2,827,796 (9,258,123) (7,413,241) 296,502 296,502 296,502 587,838 0 0 223,285 606,022	1,100,624 1,582,745 775,861 2,884,352 (9,458,445) (7,388,898) 303,530 303,530 602,734 602,734 602,734 602,734	1,109,733 1,613,474 800,121 2,942,039 (9,661,357) (7,363,353) 310,719 310,719 617,992 0 0 282,306 635,080	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593) 318,075 318,075 633,619 0 286,952 650,115	1,127,715 1,675,444 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,601 325,601 0 649,625 0 241,691 665,497	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 333,300 333,300 336,398 0 246,525 681,234	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,589 0 251,455 697,334	102.691 1,620.183 853.047 289.051 (6,476,534) (4,362,660) 349.237 349.237 349.237 312.581 0 256,485 713.806	7102 1,68846 847064 20260 (6,405,743) (4,209,823) 357,482 357,482 310,366 0 261,614 730,658	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 365,917 0 0 266,647 747,898	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 374,546 374,546 0 0 272,184 765,536	0 1,540,761 853,372 0 (6,547,242) (3,873,537) 383,374 383,374 383,374 383,374 312,700 0 0 277,627 783,580
	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,209,263 1,279,100 2,366,173 (9,308,039) (9,308,039) 240,000 240,000 240,000 468,699 0 186,835	2,419,774 1,016,224 1,316,139 564,688 2,413,497 (7,564,290) 245,718 245,718 245,718 480,699 0 0 190,572	2,493,624 1,025,751 1,344,766 603,694 2,451,767 (7,929,602) (7,547,509) (251,569 2251,569 492,993 0 194,383	2,568,361 1,035,283 1,373,662 2,511,002 (6,111,504) (7,532,338) 257,565 257,565 257,565 505,585 0 198,271	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033) (7,515,797) 263,680 263,680 518,485 0 518,485 0 0,202,236	0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447 (6,483,192) (7,497,906) 269,948 269,948 269,948 0 0 206,281	2,797,729 1,063,556 1,461,884 885,117 2,664,695 (8,672,982) (7,478,685) 276,360 276,360 276,360 240,407	2,875,841 1,072,906 1,491,773 706,892 2,717,989 (8,865,402) (7,458,154) 2,82,921 2,921	2,954,745 1,082,205 1,521,887 729,264 2,772,349 (9,060,450) (7,436,333) (7,436,333) 289,634 289,634 289,634 289,634 289,634 289,634	1,091,446 1,552,215 752,249 2,827,796 (9,258,123) (7,413,241) 296,502 296,502 296,502 296,502 296,502 296,502 296,502 296,502 202,285	1,100,624 1,582,745 775,861 2,884,352 (9,458,445) (7,388,898) 303,530 303,530 602,734 0 227,751	1,109,733 1,613,474 800,121 2,942,039 (9,661,357) (7,363,353) 310,719 310,719 310,719 617,992 0 223,06	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593) 318,075 318,075 633,619 0 236,952	1,127,715 1,675,444 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,601 325,601 649,625 0 241,691	164,412 1,680,469 863,464 451,631 (6,603,432) (4,673,428) 333,300 333,300 333,300 334,638 0 246,625	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 314,589 0 251,455	102.691 1,620.183 853,047 289,051 (6,476,534) (4,362,660) 349,237 349,237 312,581 0 256,485	71,092 1,568,846 847,004 202,610 (6,405,743) (4,209,823) (4,209,823) 357,482 357,482 357,482 310,366 0 261,614	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 307,939 0 266,847 747,896 856,948	6,466 1,523,786 833,149 18,902 (6,249,382) (3,909,162) 374,546 374,546 374,546 305,290 0 272,184	0 1,540,761 853,372 0 (6,547,242) (3,873,537) 383,374 383,374 383,374 312,700 0 277,627
	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LOFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M SCR 0&M Biogas Upgrading 0&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263 1,279,100 2,366,173 (9,908,039) (9,908,039) 240,000 468,699 0 186,835 490,537 600,000 47,574 66,194	2,419,774 1,016,224 1,316,139 584,688 2,413,497 (7,756,322) (7,561,290) 2,45,718 2,45,718 4,400,697 502,224 612,000 4,8,556 67,518	2,493,624 1,025,751 1,344,766 603,694 2,461,767 (7,929,602) (7,547,509) 251,569 492,993 0 194,383 5,14,182 624,240 49,496 68,888	2,568,361 1,035,253 1,373,662 623,226 2,511,002 (8,111,504) (7,532,338) 257,555 257,555 257,555 257,555 505,585 0 0 198,271 526,418 636,725 50,486 70,245	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033) (7,515,797) 263,680 263,680 263,680 263,680 518,485 0 0 202,236 538,937 649,459 51,496 71,650	0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447 (8,483,192) (7,497,906) 269,948 269,948 269,948 269,948 269,948 0 0 206,281 551,747 662,448 52,526 73,083	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982) (7,478,685) 276,360 276,360 276,360 276,360 276,360 276,360 276,360 645,232 0 0 10,407 564,854 675,697 53,577 74,545	2,875,841 1,072,906 1,491,773 706,892 2,717,989 (6,865,402) (7,458,154) 7,458,154) 7,458,154) 7,458,154) 7,458,154 282,921 282,921 282,925 0,0 0 214,415 578,264 689,211 54,648 76,036	2,954,745 1,062,205 1,521,887 729,264 2,772,349 (3,060,459) (7,436,333) 289,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 209,634 207,732,944 207,7556 207,75	1,091,446 1,552,215 7,52,249 2,827,796 (9,258,123) (7,413,241) 296,502 296,502 296,502 296,502 296,502 0 223,285 606,022 717,056 56,856 79,108	1,100,624 1,582,745 775,861 2,884,352 (9,456,415) (7,388,888) 303,530 303,530 602,734 0,227,751 620,385 731,397 57,993 80,690	1 (109 733 1 (613 474 800, 121 2,942 (39 (8,661,387) (7,363,353) 310,719 310,719 617,992 0 0 0 232,306 655,080 746,025 59,153 82,304	1,644,381 825,041 3,000,880 (8,666,902) (7,336,593) 318,075 318,075 633,619 0 236,965 650,115 760,945 60,336 83,950	1,127,715 1,875,844 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,601 325,601 325,601 325,601 0 241,601 665,497 776,164 61,543 85,629	164.412 1.680.469 863.464 451.631 (6,633.422) (4,673.428) 333.300 333.300 246.595 661.234 791.687 9,081 12,634	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 0 0 251,455 697,334 807,521 7,460 10,407	102,691 1,622,043 853,047 289,051 (6,476,394) (4,352,660) 349,237 349,237 349,237 349,237 312,581 0 2256,485 713,806 823,671 5,812 8,086	17102 1,588,846 847,004 202,610 202,610 202,610 202,610 202,617 202,610 357,482 357,482 357,482 310,366 0 261,614 730,658 840,145 4,074 5,688	3,781,424 39,014 1,556,713 840,378 840,378 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,918 315,918 3	6 466 1,523 786 833 149 18,902 (6,244 352) (3,909,162) 374,546 374,546 374,546 374,546 374,546 305,290 0 272,184 765,536 874,087 380 529	0 1,540,761 853,372 0 (6,547,242) (3,873,537) 383,374 383,374 383,374 312,700 0 277,627 783,580
	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LCFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M SCR O&M Biogas Legraching O&M NG Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauling	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,909,263 1,279,100 2,366,173 (9,908,039) (9,908,039) 2240,000 240,000 468,699 0 186,835 490,537 60,000 47,574 66,194 2,066,676	2419774 1.016224 1.31616224 1.3161389 584.688 2.413.497 (7,760,322) 245.718 245.718 245.718 245.718 245.718 245.718 245.718 245.718 245.718 245.718 245.718 250.224 612.000 46.526 67.518 2.108.010	2,493,624 1,025,751 1,344,766 603,694 2,401,767 (7,547,509) 251,569 251,569 492,993 0 144,383 514,182 624,240 49,496 68,888 2,150,170	2568.361 1.055.253 1.373.662 2.511.002 (6,111,504) (7,532,338) 257.555 505.585 505.585 0 198.271 526.418 526.418 50.466 70.245 2,193,173	2.643,969 1.044,724 1.402,820 643,298 2.561,222 (6,296,033) (7,515,797) 2.63,680 2.63,680 2.63,680 2.63,680 2.63,680 2.63,680 2.63,680 2.63,680 2.63,680 2.63,680 2.63,680 2.63,680 2.64,459 5.1496 5.149	0 2,270,422 1,054,160 1,432,230 663,924 2,612,447 (8,483,192) (7,497,996) 269,948 531,698 0 206,281 551,747 52,526 73,083 2,281,777	2,797,729 1,063,556 1,461,884 085,117 2,664,605 (8,672,382) (7,478,885) (7,478,885) 276,360 276,360 276,360 276,360 276,360 276,360 545,232 0 210,407 544,854 53,577 74,545 2,327,413	2875 841 1.072.906 1.491.773 706.892 2.717.969 (8,865.402) 282.921 282.921 282.921 282.921 282.921 559.095 0 214.615 578.264 689.211 64.648 76.036 2.373.961	2 954 745 1 082 205 1 521 887 729 284 2,772 249 (9,060,450) (7,435,533) 289,634 289,634 53 294 0 218,907 591 984 5,741 77,556 2,421,440	1,091,446 1,552,215 7,652,249 2,827,796 (9,258,123) (7,413,241) 296,502 296,502 296,502 296,502 296,502 3687,838 0 223,265 606,022 717,056 55,856 79,108 2,469,869	1,100,624 1,582,745 775,861 2,884,352 (9,456,415) (7,388,888) 303,530 303,530 602,734 0 0 227,751 620,385 731,397 57,993 80,690 2,519,267	1 (109 733 1 (109 733 1 (109 733) 1 (109 734) 2 (942 039 (9,661,357) (7,363,353) 3 (10,719 3 (10,719 0 (17,992) 0 (17,992) 0 (10,992) 0 (1	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593) 318,075 633,619 0 236,952 653,115 60,336 60,336 83,950 2,621,045	1,127,715 1,875,844 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,601 325,601 325,601 325,601 0 241,691 665,497 776,164 61,543 85,629 2,673,466	164.412 1.680.469 863.464 451.631 (6,633.432) (4,673.428) 333.300 333.300 346.398 0246.525 661.234 	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 0 0 251,455 697,334 	102.691 1.620.183 853.047 289.051 (6,476,394) (4,352,660) 349.237 349.237 349.237 312.581 0 256.485 713.806 823.671 5.812 8.086 8.086 8.086	17102 1,588,846 847,004 202,610 (4,205,743) (4,209,823) 357,482 357,482 357,482 357,482 310,366 0 0 261,614 730,658 840,145 4,074 5,668 176,965	3,781,424 3,9014 1,556,713 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 840,378 98,345 98,35 98,45 98,45 98,45 98,45 98,45 98,45 98,45	6 466 1,523 786 833 149 18,502 (5,249,362) (5,299,162) 374,546 374,546 305,290 0 272,184 765,536 874,087 380 529 16,509	0 1.540,761 863,372 0 (6,347,242) (3,873,537) 383,374 394,580 0 0 0 0 0 0 0 0 0 0 0 0 0
	SCR Dig 183 Improvements Total capital outlays (Pvs) D3 RINs D5 RINs LOFS Natural Gas Sale HSW Toping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M SCR 0&M Biogas Upgrading 0&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 0&M Dewatering Polymer	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,209,263 1,279,100 2,366,173 (9,306,039) (9,306,039) 240,000 240,000 240,000 468,699 0 186,835 490,537 600,000 47,574 66,194 2,066,676 4,406,515	2,419,774 1,016,224 1,316,139 584,688 2,413,497 (7,756,322) (7,561,290) 2,45,718 2,45,718 4,400,697 502,224 612,000 4,8,556 67,518	2,493,624 1,025,751 1,344,766 603,694 2,461,767 (7,929,602) (7,547,509) 251,569 492,993 0 194,383 5,14,182 624,240 49,496 68,888	2,568,361 1,035,253 1,373,662 623,226 2,511,002 (8,111,504) (7,532,338) 257,555 257,555 257,555 257,555 0,0 198,271 526,418 636,725 50,466 70,245	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033) (7,515,797) 263,680 263,680 263,680 263,680 518,485 0 0 202,236 538,937 649,459 51,496 71,650	0 0 2,720,432 1,054,160 1,432,230 663,924 2,612,447 (8,483,192) (7,497,906) 269,948 269,948 269,948 269,948 269,948 0 0 206,281 551,747 662,448 52,526 73,083	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982) (7,478,685) 276,360 276,360 276,360 276,360 276,360 276,360 276,360 645,232 0 0 10,407 564,854 675,697 53,577 74,545	2,875,841 1,072,906 1,491,773 706,892 2,717,989 (6,865,402) (7,458,154) 7,458,154) 7,458,154) 7,458,154) 7,458,154 282,921 282,921 282,925 0,0 0 214,415 578,264 689,211 54,648 76,036	2,954,745 1,062,205 1,521,887 729,264 2,772,349 (3,060,459) (7,436,333) 289,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 298,634 209,634 207,732,944 207,7556 207,75	1,091,446 1,552,215 7,52,249 2,827,796 (9,258,123) (7,413,241) 296,502 296,502 296,502 296,502 296,502 0 223,285 606,022 717,056 56,856 79,108	1,100,624 1,582,745 775,861 2,884,352 (9,456,415) (7,388,888) 303,530 303,530 602,734 0,227,751 620,385 731,397 57,993 80,690	1 (109 733 1 (613 474 800, 121 2,942 (39 (8,661,387) (7,363,353) 310,719 310,719 617,992 0 0 0 232,306 655,080 746,025 59,153 82,304	1,644,381 825,041 3,000,880 (8,666,902) (7,336,593) 318,075 318,075 633,619 0 236,965 650,115 760,945 60,336 83,950	1,127,715 1,875,844 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,601 325,601 325,601 325,601 0 241,601 665,497 776,164 61,543 85,629	164.412 1.680.469 863.464 451.631 (6,633.422) (4,673.428) 333.300 333.300 246.595 661.234 791.687 9,081 12,634	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,178 0 0 251,455 697,334 807,521 7,460 10,407	102,691 1,622,043 853,047 289,051 (6,476,394) (4,352,660) 349,237 349,237 349,237 349,237 312,581 0 2256,485 713,806 823,671 5,812 8,086	17102 1,588,846 847,004 202,610 202,610 202,610 202,610 202,617 202,610 357,482 357,482 357,482 310,366 0 261,614 730,658 840,145 4,074 5,688	3,781,424 39,014 1,556,713 840,378 840,378 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,918 315,918 3	6 466 1,523 786 833 149 18,902 (6,244 352) (3,909,162) 374,546 374,546 374,546 374,546 374,546 305,290 0 272,184 765,536 874,087 380 529	0 1,540,761 853,372 0 (6,547,242) (3,873,537) 383,374 383,374 383,374 383,374 312,700 0 0 277,627 783,580
	SCR Dig 183 Improvements Total capital outlays (Pvs) DS RINs DS RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauing Total running costs	4,000,000 5,500,000 39,500,000 2,346,827 1,006,676 2,209,263 1,279,100 2,366,173 (9,306,039) (9,306,039) 240,000 240,000 240,000 468,699 0 186,835 490,537 600,000 47,574 66,194 2,066,676 4,406,515	2,419,774 1,016,224 1,316,139 544,688 2,413,477 (7,750,322) (7,561,290) 2,45,718 2,45,718 2,45,718 2,45,718 2,45,718 2,108,017 4,500,884 4,500,884	2,493,624 1,025,751 1,344,766 603,684 2,461,767 (7,929,602) (7,547,509) 251,569 251,569 251,569 251,569 492,993 492,993 492,993 624,240 49,486 68,868 2,150,170 2,150,170 4,375,938	2,568,361 1,035,283 1,373,662 623,226 (8,111,504) (7,532,338) 257,555 257,555 257,555 505,585 505,585 505,585 505,585 505,585 505,585 505,585 50,585 50,585 50,418 636,725 50,446 70,245 2,193,173 4,695,014	2.643.969 1.044,724 1.402,820 643.298 2.561,222 (6.296,033) (7,515,797) 263.680 263.680 263.680 202.236 518.485 0 202.236 538.397 649.459 51.496 71.650 2.237,037 4.796,662	0 0 2,720,432 1,054,160 1,432,230 663,924 2,812,447 (8,483,192) (7,497,906) 2269,948 2269,948 2269,948 531,698 0 0 206,281 551,747 662,448 52,526 73,083 2,281,777 4,889,457	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982) (7,478,685) 276,360 276,360 276,360 276,360 276,360 276,360 276,360 276,360 276,360 276,360 276,360 276,360 276,370 74,545 2,327,413 5,004,445	2,875,841 1,072,906 1,491,773 706,882 2,717,989 (8,865,402) (7,458,154) 282,921 282,921 282,921 282,921 282,921 282,921 282,921 282,921 689,211 54,648 76,036 2,373,961 5,111,672	2,964,745 1,062,205 1,521,887 729,264 2,772,349 (9,060,450) (7,436,333) 289,634 289,634 299,634 573,294 0 218,907 561,864 70,296 702,996 55,741 77,556 2,421,440 2,212,187	1,091,446 1,652,245 752,249 (9,255,123) (7,413,241) (7,413,241) (7,413,241) 2,96,502 2,96,502 2,96,502 2,96,502 2,96,502 5,87,838 0,022 7,17,056 7,17,056 7,51,08 2,466,869 5,333,038	1,100,624 1,582,745 775,861 2,884,352 (3,458,415) (7,388,898) (7,398,898)(7,398) (7,398,9	1109733 1613474 800121 2.942039 (9.661357) (7.663353) 310,719 310,719 617,992 0 2.22,306 6635,080 746,025 746,025 78,153 82,304 2,569,652	1,644,381 825041 3,000,880 (9,866,902) (7,336,593) 318,075 318,075 633,619 0 236,952 650,115 760,945 60,336 83,960 2,621,045 5,683,112	1,127,715 1,075,844 850,638 3,060,988 (10,075,029) (7,308,631) 225,601 325,601 649,625 0 0,241,661 665,497 776,164 61,543 85,629 2,673,466 5,804,815	164.412 1.680.469 863.464 451.631 (6.603.422) (4.673.428) (4.673.423) 333.300 33.6380 0 246.625 661.234 791.687 791.687 9.081 1.2.634 3.3.466 3.118.625	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 341,178 341,178 341,589 0 251,455 667,334 807,521 7,460 10,407 324,934 3,095,076	102,691 1,522,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 342,237 312,581 0 256,485 713,806 252,464 3,071,378	71092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 310,366 0 261,614 730,658 840,145 4,074 5,688 176,965 3,044,454	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 377,918 3	6.466 1.523.766 8.33.149 (6.249.382) (3.909.162) 374.546 374.546 374.546 374.546 374.546 374.546 765.536 765.536 874.087 874.087 874.087 874.087 870.0877 870.0877 870.087 870.087 870.087 870.087 8	0 1.540,761 853,372 0 (6,347,242) (3,873,537) 383,374 383,374 383,374 312,700 0 277,527 783,580 891,568 0 0 0 0 0 3,032,225
Annual Running Costs:	SCR Dig 183 Improvements Total capital outlays (Pvs) DS RINs DS RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauing Total running costs	4,000,000 5,500,000 39,500,000 2,246,827 1,006,676 2,299,263 1,279,100 2,366,173 (9,908,039) (9,908,039) 240,000 240,000 240,000 468,699 0 186,835 490,537 600,000 47,574 66,194 2,066,676 5,4406,515 4,406,515	2,419,774 1,016,224 1,316,139 544,688 2,413,477 (7,750,322) (7,750,32) (7,75	2,493,624 1,025,751 1,344,766 603,684 2,461,767 (7,929,602) (7,547,509) 251,569 251,569 251,569 251,569 492,993 492,993 492,993 624,240 49,486 68,868 2,150,170 2,150,170 4,375,938	2,568,361 1,035,283 1,373,662 623,226 2,511,002 (6,111,504) (7,532,338) 257,555 267,555 267,555 267,555 267,555 505,585 505,585 505,585 505,585 505,585 50,486 70,245 50,486 70,245 5,0,486 70,245 2,193,173 4,896,014 4,360,716	2.643.969 1.044,724 1.402,820 643.298 2.561.222 (8.296,033) (7,515,797) 263.880 263.880 263.880 263.880 0 202.236 518.485 0 202.236 538.337 649.459 51.496 71.650 2.237,037 4.796,662 4.345,539	0 0 2,720,432 1,054,160 1,432,230 663,924 2,812,447 (8,483,192) (7,497,906) 226,948 226,948 226,948 531,686 0 0 206,281 551,747 662,448 52,526 73,083 2,281,777 4,889,457 4,330,406	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982) (7,478,685) 276,360 277,745,455 3,577 74,545 3,500 4,455 4,315,317 3,577 3	2,875,841 1,072,906 1,491,773 706,882 2,717,899 (6,865,402) (7,458,154) 282,921 282,921 282,921 282,921 282,921 282,921 282,921 559,095 0 214,615 578,264 689,211 54,648 76,036 2,373,961 5,111,672 4,300,272	2,954,745 1,062,205 1,521,887 729,264 2,772,349 (9,060,450) (7,435,333) 289,634 299,634 573,294 0 2418,907 591,884 702,996 55,741 77,556 2,421,440 2,241,1440 2,241,147	1,091,446 1,652,215 752,249 (9,255,123) (7,413,241) (7,413,241) (7,413,241) 2,96,502 2,96,502 2,96,502 2,96,502 2,96,502 5,87,838 0,022 2,96,502 7,17,055 7,17,055 7,17,055 7,17,055 7,17,055 5,333,038 4,270,315	1,100,624 1,582,745 775,861 2,884,352 (3,458,415) (7,388,898) (7,398,898) (7,3	1 (109.73) 1 (513.474 800.121 2 942.039 (9.661.357) (7.63.353) 310.719 310.719 0 10.719 0 746.025 5.9.153 82.304 2.569.652 5.563.949 4.240.535	1,644,381 825041 3,000,880 (9,866,902) (7,336,583) 318,075 318,075 633,619 0 236,952 650,115 760,945 600,336 83,950 2,621,045 5,683,112 4,225,711	1,127,715 1,075,844 850,638 3,060,988 (10,075,029) (7,308,631) 225,601 325,601 649,625 0 241,661 665,497 776,164 61,543 85,629 2,673,466 5,804,815 4,210,931	164.412 1.680.469 863.464 451.631 (6.603.432) (4.673.428) (4.673.428) 0 333.300 33.6380 0 0 24.6.625 681.234 791.687 791.687 9.081 1.2.634 3.3.466 3.418.625 2.207.138	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 34	102,691 1,522,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 312,581 0 256,485 713,806 252,464 5,812 8,086 252,464 3,071,378 2,068,957	71092 1,588,846 847,004 202,610 (6,405,743) (4,209,823) 357,482 357,482 357,482 367,482 310,366 0 261,614 730,658 840,145 4,074 5,688 176,965 3,044,454 2,000,800	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 307,939 0 0 266,847 747,896 856,948 2,264 3,150 98,345 3,015,223 1,933,258	6.466 1.523.766 8.33.149 (6.249.382) (3.909.162) 374.546 374.546 374.546 374.546 374.546 765.536 765.536 874.087 380 529 1.865.328	0 1.540,761 853,372 0 (6,347,242) (3,873,537) 383,374 383,374 383,374 312,700 0 277,627 783,580 0 0 0 0 0 0 0 0 0 0 0 0 0
Annual Running Costs: Net escalated benefit/(cost) Life cycle cost analysis PVs in 2020	SCR Dig 183 Improvements Total capital outlays (Pvs) DS RINs DS RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauing Total running costs	4,000,000 5,500,000 39,500,000 2,246,827 1,006,676 2,299,263 1,279,100 2,366,173 (9,908,039) (9,908,039) 240,000 240,000 240,000 468,699 0 186,835 490,537 600,000 47,574 66,194 2,066,676 5,4406,515 4,406,515	2,419,774 1,016,224 1,316,139 544,688 2,413,477 (7,750,322) (7,750,32) (7,75	2,493,624 1,025,751 1,344,766 603,604 2,451,767 (7,929,602) (7,547,509) 251,569 251,569 251,569 251,569 492,933 0 194,383 514,182 624,240 49,496 68,868 2,150,170 4,375,938 (3,332,132)	2,568,361 1,035,283 1,373,662 623,226 2,511,002 (6,111,504) (7,532,338) 257,555 267,555 267,555 267,555 267,555 505,585 505,585 505,585 505,585 505,585 50,486 70,245 50,486 70,245 5,0,486 70,245 2,193,173 4,896,014 4,360,716	2.643.969 1.044,724 1.402,820 643.298 2.561.222 (8.296,033) (7,515,797) 263.880 263.880 263.880 263.880 0 202.236 518.485 0 202.236 538.337 649.459 51.496 71.650 2.237,037 4.796,662 4.345,539	0 0 2,720,432 1,054,160 1,432,230 663,924 2,812,447 (8,483,192) (7,497,906) 226,948 226,948 226,948 531,686 0 0 206,281 551,747 662,448 52,526 73,083 2,281,777 4,889,457 4,330,406	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982) (7,478,685) 276,360 277,745,455 3,577 74,545 3,500 4,455 4,315,317 3,577 3	2,875,841 1,072,906 1,491,773 706,882 2,717,899 (6,865,402) (7,458,154) 282,921 282,921 282,921 282,921 282,921 282,921 282,921 559,095 0 214,615 578,264 689,211 54,648 76,036 2,373,961 5,111,672 4,300,272	2,954,745 1,062,205 1,521,887 729,264 2,772,349 (9,060,450) (7,435,333) 289,634 299,634 573,294 0 2418,907 591,884 702,996 55,741 77,556 2,421,440 2,241,1440 2,241,147	1,091,446 1,552,215 7,52,249 2,827,796 (9,258,123) (7,413,241) 296,502 296,502 296,502 296,502 296,502 0 0 223,285 606,022 717,056 56,856 79,108 2,469,809 5,333,038 4,270,315 (3,925,084)	1,100,624 1,582,745 775,861 2,884,352 (9,458,415) (7,388,888) 303,530 303,530 303,530 602,734 0 0 227,751 620,385 731,397 57,993 80,660 2,519,267 5,447,275 4,255,402 (4,011,140) (3,133,496)	1 (109.73) 1 (513.474 800.121 2 942.039 (9.661.357) (7.63.353) 310.719 310.719 0 10.719 0 746.025 5.9.153 82.304 2.569.652 5.563.949 4.240.535	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593) 318,075 633,619 0 236,952 655,115 60,336 9,036 83,950 2,621,045 5,683,112 4,225,711 (4,183,791) (3,110,882)	1,127,715 1,075,844 850,638 3,060,988 (10,075,029) (7,308,631) 225,601 325,601 649,625 0 241,661 665,497 776,164 61,543 85,629 2,673,466 5,804,815 4,210,931	164.412 1.680.469 863.464 451.631 (6.603.432) (4.673.428) (4.673.428) 0 333.300 33.6380 0 0 24.6.625 681.234 791.687 791.687 9.081 1.2.634 3.3.466 3.418.625 2.207.138	133,800 1,650,721 858,527 372,023 (6,542,236) (4,517,189) 341,178 34	102,691 1,522,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 312,581 0 256,485 713,806 252,464 5,812 8,086 252,464 3,071,378 2,068,957	17102 1,688.46 847.004 847.004 847.004 (6,405,743) (4,209,823) (4,209,823) 357.482 357.482 357.482 357.482 310.366 0 261.614 730.658 840.145 5.668 176.965 3.044.454 2.000,800 (3,361,289)	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 307,939 0 0 266,847 747,896 856,948 2,264 3,150 98,345 3,015,223 1,933,258	6.466 1.523.766 8.33.149 (6.249.382) (3.909.162) 374.546 374.546 374.546 374.546 374.546 765.536 765.536 874.087 380 529 1.865.328	0 1.540.761 853.372 0 (6.347.243) (3.873.537) 383.374 383.374 383.374 383.374 383.374 383.374 383.374 383.374 0 0 0 277.627 783.580 891.568 991.568 0 0 0 0 (3.315,017) (3.315,017)
Annual Running Costs: Net escalated benefit/(cost) Life cycle cost analysis	SCR Dig 183 Improvements Total capital outlays (Pvs) DS RINs DS RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 20205) Engine O&M SCR O&M Biogas Upgrading O&M NC Demand Natural Gas Purchased - Dryer Natural Gas Purchased - Engine Dig 1 & 5 O&M Dewatering Polymer Dewatering Polymer Dewatering Polymer Class B Hauing Total running costs	4.000,000 5.500,000 39,500,000 2.346,827 1.066,676 2.909,263 1.279,100 2.366,173 (9,908,039) (9,908,039) 240,000 240,000 440,609 0 186,835 490,537 600,000 47,574 6,194 2,066,676 3,098,476 3,3998,476	2,419,774 1,016,224 1,316,139 584,688 2,413,497 (7,750,322) (7,561,290) 400,699 0 0 190,572 502,224 612,000 48,526 67,518 2,108,010 48,526 67,518 2,108,010 (3,249,338)	2,493,624 1,025,751 1,344,766 603,604 2,451,767 (7,929,602) (7,547,509) 251,569 251,569 251,569 251,569 492,933 0 194,383 514,182 624,240 49,496 68,868 2,150,170 4,375,938 (3,332,132)	2,568,361 1,035,253 1,373,662 623,226 623,226 (6,111,504) (7,532,338) 267,555 267,555 267,555 267,555 505,585 0 198,271 526,418 638,725 50,486 70,245 2,193,173 2,193,173 2,193,173 (3,415,490)	2,643,969 1,044,724 1,402,820 643,298 2,561,222 (8,296,033) (7,515,797) 263,880 263,880 263,880 263,880 518,485 0 202,236 538,937 649,459 51,496 71,650 2,237,037 4,769,662 4,345,539 (3,499,372)	0 0 0 2,720,432 1,054,160 663,924 2,612,447 (8,483,192) (7,497,906) 269,948 269,948 269,948 531,698 0 206,281 551,747 662,448 552,56 73,063 2,281,777 4,339,457 4,339,456 (3,583,736)	2,797,729 1,063,556 1,461,884 685,117 2,664,695 (8,672,982) (7,478,685) 276,380 270,407 533,577 74,545 5,097 5,097 5,097 5,097 5,3577 74,545 5,097 5,	2.875.841 1.072.906 1.491.773 706.892 2.717.989 (8.855.402) (7.455.154) 282.921 282.921 282.921 282.921 559.095 0 214.615 578.264 689.211 54.648 76.036 2.373.961 5.111.672 4.300.272 (3.753.729)	2,964,745 1,082,206 1,521,887 729,264 2,772,349 (9,060,450) (7,436,333) 269,634 269,634 269,634 269,634 269,634 273,294 0 0 218,307 551,984 702,996 55,741 77,556 2,421,440 5,221,187 4,225,272 (3,839,263)	1,091,446 1,652,215 752,249 2,827,796 (9,255,123) (7,413,241) 296,502 296,502 296,502 296,502 397,838 0,0 223,285 606,022 717,056 56,856 79,108 2,469,869 5,333,038 4,270,315 (3,925,084)	1,100,624 1,582,745 775,861 2,844,352 (9,458,415) (7,388,888) 303,530 303,530 602,734 0 227,751 620,385 731,397 731,397 757,993 80,690 2,519,267 5,5427,275 4,2255,402 (4,011,140)	1109733 1613474 800121 2.942039 (9,661,357) (7,383,353) 310,719 310,719 017,992 0222,306 635,080 746,025 59,153 82,304 2,569,652 4,240,535 (4,097,408)	1,644,381 825,041 3,000,880 (9,866,902) (7,336,593) 318,075 633,619 0 236,952 660,115 760,945 60,336 83,950 2,621,045 5,663,112 4,225,711 (4,183,791)	1,127,715 1,675,844 850,638 3,060,898 (10,075,029) (7,308,631) 325,601 325,60	164.412 1.680.469 863.464 451.631 (6.603.432) (4.673.428) 333.300 335.300 335.300 335.300 0 246.525 681.234 791.687 9.061 12.634 394.466 3,118.625 2,207,136 (3,484,807)	133.800 1.650.721 858.527 372.023 (6,542.236) (4,517,189) 341.178 341.178 341.178 341.599 0 251.455 697.334 807.521 7.480 10.407 3.096.076 2.137.734 (3,446,160)	102,691 1,522,183 853,047 289,051 (6,476,394) (4,362,660) 349,237 349,237 349,237 349,237 312,581 0 256,485 713,806 823,671 5,812 8,086 252,464 3,077,378 2,068,957 (3,405,016)	17102 1,688.46 847.004 847.004 847.004 (6,405,743) (4,209,823) (4,209,823) 357.482 357.482 357.482 357.482 310.366 0 261.614 730.658 840.145 5.668 176.965 3.044.454 2.000,800 (3,361,289)	3,781,424 39,014 1,556,713 840,378 112,597 (6,330,126) (4,058,661) 365,917 365,917 365,917 365,917 307,339 0 266,647 747,698 856,948 2,264 3,315,223 1,933,256 (3,314,903)	6.466 1.523.766 8.33.149 18.902 (6.249.382) (3.909.162) 374.546 374.546 374.546 374.546 374.546 374.546 374.546 305.280 0 0 2.27.184 765.536 874.087 1.65.99 1.65.99 1.65.938.606 1.866.528 (3.265.776)	0 1.540.761 853.372 0 (6.347.243) (3.873.537) 383.374 383.374 383.374 383.374 383.374 383.374 383.374 383.374 0 0 0 277.627 783.580 891.568 991.568 0 0 0 0 (3.315,017) (3.315,017)

SOLIDS CALCULATIONS

		Sludge Flows and Loads									
		Д	A	Max M	lonth	Max 2	-Week	Max-I	Day		
		Flow	VS Loads	Flow	VS Loads	Flow	VS Loads	Flow	VS Loads		
Year		gpd	ppd			gpd	ppd	gpd	ppd		
	2020	220,934	71,222	270,138	87,001	284,656	91,646	348,593	112,15		
	2021	225,437	72,677	275,664	88,785	290,515	93,539	355,808	114,48		
	2022	229,940	74,133	281,191	90,569	296,375	95,432	363,024	116,81		
	2023	234,443	75,588	286,717	92,354	302,234	97,325	370,240	119,14		
	2024	238,946	77,044	292,243	94,138	308,094	99,218	377,455	121,47		
	2025	243,449	78,499	297,769	95,922	313,953	101,112	384,671	123,80		
	2026	247,953	79,954	303,295	97,706	319,813	103,005	391,887	126,13		
	2027	252,456	81,410	308,822	99,490	325,672	104,898	399,102	128,46		
	2028	256,959	82,865	314,348	101,275	331,531	106,791	406,318	130,79		
	2029	261,462	84,321	319,874	103,059	337,391	108,684	413,534	133,12		
	2030	265,965	85,776	325,400	104,843	343,250	110,577	420,749	135,45		
	2031	270,476	87,232	330,905	106,619	349,139	112,479	427,944	137,78		
	2032	274,987	88,688	336,410	108,395	355,028	114,381	435,138	140,10		
	2033	279,498	90,144	341,915	110,172	360,916	116,282	442,332	142,42		
	2034	284,010	91,600	347,420	111,948	366,805	118,184	449,526	144,74		
	2035	288,521	93,057	352,925	113,724	372,694	120,086	456,720	147,07		
	2036	293,032	94,513	358,429	115,500	378,582	121,988	463,915	149,39		
	2037	297,543	95,969	363,934	117,276	384,471	123,890	471,109	151,71		
	2038	302,054	97,425	369,439	119,053	390,360	125,791	478,303	154,04		
	2039	306,565	98,881	374,944	120,829	396,248	127,693	485,497	156,36		
	2040	311,076	100,337	380,449	122,605	402,137	129,595	492,692	158,68		

	Mesophilic + 2 Small Dig (HSW sent only to Dig 1&3)														
	HRT Based Capacity		OLR Based Capacity												
	Omnivore Digester				HSW					HSW to	Class B Disposal	Dewatering	Dewatering	Class B	HSW Tip
Sludge	Capacity for FW	HSW	HSW	HSW	Imported	HSW	HSW TS	HSW VS	HSW VSR	Dewateri	@ 22% TS	Polymer	Power	Hauling	Fee
gal	gal	gpd	ppd VS (0.35 OLR)	gpd	gpd	gpd	ppd	ppd	ppd	ppd	wtpd	\$/yr	\$/yr	\$/yr	\$/yr
3,314,003	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24	- /	13,480	420,853	481,842
3,381,550	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24		13,480	420,853	481,842
3,449,098	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24	- /	13,480	420,853	481,842
3,516,646	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24	- /	13,480	420,853	481,842
3,584,194	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24		13,480	420,853	481,842
3,651,742	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24		13,480	420,853	481,842
3,719,290	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24		13,480	420,853	481,842
3,786,838	600,000	40,000	28,075	33,003	33,003	33,003	33,029		22,460	10,569	24		13,480	420,853	481,842
3,854,386	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24		13,480	420,853	481,842
3,921,933	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24	-,	13,480	420,853	481,842
3,989,481	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24	-,	13,480	420,853	481,842
4,057,147	600,000	40,000	28,075	33,003	33,003	33,003	33,029	28,075	22,460	10,569	24		13,480	420,853	481,842
4,124,812	575,188	38,346	26,914	31,638	31,638	31,638	31,663	26,914	21,531	10,132	23		12,922	403,449	461,916
4,192,477	507,523	33,835	23,748	27,916	27,916	27,916	27,938	23,748	18,998	8,940	20	-7	11,402	355,987	407,576
4,260,143	439,857	29,324	20,582	24,194	24,194	24,194	24,214	20,582	16,465	7,748	18	, .	9,882	308,525	353,236
4,327,808	372,192	24,813		20,472	20,472	20,472	20,489	17,415	13,932	6,556	15		8,362	261,063	298,896
4,395,474	304,526	20,302	14,249	16,750	16,750	16,750	16,764	14,249	11,399	5,364	12	7-	6,841	213,601	244,556
4,463,139	236,861	15,791	11,083	13,028	13,028	13,028	13,039	11,083	8,866	4,172	9	3,824	5,321	166,139	
4,530,804	169,196	11,280	7,917	9,307	9,307	9,307	9,314	7,917	6,334	2,980	7	2,732	3,801	118,677	135,876
4,598,470	101,530	6,769	4,751	5,585	5,585	5,585	5,589	4,751	3,801	1,789	4	1,639	2,281	71,215	81,536
4,666,135	33,865	2,258	1,585	1,863	1,863	1,863	1,864	1,585	1,268	597	1	547	761	23,754	27,196

Page 1 of 1



9665 Chesapeake Drive, Suite 201 San Diego, CA 92123

Technical Memorandum FINAL

T: 858.514.8822 F: 858.514.8833

- Prepared for: Encina Wastewater Authority
- Project title: Biosolids, Energy, and Emissions

Project no.: 150871.300

Technical Memorandum 9.1

- Subject: Encina Renewable Natural-gas Injection Feasibility Study
- Date: March 27, 2019
- To: Scott McClelland, Assistant General Manager
- From: Scott Lacy, Project Manager

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Table of Contents

List of Figures	iv
List of Tables	iv
List of Abbreviations	V
Acknowledgements	vi
Executive Summary	1
Section 1: Introduction	3
1.1 Purpose and Scope	3
Section 2: Basis of Evaluation	4
2.1 Existing DG Production	
2.2 Co-digestion Parameters	
2.3 RNG Specifications	
2.4 EPA Renewable Fuel Standard Regulations	
Section 3: Pipeline Injection Alternatives	6
Section 4: DG Upgrading Technologies	
4.1 Technologies Considered	
4.2 Membranes	
4.3 Pressure Swing Adsorption	
4.4 Solvents	
4.4.1 Water Solvents	
4.4.2 Amine Solvents	
4.5 Summary of Gas Upgrading Technologies	
Section 5: Present Worth Cost Analysis	
5.1 Capital Costs	
5.2 Operating Costs	
5.3 Benefits5.4 Results	
Section 6: Summary	
Attachment A: Calculations	A



iii

List of Figures

Figure ES-1. Pipeline injection cost benefits	2
Figure 4-1. DG upgrading system at the San Mateo Wastewater Treatment Plant (California) using Unison's BioCNG system	8
Figure 4-2. PSA system profess flow diagram	10
Figure 4-3. Guild system at Dos Rios Water Reclamation Facility, San Antonio, Texas	11
Figure 4-4. Simplified process flow diagram of solvent system for DG upgrading	12
Figure 4-5. Greenlane Totara plus process vessels at Fair Oaks Dairy in Indiana	13
Figure 5-1. Summary of 10-year NPV results	19

List of Tables

Table 2-1. Annual Average Projected DG Production, scfm	4
Table 2-2. Digestion Parameters and Assumptions	5
Table 2-3. Digestion Design Parameters for HSW Capacity Analysis	5
Table 3-1. List of Pipeline Injection Alternatives	7
Table 4-1. Summary of DG Upgrading Technologies	15
Table 5-1. Summary of Capital Costs for Pipeline Injection Alternatives ^a	16
Table 5-2. Summary of Unit Costs and Operating Assumptions	16
Table 5-3. Annual Operating Costs for All Alternatives for Year 2020	17
Table 5-4. Summary of Benefit Unit Costs	18
Table 5-5. Annual Benefits for All Alternatives for Year 2020	18
Table 5-6. Summary of Business Case Evaluation Results	19



iv

List of Abbreviations

\$	dollar(s)	RTO	regenerative thermal oxidizer
\$/DGE	dollars per diesel gallons equivalents	scf/lb VS	standard cubic feet per pound of volatile
\$/MMscf	dollars per million standard cubic feet		solids
\$/therm	dollars per therm	scfm	standard cubic foot/feet per minute
\$/year	dollars per year	SDG&E	San Diego Gas and Electric
AFRF	Alternative Fuel Receiving Facility	SoCalGas	Southern California Gas Company
BEE	Biosolids Energy and Emission	TM	technical memorandum
Btu/cf	British thermal units per cubic foot/feet	TS	total solids
cfm	cubic feet per minute	TSA	temperature swing adsorption
CO ₂	carbon dioxide	Unison	Unison Solutions
DG	digester gas	VOC	volatile organic compound
EPA	Environmental Protection Agency	VPSA	vacuum pressure swing adsorption
ERNI	Encina Renewable Natural-gas Injection	VS	volatile solids
EWA	Encina Wastewater Authority	VSR	volatile solids reduction
EWPCF	Encina Water Pollution Control Facility		
FOG	fats, oil, and grease		
FW	food waste		
GCS	gas conditioning system		
gpd	gallon(s) per day		
H_2S	hydrogen sulfide		
HSW	high-strength waste		
kW	kilowatt(s)		
kWh	kilowatt hour(s)		
lb/cf-day	pound(s) per cubic feet per day		
LCFS	Low Carbon Fuel Standard		
Μ	million		
MG	million gallons		
muni sludge	municipal wastewater solids		
02	oxygen gas		
0&M	operations and maintenance		
N/A	non applicable		
N ₂	nitrogen gas		
NPV	net present value		
PSA	pressure swing adsorption		
psig	pounds per square inch gage		
RFS	Renewable Fuel Standard		
RIN	Renewable Identification Number		
RNG	renewable natural gas		

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- Scott McClelland (EWA)
- Tucker Southern (EWA)
- · Brad Pleima (Eco Engineers)
- · Ellen Camara (Eco Engineers)



Executive Summary

This Technical Memorandum (TM) 9.1 describes the required steps for implementing the Encina Renewable Natural-gas Injection (ERNI) Project at the Encina Water Pollution Control Facility (EWPCF). The EWPCF currently operates three digesters for municipal solids and high-strength waste (HSW) digestion. The digester gas (DG) is beneficially used in either the internal combustion engines or biosolids thermal dryer. The purpose of this ERNI project is to evaluate the feasibility and benefits of sending upgraded DG, or renewable natural gas (RNG), to the San Diego Gas and Electric (SDG&E) natural gas pipeline. Environmental attributes are available through the Renewable Fuel Standard (RFS) and the Low Carbon Fuel Standard (LCFS) programs to offer financial incentives for upgrading DG to RNG for use as a transportation fuel.

This study compares various pipeline injection alternatives against Encina Wastewater Authority's (EWA's) current operation over a 10-year analysis period. Given the RFS regulations at the time of this analysis, D3 RNG generated from municipal sludge is approximately ten times more valuable than D5 RNG generated from the co-digestion feedstocks EWA receives (e.g., brewery waste and fats, oil, and grease [FOG]). "D3" and "D5" are two of the categories assigned by the Environmental Protection Agency (EPA) for types of renewable fuels. Because of the current D3 and D5 definitions and relative value under the RFS, the alternatives in this TM assume only D3 RNG is sent to the pipeline to maximize EWA's return on investment. Additionally, there are some risks related to the long-term viability of a pipeline injection project as the values for the environmental attributes and duration of these programs seems uncertain; hence, a 10-year net present value (NPV) is considered rather than a 20-year analysis.

The evaluation was based on the following assumptions:

- EWA will continue to accept the current volumes of brewery waste and FOG throughout the 10-year analysis period
- Three large digesters are in operation to digest municipal solids and accept HSW
- . D3 RNG is sent to the pipeline while D5 DG is used in the existing engines
- Digester heating requirements are satisfied by supplemental heat with boiler operation (natural gas fueled) as needed.

The following alternatives were developed and evaluated:

- Alternative 0: Accept current amounts of FOG and brewery waste and use all DG in the existing cogeneration system.
- Alternative 0 gas conditioning system (GCS): Accept current amounts of FOG and brewery waste and use all DG in the existing cogeneration system; install DG conditioning upstream of engines.
- Alternative 1: Municipal wastewater solids (muni sludge) digestion only (no FOG or brewery waste); all gas is upgraded and sent to the pipeline. Digester heat provided by boiler running on natural gas.
- Alternative 2: Separate feedstock digesters for D3 and D5. Some muni sludge is co-digested with HSW. D3 gas to pipeline; D5 gas to engines.
- Alternative 3: Accept food waste (FW) to co-digest with FOG and brewery waste. Separate digester feedstocks. D3 gas sent to pipeline; D5 gas sent to engines.
- Alternative 4: Accept FW to co-digest with FOG and brewery waste. Prioritize use of gas in engines with two D5 digesters. One D3 digester sending gas to pipeline.

The results of this analysis indicate that any pipeline injection project can provide financial benefits to EWA as shown in Figure ES-1. Alternative 0 assumes DG is sent to the engines while Alternatives 1 to 4 send upgraded D3 RNG to the pipeline.



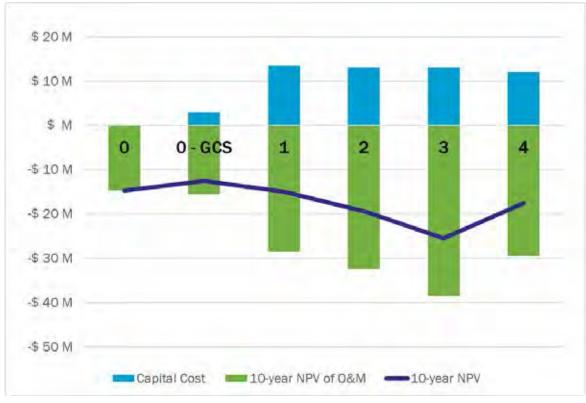


Figure ES-1. Pipeline injection cost benefits

The results from this ERNI study show that DG upgrading to pipeline injection projects can offer financial benefits over the current operation of DG fired engines on a 10-year life-cycle cost. Alternative 3 provides the greatest NPV benefit over the baseline operation; however, it would require EWA to accept pre-processed FW as co-digestion feedstock. In general, the results of this feasibility study indicate that a pipeline injection project has the potential to provide a greater NPV benefit over the current operation, even in a 10-year analysis. While the RFS and LCFS programs may extend beyond 2030, it is uncertain what the marketplace for the environmental attributes will look like in the future. Hence, a 10-year analysis was performed. These pipeline injection projects still offer a 3- to 5-year return on investment and are viable projects for EWA to pursue.

All pipeline injection alternatives, regardless of digester feedstock separation, converged on a 500 standard cubic foot/feet per minute (scfm) gas upgrading system, the recommended system size for a pipeline injection project. Given the 500 scfm equipment sizing, membranes would be the recommended technology for DG upgrading based on installations of comparable size in North America.

The ERNI project is being put on hold due to the following barriers:

- Limited capital budget available due to other high-priority projects
- . Uncertainty about future HSW and FW receiving volumes and resultant DG production
- Uncertainty about future RFS and LCFS values, including EPA's definition of D3/D5 fuels and separation requirements.



Considering these barriers, any one of the following developments would trigger EWA to resume project development:

- Successful procurement of grant funding offered for renewable fuel projects (EWA should continue to track these opportunities)
- Emergence of a strong partner for a public/private partnership where the private company would provide the capital financing for the project in exchange for revenue sharing (EWA should remain open to discussions with project developers)
- Emergence of a HSW or FW source which would increase DG production (EWA should remain open to discussions with local haulers)
- Changes to the RFS program which either increase D3 or D5 values, designate co-digestion feedstocks as the higher-valued D3 fuel, or remove the physical separation requirements for distinguishing between D3 and D5 fuels. Any of these changes would further increase the economic incentive to move forward with the project.

Section 1: Introduction

Brown and Caldwell recently submitted a comprehensive Biosolids Energy and Emission (BEE) Plan to Encina Wastewater Authority (EWA). Technical memorandum (TM) 7 of the BEE Plan developed various alternative scenarios for solids processing as well as energy production and digester gas (DG) utilization. This TM is an Encina Renewable Natural-gas Injection (ERNI) study that provides life-cycle costs as well as estimated capital costs associated with potential pipeline injection projects at the Encina Water Pollution Control Facility (EWPCF). EWA has indicated that TM 9.1 will be based on the assumption that three large digesters are in service and the engines will continue to operate on DG produced from co-digestion of high-strength waste (HSW). DG produced from the digestion of municipal sludge will be upgraded to renewable natural gas (RNG) and injected into the Southern California Gas Company (SoCalGas) pipeline.

1.1 Purpose and Scope

TM 9.1 evaluates the feasibility of installing gas separation equipment to upgrade DG to RNG at the EWPCF. This TM builds on the prior work done as part of the BEE project, which recommended EWA further evaluate the feasibility of a pipeline injection project. This TM provides a summary of the design criteria for the ERNI project, a gas upgrading technology overview and recommendation, a conceptual site and piping layout, and refined business case evaluation results.

This TM will be combined with the BEE project. The previous TMs associated with the BEE project include:

- TM 1: Baseline Energy Profiles and Projections
- TM 2: Technology Evaluations for Biosolids Handling
- . TM 3: Technology Evaluations for Alternative Power Production
- TM 4: Technology Evaluations for Biogas Production
- . TM 5: Technology Evaluations for Waste Heat
- TM 6: Air Emissions
- . TM 7: Alternatives Development, Evaluation, and Selection
- TM 8: Grant and Incentive Programs Summary
- . TM 9: High Strength Waste Feasibility Study



Section 2: Basis of Evaluation

This section summarizes the basis of evaluation and design criteria for the ERNI project. All alternatives assume three large digesters in service without any rehabilitation projects to put the small digesters in service.

2.1 Existing DG Production

As part of the BEE project, the existing DG production was evaluated based on feedstock characteristics of municipal wastewater solids (muni sludge) and HSW. The projections of DG and a discussion on the estimation of these values is summarized in TM 1. The EWA currently receives approximately 150,000 gallons per week (about 21,100 gallons per day) of fats, oil, and grease (FOG) and brewery waste for co-digestion. The DG projections in Table 2-1 are based on the assumption that EWA will continue to receive similar amounts of FOG and brewery waste in the future.

DG production estimates for the years included in the analysis are summarized in Table 2-1 using the solids loading rates associated Digesters 4, 5, and 6 in service (three large digesters). These DG production estimates will be used as the basis of evaluation to determine annual operations and maintenance (0&M) costs, sizing of the DG upgrading system, and capital costs.

Table 2-1. Annual Average Projected DG Production, scfm											
Year	DG from Sludge	DG from FOG and Brewery Waste	Total DG								
2020	446	87	533								
2021	456	87	543								
2022	465	87	552								
2023	475	87	562								
2024	485	87	572								
2025	494	87	581								
2026	504	87	591								
2027	513	87	600								
2028	523	87	610								
2029	532	87	619								

scfm = standard cubic foot/feet per minute

2.2 Co-digestion Parameters

EWA provided metering logs of the quantities of FOG and brewery waste that were delivered between September and December 2018. On average, EWA accepted 10,500 gallons per day (gpd) of FOG and 10,600 gpd of brewery waste; however deliveries are generally only received on weekdays. The normal delivery quantities are therefore 14,700 gpd of FOG and 14,840 gpd of brewery waste Monday through Friday, and no weekend deliveries. With this delivery schedule, the average weekday gas production will be higher than weekend gas production. This weekly cycle was not incorporated into the analysis. As the project progresses with further analysis and development, delivery load leveling measures should be considered, such as scheduling weekend deliveries or increased HSW storage.



All alternatives evaluated in this TM assume EWA will continue to accept the same quantities of FOG and brewery waste for co-digestion. These assumptions, as well as other parameters on all feedstocks used in this evaluation, are summarized in Table 2-2.

Table 2-2. Digestion Parameters and Assumptions										
Feed Characteristics Sludge FOG Brewery Waste FW										
TS	(%)	4.5	5.5	5	16					
VS	(%)	84.6	95	98	90					
SG		1.0	0.9	1.0	1.0					
VSR		63%	90%	90%	80%					
Gas Prod. Rate	scf/lb VS	15	18	15	15					
Flow	gpd		10,500	10,600						

scf/lb VS = standard cubic feet per pound of volatile solids

TS = total solids

VSR = volatile solids reduction

To determine the available capacities of the digesters, the digestion design parameters summarized in Table 2-3 were assumed. Additionally, the analysis assumed the volatile solids (VS) contribution from FOG does not exceed more than 30 percent of the overall digester load to prevent an upset in the digesters.

Table 2-3. Digestion Design Parameters for HSW Capacity Analysis											
Parameter	Units	D3 Digesters	D5 Digesters								
Organic loading rate	lb/cf-day	0.18	0.5								
Hydraulic residence time	days	15	15								
Active capacity	MG	2.05	2.05								

lb/cf-day = pound(s) per cubic feet per day

MG = million gallons

2.3 RNG Specifications

Upgraded DG will be routed to the San Diego Gas and Electric (SDG&E) natural gas pipeline located West of Avenida Encinas, which is owned by SoCal Gas. SoCalGas Rule No. 30 (Transportation of Customer-owned Gas) provides requirements for gas to be injected into the utility pipeline. The requirements for DG upgrading under SoCalGas Rule 30 are included at https://www.socalgas.com/regulatory/tariffs/tm2/pdf/30.pdf. DG upgraded to pipeline quality natural gas under the ERNI project would meet Rule 30 regulations.

In addition to meeting the fuel specifications, EWA would also be subject to two agreements regarding uniform flow and operational imbalance. To summarize these agreements, gas injected to the SoCalGas pipeline must be delivered on a uniform hourly basis equal to 1/24 (+/- 5 percent) of the total daily scheduled quantities for a particular gas flow day. If EWA does not abide by this provision, SoCalGas can suspend service until action is taken to ensure compliance or install a flow control device at EWA's cost. If EWA deviates by more than 10 percent from uniform daily deliveries more often than they are complying, SoCalGas also reserves the right to suspend service. This agreement drives the ERNI project towards a DG upgrading system sized for a constant flow gas production to avoid being penalized for variable RNG delivered to the pipeline. To avoid being penalized for variations in RNG production, EWA can manage



operations such that a set quantity of RNG is delivered to the pipeline by including a setpoint for the biogas upgrading system. Any excess gas will be utilized in the engines or thermal dryer, thereby eliminating storage requirements to buffer out any variations.

2.4 EPA Renewable Fuel Standard Regulations

Under current regulations, RNG produced from municipal wastewater sludge is characterized as D3 (cellulosic) biofuel category as shown under row Q of Table 1 to § of CFR 80.1426, while RNG produced from food waste, FOG, or other high strength organic wastes are characterized as D5 (advanced) biofuel category under row T. Current EPA interpretation considers RNG produced from comingled D3 and D5 feedstocks to be classified as entirely D5 biofuel. Based on recent RIN trading values, a D5 RIN has been valued at between 10 and 15 percent of the monetary value of a D3 RIN. Therefore, physical separation of D3 and D5 digester feedstocks is encouraged to maximize potential RIN revenue from producing RNG. The alternatives in this TM take the EPA Renewable Fuel Standard (RFS) regulations into account, hence D3 gas is prioritized for the engines.

Section 3: Pipeline Injection Alternatives

This feasibility study evaluates several pipeline injection alternatives that are coupled with a few co-digestion scenarios. Since the value of environmental attributes called renewable identification numbers (RINs) associated with pipeline injection of natural gas for use as vehicle fuel varies depending on the type of digester feedstock used to generate that fuel, several scenarios were analyzed to review the financial and operational impacts. Baseline alternatives were evaluated both with and without a gas conditioning system (GCS). DG generated from muni sludge qualifies for a D3 cellulosic RIN, currently valued at \$2 per RIN, while DG generated from FOG, brewery waste, FW, and other HSW qualifies for a D5 RIN advanced biofuel, currently valued at \$0.25 per RIN. Co-digesting muni sludge and HSW feedstocks generates a D5 RIN; therefore, separating D3 and D5 feedstocks provides the greatest return on investment for a DG upgrading system. The list of alternatives evaluated are as follows:

- Alternative 0: Accept current amounts of FOG and brewery waste and use all DG in the existing cogeneration system.
- Alternative 0 GCS: Accept current amounts of FOG and brewery waste and use all DG in the existing cogeneration system; install DG conditioning upstream of engines.
- Alternative 1: Muni sludge digestion only (no FOG or brewery waste); all gas is upgraded and sent to the pipeline. Digester heat provided by boiler running on natural gas.
- Alternative 2: Separate feedstock digesters for D3 and D5. Some muni sludge is co-digested with HSW. D3 gas to pipeline; D5 gas to engines.
- Alternative 3: Accept FW to co-digest with FOG and brewery waste. Separate digester feedstocks. D3 gas sent to pipeline; D5 gas sent to engines.
- Alternative 4: Accept FW to co-digest with FOG and brewery waste. Prioritize use of gas in engines with two D5 digesters. One D3 digester sending gas to pipeline.

Table 2-4 summarizes these alternatives in terms of co-digestion feedstocks, the number of D3 and D5 digesters, and expected DG production.



		Table	e 3-1. List of P	ipeline Inject	ion Alternatives		
Alternative	Co-digestion	No. of D3 Digesters	No. of D5 Digesters	2020 DG, cfm	2020 D3 DG, scfm	2020 D5 DG, scfm	DG Use
0	FOG + Brewery	0	3	533	0	533	All to engines
0 - GCS	FOG + Brewery	0	3	533	0	533	All to engines
1	No	3	0	446	446	0	All to pipeline - D3
2	FOG + Brewery	2	1	533	412	122	D3 to pipeline; D5 to engines
3	FOG + Brewery + FW	2	1	577	446	131	D3 to pipeline; D5 to engines
4	FOG + Brewery + FW	1	2	533	285	249	D3 to pipeline; D5 to engines

cfm = *cubic feet per minute*

Section 4: DG Upgrading Technologies

A broad range of available technologies, both in North America and Europe, were considered in this technology screening. This section describes the manufacturers and type of technologies reviewed, the evaluation criteria used to perform an initial screening of technologies, and the results of the criteria comparison. Common to all alternatives, a thermal oxidizer or regenerative thermal oxidizer (RTO) is required to safely dispose of reject gas from the upgrading process. Since EWA already has an RTO on site for the thermal dryer, a future design project should evaluate whether it has capacity and can be repurposed for DG upgrading off gas. This study assumes a new RTO is required, but future efforts may demonstrate that it is feasible to use the existing unit.

4.1 Technologies Considered

Four technologies for DG upgrading were reviewed in the conceptual-level technology screening. The list below represents the technologies known to Brown and Caldwell that are currently marketed in the United States for DG upgrading and several European manufacturers that have shown some intent on marketing in the United States. The list below identifies the main technology used for gas separation:

- . Membranes
- · Pressure swing adsorption (PSA)
- · Chemical solvent
- · Water solvent

Attributes that are considered for each DG upgrading technology include the following:

- Power use
- · Methane capture
- · Non-regenerating media consumption
- · Capital cost
- · 0&M cost
- · Footprint
- · Complexity/familiarity



4.2 Membranes

The two manufacturers who provide membranes for DG upgrading are Unison Solutions (Unison) and Air Liquide; Unison packages systems up to 600 scfm and Air Liquide packages systems greater than 400 scfm.

Membranes are thin, semi-permeable barriers that selectively separate carbon dioxide (CO₂) from DG. The driving force for the process is differential partial pressures with a high pressure on the process side and low pressure on the waste side. The CO₂ dissolves and diffuses through the thin, non-porous membranes faster than methane does. The selectivity for CO₂ is not as high as adsorbents or solvents and, as a result, a two-stage process is usually required to maintain higher overall methane capture efficiency. The waste gas from the second-stage membranes has a high methane concentration and is recycled to the suction of the compression system to improve methane recovery. The waste gas from the first-stage membranes in the Unison system has a low methane concentration and would be combusted in a thermal oxidizer.

Membranes also remove residual water and hydrogen sulfide (H₂S), although H₂S can degrade the membrane life, and to a lesser degree oxygen gas (O₂) and nitrogen gas (N₂) from DG. Membranes are subject to degradation if volatile organic compound (VOC), siloxanes, or H₂S are sent through the membranes, so these constituents must be removed upstream. H₂S removal is generally the first process in the system and is achieved with a scavenging media such as iron sponge or granular iron oxide. The Unison system then requires DG compression to 160 to 200 pounds per square inch gage (psig) with cooling and moisture removal and siloxane and VOC removal. Figure 4-1 below shows the activated carbon beds for VOC/siloxane removal and membranes from a 100 scfm Unison installation in San Mateo, California.



Figure 4-1. DG upgrading system at the San Mateo Wastewater Treatment Plant (California) using Unison's BioCNG system Includes H₂S removal, moisture removal, compression, siloxane removal, and membrane separation.



The system can reportedly achieve a 93 percent methane recovery (meaning 93 percent of the methane in the DG ends up in the product gas) while recycling 35 percent of the inlet gas flow from the second-stage membranes. A higher methane capture rate can be achieved with this technology, but the recycle rate from the second-stage membranes increases, which increases power consumption. At 93 percent methane recovery, the unit power requirement is about 7 kilowatt hours (kWh) per 1,000 standard cubic feet (scf). At 95 percent methane recovery, the unit power requirement would increase to 7.7 kWh per 1,000 scf. The system can be turned down to 25 percent methane recovery rate and both vendors can meet pipeline specifications with membranes as proven with the Point Loma installation.

Unison and Air Liquide both provided an equipment quote and footprint for a 500 scfm system:

- Unison:
 - Budgetary quote: \$2.2 million
 - Skid Dimensions: 12 feet by 28 feet
 - Chiller Dimensions: 68 inches by 90 inches
 - Estimated layout dimensions: 30 feet by 35 feet
- · Air Liquide:
 - Budgetary quote: \$1.5 million
 - Layout dimensions: 35 feet by 50 feet

4.3 Pressure Swing Adsorption

PSA systems are multiple packed beds which operate continuously by having one vessel "online" and the other(s) in a state of regeneration. PSA systems take advantage of the difference in equilibrium capacities of adsorbents, which are porous materials that have high surface areas per volume used as a molecular sieve. For a DG upgrading system, the adsorbent will be selective towards CO₂ at high pressures.

Guild is one of the leading manufacturers that provide a PSA system for DG. Greenlane also packages PSA systems but does not provide the Molecular Gate media that is highly selective to CO_2 (discussed later in this section). The Guild system compresses the raw DG to 100 psig which then flows through one of four vessels packed with adsorbent where the CO_2 is removed. When the online bed reaches its capacity (as measured by a CO_2 analyzer on the discharge) it is isolated from the process, and the DG flows through a newly regenerated packed bed. The spent bed is regenerated by depressurizing the vessel and drawing a deep vacuum on the vessel using vacuum pumps. Figure 4-2 shows a process flow diagram of the PSA system.



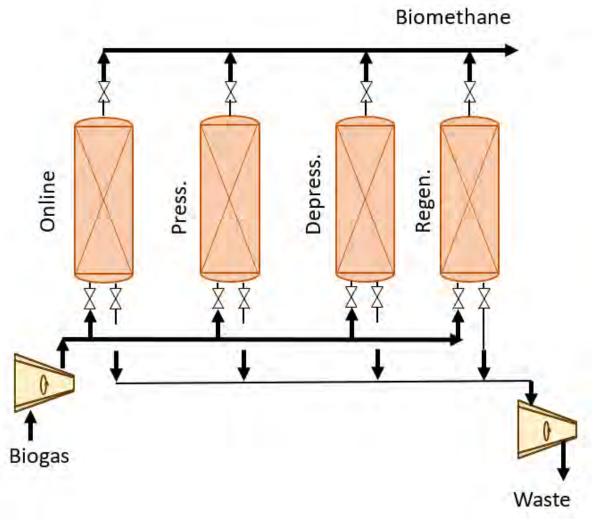


Figure 4-2. PSA system profess flow diagram

The inherent batch-nature of this process requires buffer vessels to smooth out pressure, flow, and gas composition fluctuations. The buffer vessels store and release gas to re-pressurize beds coming back online from the regeneration step and to buffer pressure fluctuations in the product gas. Waste gas from the regeneration step is variable in flow and composition. A tail gas buffer vessel stores the waste gas, which is then metered out at a constant flow and near constant composition to the thermal oxidizer for combustion. Figure 4-3 shows the 1,250 scfm Guild PSA system installed at the Dos Rios Water Reclamation Facility in San Antonio, Texas.



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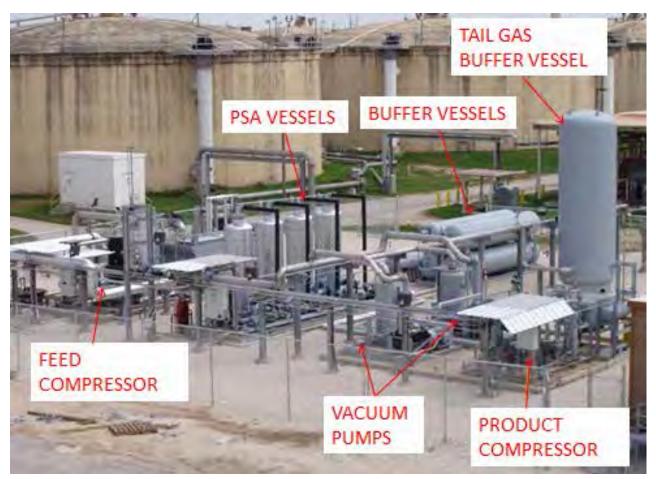


Figure 4-3. Guild system at Dos Rios Water Reclamation Facility, San Antonio, Texas

The Guild system is unique in that its proprietary molecular sieve adsorbent can be used to remove CO₂, H₂S, VOCs, siloxanes, and moisture in a single step in comparison to the Unison system that requires separate vessels to remove these constituents. The Guild media would also remove about 20 percent of the N₂ from the DG, which would assist in meeting the SoCalGas Rule 30 quality requirements to a small degree. Guild is the sole licensor of BASF Group's Molecular Gate® media that undergoes a specialized manufacturing process to make it highly selective. Unlike other PSA manufacturers, gas treatment is not required upstream of its system to protect the adsorbent (Greenlane's system requires activated carbon upstream of the PSA to remove H₂S and siloxanes). A pre-cooling heat exchanger can be installed to cool the raw DG to approximately 80 to 85 degrees Fahrenheit to remove bulk moisture, therefore decreasing the potential for corrosion downstream. Condensate that condenses out of the gas during compression and cooling would contain a portion of the VOCs and siloxanes as well. The pressure leaving the PSA vessels is about 90 psig.

Guild and Greenlane claim the PSA technology can achieve 95 percent methane recovery. This recovery rate would effectively be reduced to about 92 to 93 percent when the DG inlet methane concentrations are at 60 percent because the waste gas does not have enough energy to keep the combustion chamber of the thermal oxidizer hot. A support gas (either natural gas or biomethane) is required to keep the chamber hot. A higher methane concentration at the inlet would reduce the amount of support gas required. The unit power requirement is 7.7 kWh per 1,000 scf. The Guild system can remove CO₂ down to a concentration of 1 percent or less.



Greenlane and Guild provided equipment quotes and footprints for a 500 scfm system:

- Greenlane:
 - Budgetary quote: \$1.5 million
 - Layout dimensions: 48 feet by 33 feet
- Guild:
 - Budgetary quote: non applicable (N/A). No quote provided.
 - Layout dimensions: 45 feet by 40 feet

4.4 Solvents

Two types of solvent absorption technologies are available for DG upgrading to RNG: water and amine. Both technologies operate under a similar concept that the solvent selectively absorbs CO₂ and other constituents from DG while allowing methane to pass through the vessel with little absorption. Absorption is the transfer process of a gas constituent into a liquid in which it is soluble.

In general, raw DG is compressed prior to entering the scrubber vessel, where it enters at the bottom of the tower above the liquid level. The DG pressure is controlled to optimize for selective absorption of CO₂ over methane while also removing H₂S, some VOCs, and siloxanes. A solvent is then added at the top of the absorption column above the packing material. DG flows upward through the packing material where CO₂ is selectively absorbed by the solvent, allowing methane to flow counter currently to the top of the scrubbing vessel. The compressed gas exits the scrubber vessel with CO₂ levels reduced to 1 percent to meet RNG specifications. Figure 4-4 shows a simplified process flow diagram of the solvent system.

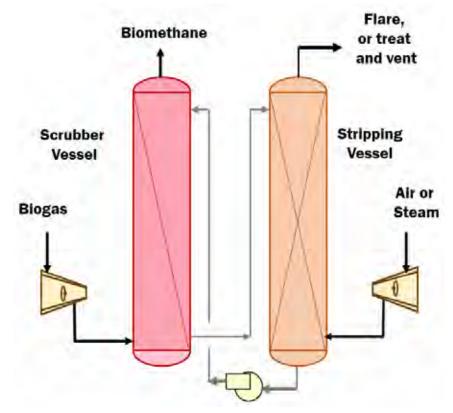


Figure 4-4. Simplified process flow diagram of solvent system for DG upgrading



In solvent systems, H₂S must be removed in one of two locations: the raw DG or the waste gas. H₂S must be removed to prevent it from being discharged with the vent gas and posing an odor concern. H₂S would likely be removed with a scavenging media such as iron sponge, iron hydroxide, or SulfaTreat. Removing H₂S upstream reduces the potential for corrosion through the system and may require low-pressure booster blowers to accommodate the pressure drop of the H₂S removal system without resulting in a vacuum at the inlet of the system.

4.4.1 Water Solvents

Greenlane is one of the recognized water solvent vendors in the industry with several North America installations and is the basis of evaluation for this study. DG is first compressed to about 135 psig. The DG and compressor oil are then cooled with air-cooled radiators (an intercooler and aftercooler), allowing for condensate that contains portions of the condensable VOCs and siloxanes to form downstream of the radiators.

The standard Greenlane system uses a closed water solvent loop that is regenerated in a two-stage process. The first regeneration step reduces the pressure of the saturated water from the scrubber vessel pressure of 130 psig to a pressure of 30 psig in a flashing vessel. Reducing the pressure of the water causes some of the dissolved gases to evolve from the water including enough methane to warrant capture. The flash gas is recycled to the suction of the first inlet compressor to improve the methane recovery rate of the system. The second stage of regeneration occurs when the saturated water is dropped to atmospheric pressure and run downward through another packed tower, the stripping vessel. A blower pushes air up through the vessel, which strips the remaining CO₂, H₂S, and methane out of solution. The waste gas mixture of air, CO₂, H₂S, and methane is scrubbed of H₂S and vented, or combusted, in an RTO. The regenerated water is then chilled and pumped back to the top of the packed tower. A chiller is used to cool the water and improve its capacity for absorption prior to reentering the scrubber vessel. Small flows of fresh makeup water to the water loop and wastewater from the water loop maintain proper water quality for absorption. Figure 4-5 below is a picture of the 1,100 scfm Greenlane Totara system process vessels installed at the Fair Oaks Dairy.

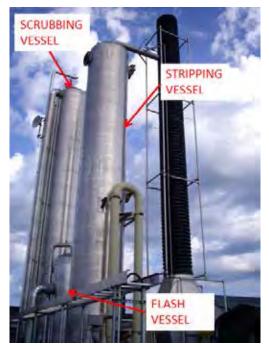


Figure 4-5. Greenlane Totara plus process vessels at Fair Oaks Dairy in Indiana



A vacuum pressure swing adsorption (VPSA) system may be required to reduce O_2 and further reduce CO_2 from the product gas. O_2 and N_2 levels get elevated in the product gas leaving the scrubber vessel because the water solvent entering the scrubber vessel is saturated with N_2 and O_2 from air in the stripping vessel. Without additional separation, the O_2 levels in the product gas may exceed the Rule 30 requirement for O_2 at 0.2 percent, and the additional N_2 might mean the required heating value could not be met even at 1 percent CO_2 in the product gas. One of the drawbacks of the water solvent system is that it does not remove O_2 . In order to remove O_2 , a VPSA system is required, which would result in an additional 2 percent methane loss.

The product gas leaving the scrubber vessel would need further processing to cool, dry, compress, and possibly remove O₂ to meet the product gas quality requirements. The solvent-saturated product gas is first dried through a dual-vessel temperature swing adsorption (TSA)/PSA dryer. The gas that is depressurized from and used to regenerate the TSA/PSA dryer beds is sent back to the suction of the compressor. The dry gas leaving the TSA/PSA would require compression to meet pipeline requirements.

Greenlane typically guarantees a methane recovery rate of 96 percent with the standard closed-loop system including 2 percent methane loss from the VPSA system for O₂ reduction, and 98 percent with the oncethrough system. The unit power requirement is 8.0 kWh per 1,000 scf for the standard system with a VPSA, and 11.1 kilowatts (kW) per 1,000 scf for the once-through system. For the standard Greenlane systems, the makeup water would be only 4 gallons per minute and is assumed to be potable water. Greenlane normally designs systems to remove CO₂ to 2 percent, but can achieve a CO₂ concentration of 1 percent or less in the product gas to meet Rule 30 by installing systems that are designed for a higher flow rate and running them at a lower DG flow rate.

Brown and Caldwell contacted Greenlane for a water solvent quote, but Greenlane recommended a PSA system with upstream activated carbon since a VPSA system would still be required for the water solvent technology to remove CO₂ and O₂ from the product gas and would increase costs.

4.4.2 Amine Solvents

Amine solvent systems operate in a similar method to the water solvent technology, but the main difference is a chemical solvent is used instead of water. Amines have the advantage of having a very high selectivity towards CO₂ and has no affinity to methane and can, therefore, provide higher methane capture efficiencies up to 99.9 percent. Two of the manufacturers that can provide equipment in North America are Morrow Renewables and Puregas Solutions. Any remaining H₂S still left in the clean gas is removed in an H₂S polishing vessel. The product gas is then compressed to pipeline pressure prior to being sent to the metering station.

In discussing the project with Puregas Solutions, the supplier did not feel that the cost associated with an amine system was competitive with a membrane system of EWPCF's size range, but still provided a budgetary quote for the smallest system. Morrow Renewables also provided a quote.

Morrow Renewables provided an equipment quote and footprint for a 500 scfm system, but not provide a layout drawing:

- \$2.7 million (M)
- Layout Dimensions: N/A. Vendor did not provide a footprint.

Puregas Solutions provided an equipment quote and footprint for an 800 scfm system:

- \$2.5M
- Layout Dimensions: 50 feet wide by 35 feet long



4.5 Summary of Gas Upgrading Technologies

The four technologies considered for installation at EWPCF to upgrade DG gas to RNG for pipeline injection are summarized in Table 4-1.

		Т	able 4-1. Sum	mary of DG Up	ograding Technologies		
Technology	Vendors ^a	Vendor Quote	Footprint ^b	% Methane Recovery	Operating Cost	O&M Complexity	Power Required, kWh/1,000 scf
Membranes	Unison Air Liquide	\$2.2M \$1.5M	50′ x 35′	95	Moderate - pre-treatment media consumption. Membrane replacement every 10 years.	Simple – fewest moving parts	7.7
PSA	Greenlane Guild	\$1.5M N/A	48′ x 50′	92 to 95	Moderate - media requires replacement every 10 years.	Moderate	7.7
Water Solvents	N/A	N/A	N/A ^c	98%	Low	Moderate	8 to 11
Amine Solvents	Puregas Solutions Morrow Renewables	\$2.5M \$2.7M	50′ x 35′°	>99	High - chemical consumption and requires H ₂ S reduction upstream	Complex	9d

a. Vendors that provided quotes or recommend technology for EWPCF's basis of evaluation listed.

b. If two vendors provided information, the largest possible footprint is shown in the table for conservative siting assumptions.

c. Solvent systems may have scrubber vessel heights up to 48'.

d. Gross consumption. Approximately 10-14 kWh/1,000 scf can be recovered as useable heat; actual amount dependent on design conditions and layout.

Given the DG upgrading equipment capacity required for the ERNI project, the membrane technology is the best apparent technology based on a low capital cost, high methane recovery rate, and moderate power requirements. Capital costs for ERNI alternatives will be developed assuming membranes as the basis of design.

Section 5: Present Worth Cost Analysis

The following subsections describe the various assumptions made on capital costs, operating costs, and benefits along with results from the present worth cost analysis.

5.1 Capital Costs

Cost assumptions were made on the following items, which are required for the EWPCF to beneficially reuse DG through pipeline injection for use as vehicle fuel. Detailed cost estimating was not performed but costs available from relevant projects around Northern and Southern California were used assuming a membrane technology for gas upgrading. Given the size of the gas upgrading system required, membranes are generally the most suited technology that is cost competitive.

Table 5-1 provides a summary of capital cost investments required for each alternative and the equipment sizing assumptions. The costs shown are Class V planning-level costs.



Tab	ole 5-1. Summ	ary of Capital Costs for Pipeline Injection Alternatives ^a
Alternative	Capital Cost	Assumptions
0	\$0.0M	No capital
0 - GCS	\$3.0M	Gas conditioning for 550 scfm
1	\$13.5M	DG upgrading for 500 scfm. Pipeline interconnection. Standby boiler
2	\$13.0M	DG upgrading for 500 scfm. Pipeline interconnection
3	\$13.0M	DG upgrading for 500 scfm. Pipeline interconnection
4	\$12.0M	DG upgrading for 400 scfm. Pipeline interconnection

a. Costs shown in 2020 dollars.

5.2 Operating Costs

To the best degree possible, the following operating cost estimates reflect the actual operating parameters and unit costs at EWPCF. Information was requested during the BEE Plan from EWA staff for utilities such as water, natural gas, and electricity and are used in this evaluation.

The following Table 5-2 summarizes the unit costs used for operating cost analysis.

Table 5-2. Summary of	Unit Costs and Operatin	g Assumptions
Parameter	Unit	Cost
Natural Gas Sale	\$/therm	0.25
Cogen O&M with GCS	\$/kWh	0.015
Cogen O&M without GCS	\$/kWh	0.025
DG upgrading O&M	\$/MMscf	1,100
Gas Conditioning O&M	\$/kWh	0.005
Alternative 1 Boiler 0&M	\$/year	15,000
Electricity	\$/kWh	0.09
Non-coincident demand charge	\$/kW	24.51
DG upgrading labor	\$/year	125,000
DG upgrading methane recovery	%	95
DG upgrading uptime	%	95
DG heating value, lower heating value	Btu/cf	560

\$/MMscf = dollars per million standard cubic feet

\$/therm = dollars per therm

\$/year = dollars per year

Btu/cf = British thermal units per cubic foot/feet



The following operating assumptions are consistent amongst all alternatives:

- No HSW tipping fees are included in the benefits. The revenue from tipping fees is assumed to be approximately equal to the increase in costs from O&M of the Alternative Fuel Receiving Facility (AFRF) and increased solids load contributing to the downstream processes.
- Digester heating demands are satisfied in all alternatives, including the additional heat required for increased HSW co-digestion. Natural gas is used in the boiler to meet additional heating demands if the engines on D5 gas cannot satisfy the full heating demands.
- Savings from cogeneration assume non-coincident demand charges are avoided each month since two redundant engines (out of four) are available. This is a conservative assumption that may favor cogeneration alternatives.
- All renewable fuel produced is sold to an off-taker and all RINs and Low Carbon Fuel Standard (LCFS) credits are sold to an obligated party.
- All pipeline injection alternatives assume an additional (one) full-time employee for O&M.

Table 5-3 summarizes the annual costs for each alternative. All costs are compared assuming 2020 operating conditions to maintain consistency.

Table	e 5-3. Annual Operati	ing Costs for All Alternatives for Year 2020
Alternative	Annual O&M Costs	Contributing Costs
0	\$0.6M	O&M: engines Natural gas for dryer
0 - GCS	\$0.5M	O&M: engines, gas conditioning Natural gas for dryer
1	\$0.9M	O&M: DG upgrading, labor, boiler Running costs: power for DG upgrading, natural gas for digester heat and dryer
2	\$0.9M	O&M: engines, DG upgrading, labor Running costs: power for DG upgrading, natural gas for digester heat and dryer
3	\$1.0M	O&M: engines, DG upgrading, labor Running costs: power for DG upgrading, natural gas for digester heat and dryer
4	\$0.9M	O&M: engines, DG upgrading, labor Running costs: power for DG upgrading, natural gas for dryer

5.3 Benefits

Table 5-4 shows a summary of benefit cost assumptions used in the analysis. The D3, D5, and LCFS credit values all assumed a 1 percent deflation value over the 10-year analysis as there is uncertainty in future values of these attributes. Note that these values have been updated to reflect the current market value for RINs since the initial BEE project. The current market values have been updated to reflect January 2019 pricing; actual revenue is de-rated to account for broker and verification fees that subtract from the RIN revenue.



Table	Table 5-4. Summary of Benefit Unit Costs								
Parameter	Unit	Cost							
D3 RIN value	\$	1.75							
D5 RIN value	\$	0.25							
LCFS value	\$/DGE	0.80							
Natural Gas Sale	\$/therm	0.25							
Avaided electricity easter	\$/kWh +	0.09							
Avoided electricity costs	\$/kW (engine output)	24.51							

\$/DGE = dollars per diesel gallons equivalents
\$/therm dollars per therm

Attachment A includes a calculation that summarizes the annual estimated revenue from pipeline injection for RINs, LCFS, the commodity value of the fuel, and electricity. These economic benefits range from approximately \$3 to \$5M annually, with the D3 RIN revenue generating approximately half of the total. Table 5-5 summarizes the annual benefits for all alternatives using projections on year 2020.

Table 5-5. Annual Benefits for All Alternatives for Year 2020											
Alternative	RIN Revenue	LCFS Revenue	Power Savings	Total Revenue							
0	\$0.0M	\$0.0M	\$2.0M	\$2.0M							
0 - GCS	\$0.0M	\$0.0M	\$2.0M	\$2.0M							
1	\$2.6M	\$0.7M	\$0.0M	\$3.7M							
2	\$2.4M	\$0.9M	\$0.4M	\$4.1M							
3	\$2.6M	\$1.2M	\$0.5M	\$4.7M							
4	\$1.7M	\$0.9M	\$0.9M	\$3.8M							

5.4 Results

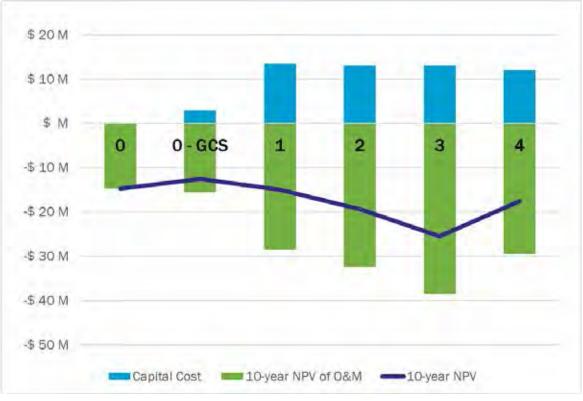
A present worth cost analysis was performed to identify capital and operating costs associated with DG upgrading for natural gas pipeline injection. The analysis uses an escalation rate of 2.0 percent and a discount rate of 2.5 percent performed over a 10-year period from 2020 to 2029. The analysis was ultimately used to determine the net benefits of each alternative in comparison to the status quo operation of running engines on DG. A summary of the net present value (NPV) results from this feasibility study are included in Table 5-6.

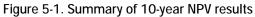


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		Table 5	-6. Summary of	Business C	ase Evaluation I	Results	
Alternative	Description	Capital	Annual Revenue	Annual Costs	10-year NPV	10-year NPV Benefit over Baseline	2020 DG, cfm
0	All gas to engines, no GCS	\$0.0 M	(\$2.0M)	\$0.6M	(\$14.7M)	\$0.0M	533
0 - GCS	GCS 550 scfm; all gas to engines	\$3.0 M	(\$2.0M)	\$0.5M	(\$12.5M)	\$2.2M	533
1	DG Upgrading 500 scfm; three digesters (D3)	\$13.5 M	(\$3.7M)	\$0.9M	(\$15.0M)	(\$0.3M)	446
2	DG Upgrading 500 scfm; three digesters (two D3, one D5)	\$13.0 M	(\$4.1M)	\$0.9M	(\$19.4M)	(\$4.7M)	533
3	DG Upgrading 500 scfm; three digesters (two D3, one D5)	\$13.0 M	(\$4.7M)	\$1.0M	(\$25.5M)	(\$10.8M)	577
4	DG Upgrading 400 scfm; three digesters (one D3, two D5)	\$12.0 M	(\$ 3.8M)	\$0.9M	(\$17.5M)	(\$2.8M)	533

red = negative values





Brown *** Caldwell

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Alternative 3 provides the greatest NPV benefit over the baseline operation; however, it would require EWA to accept FW as co-digestion feedstock. If EWA is able to accept FW to stabilize the FOG in a separate D5 digester, less municipal sludge would be required in the D5 digester, allowing EWA to maximize revenue from the RFS program. This alternative may be a more feasible option in the future as California Senate Bill No. 1383 will require solid waste haulers to divert organics from landfills, thereby creating an organics marketplace. AFRF improvements could potentially be required to accommodate FW introduced to the HSW mix, as it may increase pumping requirements.

Alternatives 2 and 4 are also attractive and minimize the risks of accepting FW as a feedstock. Maintaining two D3 digesters provides a slight economic benefit over the single D3 digester operation; however, both offer an increase in revenue over the current operation. In general, the results of this feasibility study indicate that a pipeline injection project has the potential to provide a greater NPV benefit over the current operation, even in a 10-year analysis. While the RFS and LCFS programs may extend beyond 2030, it is uncertain what the marketplace for the environmental attributes will look like in the future. Hence, a 10-year analysis was performed. These pipeline injection projects still offer a 3- to 5-year return on investment and are viable projects for EWA to pursue.

All alternatives converge on a DG upgrading system of roughly 500 scfm, the recommended system size for a pipeline injection project. As previously mentioned, the technology assumed in developing the capital costs is conventional gas conditioning followed by membrane separation.

Section 6: Summary

The results from this ERNI study show that DG upgrading to pipeline injection projects can offer financial benefits over the current operation of DG-fired engines on a 10-year life-cycle cost. At the time of this evaluation, the Environmental Protection Agency RFS regulations require separate digester feedstocks for municipal sludge and HSW feedstocks to maintain separate D3 and D5 RINs. Should regulations on the D3 and D5 feedstocks change, the results of this analysis would be impacted, and EWA should continue to monitor the RFS program and RIN market. It is also recommended that EWA continue to track grant and funding opportunities offered by the California Public Utilities Commission, SoCalGas, the California Energy Commission, and others to potentially reduce capital costs of a pipeline injection project.

All pipeline injection alternatives, regardless of digester feedstock separation, converged on a 500 scfm gas upgrading system. Based on the 500 scfm DG upgrading system, there are no foreseen issues with siting equipment at the EWPCF. Potential locations were selected by EWA, but the evaluation ceased prior to a full siting analysis. Given the 500 scfm equipment sizing, membranes would be the recommended technology for DG upgrading based on installations of comparable size in North America.



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Attachment A: Calculations



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Alternative 0 Results

	Year of analysis Escalation rate Discount rate	2020 2.00% 2.50%	Risk adjustments (+/- percent):	Benefits Capital costs Running costs	0% 0% 0%			Alternative Study Alternati ternative Cost A	nalysis (\$)	(ear	
Expressed in 2020 dollars, unesc	alated - dollare	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Capital Outlays											
	Total capital outlays	0	0	0	0	0	0	0	0	0	0
Benefits:											
	Power Savings	1,960,919	1,996,036	2,031,153	2,066,270	2,101,386	2,136,503	2,171,620	2,206,736	2,241,853	2,276,970
	Total benefits	(1,960,919)	(1,996,036)	(2,031,153)	(2,066,270)	(2,101,386)	(2,136,503)	(2,171,620)	(2,206,736)	(2,241,853)	(2,276,970)
Annual Running Costs:	Engine O&M	396,705	403,810	410,914	418,018	425,122	432,227	439,331	446,435	453,540	460,644
	GCS O&M										
	Natural Gas Purchased - Dryer	186,835	186,836	186,837	186,838	186,839	186,840	186,841	186,842	186,843	186,844
	-	500 510	500.010	500 051							0.17.100
	Total running costs	583,540	590,646	597,751	604,856	611,962	619,067	626,172	633,278		647,488
Net Benefit/(cost)		(1,377,379)	(1,405,390)	(1,433,402)	(1,461,413)	(1,489,425)	(1,517,436)	(1,545,447)	(1,573,459)	(1,601,470)	(1,629,482)
Expressed in escalated dollars w	ith sensitivity adjustments										
Expressed in escalated dollars w Capital Outlays	ith sensitivity adjustments										
	ith sensitivity adjustments 0 0	0	0	0	0	0	0	0	0		0
	ith sensitivity adjustments 0 0 Total capital outlays (Pvs)		0 0					0 0 0 0		0	
	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0	0	0 0 0	0 0 0
Capital Outlays	0 0 0	0 0 0 1,960,919	0 0 0 2,035,957	0 0 0 2,113,211	0 0 0 2,192,742	0 0 0 2,274,608	0 0 0 2,358,872	0 0 2,445,596	0 0 0 2,534,846	0 0 0 2,626,688	0 0 0 2,721,190
Capital Outlays	0 0 Total capital outlays (Pvs) 0	0 0 0 1,960,919 0 0	0 0 0 2.035,957 0 0	0 0 2,113,211 0 0	0 0 0 2,192,742 0 0	0 0 0 2,274,608 0 0	0 0 0 2,358,872 0 0	0 0 2,445,596 0 0	0 0 2,534,846 0 0	0 0 2,626,688 0 0	0 0 2,721,190 0
Capital Outlays	0 Total capital outlays (Pvs) Power Savings 0 Total benefits	0 0 0 1,960,919 0 0 (1,960,919)	0 0 0 2.035,957 0 0 0 0 0 (2.035,957 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,113,211 0 0 (2,113,211) 0 0 (2,113,211)	0 0 2,192,742 0 0 0 (2,192,742)	0 0 2,274,608 0 0 (2,274,608)	0 0 2,358,872 0 0 0 (2,358,872)	0 0 2,445,596 0 0 0 (2,445,596)	0 0 2,534,846 0 0 0 (2,534,846)	0 0 2,626,688 0 0 (2,626,688)	0 0 0 2,721,190 0 0 (2,721,190)
Capital Outlays Benefits:	0 Total capital outlays (Pvs) Power Savings 0 0 0	0 0 0 1,960,919 0 0 0 0	0 0 0 2.035,957 0 0 0 0 0	0 0 0 2,113,211 0 0 0	0 0 2,192,742 0 0 0	0 0 0 2,274,608 0 0 0 0	0 0 2,358,872 0 0 0 0	0 0 2,445,596 0 0 0	0 0 2,534,846 0 0 0 0	0 0 2,626,688 0 0 0	0 0 0 2,721,190 0 0 0 0
Capital Outlays	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M	0 0 0 1.960,919 0 0 (1,960,919) (1,960,919) 396,705	0 0 0 2.035,957 0 (2,035,957) (1,966,299) 411,886	0 0 0 2,113,211 0 0 (2,113,211) (2,011,385) 427,515	0 0 2,192,742 0 0 (2,192,742) (2,036,179) 443,604	0 0 2,274,608 0 0 (2,274,608) (2,060,683) (2,060,683)	0 0 2,356,872 0 0 (2,358,872) (2,084,899) 477,213	0 0 2,445,596 0 0 (2,445,596) (2,108,830) 494,758	0 0 0 2,534,846 0 0 (2,534,846) (2,132,478) 512,814	0 0 0 2,626,688 0 0 (2,626,688) (2,155,845) 531,394	0 0 2,721,190 0 0 (2,721,190) (2,178,934) 550,512
Capital Outlays Benefits:	0 Total capital outlays (Pvs) Power Savings 0 Total benefits Discounted Benefits (in 2020\$)	0 0 0 1,960,919 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,035,957 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 0 (2,113,211) (2,011,385) 427,515 0 0	0 0 2.192.742 0 0 (2.192.742) (2.036,179) (2.036,179) 443.604 0 0	0 0 0 2,274,608 (2,274,608) (2,060,683) 460,166 0 0	0 0 0 2,356,872 2,356,872 0 0 0 2,356,872 (2,084,899) 477,213 0 0	0 0 2,445,596 0 0 (2,445,596) (2,108,830) 494,758 0 0 0	0 0 2,534,846 0 0 (2,534,846) (2,132,478) (2,132,478) 512,814 0 0	0 0 0 2,826,688 0 0 (2,626,688) (2,155,845) 531,394 0 0	0 0 0 2.721,190 0 (2.721,190) (2.178,934) (2.178,934) 550,512 0 0
Capital Outlays Benefits:	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M	0 0 0 1,960,919 0 0 0 0 (1,960,919) (1,960,919) (1,960,919) 396,705 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.035,957 0 0 0 (1,966,299) (1,966,299) (1,966,299) (1,966,299) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 0,0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,192,742 0 0 (2,192,742) (2,036,179) 443,604 443,604 0 0 0 0 0 0 0 0	0 0 0 2,274,608 0 0 0 0 (2,274,608) (2,060,683) 460,166 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,358,872 0 0 (2,358,872) (2,084,899) 477,213 0 0 0 0 0 0 0 0 0 0	0 0 2,445,596 0 0 (2,445,596) (2,108,830) (2,108,830) 494,758 0	0 0 2,534,846 0 0 (2,534,846) (2,132,478) 512,814 0	0 0 0 2,826,688 0 0 (2,626,688) (2,155,845) 531,394 0 0	0 0 0 2,721,190 0 0 (2,721,190) (2,778,934) 550,512 0
Capital Outlays Benefits:	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M GCS O&M 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 1,960,919 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.035.957 (1,986,299) (1,986,299) 411.886 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 0 0 0 0 0 (2,113,211) (2,011,385) 427,515 0 0 0 0	0 0 0 2,192,742 0 0 0 0 (2,192,742) (2,036,179) 443,604 0 0 0 0	0 0 0 2,274,608 0 0 0 0 (2,274,608) (2,060,683) 460,166 0 0 0 0	0 0 0 2,358,872 2,358,872 (2,084,899) 477,213 0 0 0 0 0	0 0 2.445,596 0 0 (2,445,596) (2,108,830) 494,758 0 0 0 0 0 0 12(0,413)	0 0 0 2,534,846 0 0 0 (2,534,846) (2,132,478) 512,814 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,626,688 0 0 0 (2,626,688) (2,155,845) (2,155,845) 531,394 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,721,190 0 (2,721,190) (2,178,934) 550,512 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits:	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M GCS O&M 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 1,960,919 0 0 0 (1,960,919) (1,960,919) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,035,957 (1,366,299) (1	0 0 0 2,113,211 2,113,211 2,113,211 2,011,383) 2,011,383) 427,515 0 0 0 0 194,385 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,192,742 0 0 0 0 (2,192,742) (2,036,179) 443,604 443,604 0 0 0 0 198,274 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,274,608 0 0 0 0 (2,274,608) (2,060,683) (2,060,683) (2,060,683) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,358,872 0 0 0 0 (2,358,872 (2,084,899) (2,084,899) (2,084,899) 477,213 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2.445,596 0 0 0 (2,445,596) (2,108,330) 494.758 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,534,846 0 0 0 (2,534,846) (2,132,478) 512,814 0 0 0 0 214,623 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,626,688 0 0 0 0 0 (2,155,845) (2,155,845) (2,155,845) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.721,190 0 0 0 0 (2,721,190) (2,178,934) 2550,512 0 0 0 0 0 223,296 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits:	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M GCS O&M 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1,960,919 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.035,957 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 0 0 0 (2,113,211 (2,011,385) 427,515 0 0 0 0 194,385 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,192,742 0 0 0 (2,192,742) (2,036,179) (2,036,179) 443,604 0 0 0 198,274 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,274,608 0 0 0 0 (2,274,608) (2,060,683) (2,060,683) (2,060,683) (2,060,683) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,358,872 0 0 0 0 (2,358,872) (2,084,899) 477,213 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,445,596 0 0 (2,445,596) (2,108,830) 494,758 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,534,846 0 0 0 (2,534,846) (2,132,478) (2,132,478) (2,132,478) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,626,688 0 0 0 0 0 (2,155,845) (2,155,845) (2,155,845) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,721,190 0 0 0 0 (2,721,190) (2,178,934) (2,178,934) 550,512 0 0 0 0 223,296 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits:	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M GCS O&M Natural Gas Purchased - Dryer Total running costs	0 0 0 0 1,960,919 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 2,113,211 0 0 0 0 2,2113,211 2,211,385 0 0 0 0 194,385 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,192,742 0 0 0 0 (2,192,742) (2,036,179) (2,036,179) 443,604 0 0 0 0 198,274 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,274,608 0 0 0 0 2,274,609 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,358,872 0 0 0 0 (2,358,872) (2,084,899) 2 477,213 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,445,596 0 0 (2,445,596) (2,108,830) 494,758 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.534.846 0 0 0 (2.132.478) (2.132.478) 512.814 0 0 0 214.623 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,626,688 0 0 0 0 0 0 (2,626,688) (2,155,845) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.721.190 0 0 0 0 (2.721.190) (2.771.190) (2.773.808
Capital Outlays Benefits: Annual Running Costs:	Total capital outlays (Pvs) 0 Power Savings 0 Total benefits 0 Discounted Benefits (in 2020\$) 0 Engine O&M GCS O&M 0 Natural Gas Purchased - Dryer 0 0 0	0 0 0 1,960,919 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.035,957 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 0 0 0 0 (2,113,211) (2,011,385) 427,515 0 0 0 0 194,385 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,192,742 0 0 0 0 (2,192,742) (2,036,179) (2,036,179) (2,036,179) (2,036,179) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,274,608 0 0 0 0 0 (2,274,608) (2,060,683) (2,060,683) (2,060,683) (2,060,683) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,358,872 0 0 0 0 (2,358,872) (2,084,899) 477,213 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,445,596 0 0 0 (2,445,596) (2,108,830) 494,758 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,534,846 0 0 0 0 (2,534,846) (2,132,478) (2,132,478) 0 0 0 214,623 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,626,688 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,721,190 0 0 0 0 (2,721,190) (2,178,934) 2550,512 0 0 0 0 223,296 0 0 0 0 0 0 0 773,808 619,610
Capital Outlays Benefits:	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M GCS O&M Natural Gas Purchased - Dryer Total running costs	0 0 0 0 1,960,919 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.035.957 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 2,113,211 0 0 0 0 2,2113,211 2,211,385 0 0 0 0 194,385 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,192,742 0 0 0 0 (2,192,742) (2,036,179) (2,036,179) 443,604 0 0 0 0 198,274 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,274,608 0 0 0 0 2,274,609 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,358,872 0 0 0 0 (2,358,872) (2,084,899) 2 477,213 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,445,596 0 0 (2,445,596) (2,108,830) 494,758 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.534.846 0 0 0 (2.132.478) (2.132.478) 512.814 0 0 0 214.623 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,626,688 0 0 0 0 2,155,845) (2,155,845) (2,155,845) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.721.190 0 0 0 0 (2.721.190) (2.771.190) (2.773.808
Capital Outlays Benefits: Annual Running Costs:	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M GCS O&M Natural Gas Purchased - Dryer Total running costs	0 0 0 1,960,919 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.035,957 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 0 0 0 0 (2,113,211) (2,011,385) 427,515 0 0 0 0 194,385 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,192,742 0 0 0 0 (2,192,742) (2,036,179) (2,036,179) (2,036,179) (2,036,179) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,274,608 0 0 0 0 0 (2,274,608) (2,060,683) (2,060,683) (2,060,683) (2,060,683) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,358,872 0 0 0 0 (2,358,872) (2,084,899) 477,213 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,445,596 0 0 0 (2,445,596) (2,108,830) 494,758 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,534,846 0 0 0 0 (2,534,846) (2,132,478) (2,132,478) 0 0 0 214,623 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,626,688 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,721,190 0 0 0 0 (2,721,190) (2,178,934) 2550,512 0 0 0 0 223,296 0 0 0 0 0 0 0 773,808 619,610
Capital Outlays Benefits: Annual Running Costs: Net escalated benefit/(cost)	Total capital outlays (Pvs) Power Savings Total benefits Discounted Benefits (in 2020\$) Engine O&M GCS O&M Natural Gas Purchased - Dryer Total running costs	0 0 0 1,960,919 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.035,957 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,113,211 0 0 0 0 (2,113,211) (2,011,385) 427,515 0 0 0 0 194,385 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,192,742 0 0 0 0 (2,192,742) (2,036,179) (2,036,179) (2,036,179) (2,036,179) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,274,608 0 0 0 0 0 (2,274,608) (2,060,683) (2,060,683) (2,060,683) (2,060,683) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,358,872 0 0 0 0 (2,358,872) (2,084,899) 477,213 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,445,596 0 0 0 (2,445,596) (2,108,830) 494,758 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,534,846 0 0 0 0 (2,534,846) (2,132,478) (2,132,478) 0 0 0 214,623 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,626,688 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,721,190 0 0 0 0 (2,721,190) (2,178,934) 2550,512 0 0 0 0 223,296 0 0 0 0 0 0 0 773,808 619,610

Alternative 0-GCS Results

	Year of analysis Escalation rate Discount rate	2020 2.00% 2.50%	Risk adjustments	(+/- percent): Benefits Capital costs Running costs	0% 0% 0%			Alternative Study Alterna ernative Cost			
5 ··· 0000 ·· //		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Expressed in 2020 dollars, unes	calated dollars										
Capital Outlays	Gas Conditioning - 650 scfm	3,000,000									
	Total capital outlays	3,000,000	0	0	0	0	0	0	0	0	0
Benefits:	rour ouplar outdyo	0,000,000	, i	, i	, i	,	, i	Ŭ	v		
Denents.											
	Power Savings	1,960,919	1,996,036	2,031,153	2,066,270	2,101,386	2,136,503	2,171,620	2,206,736	2,241,853	2,276,970
	Total benefits	(1,960,919)	(1,996,036)	(2,031,153)	(2,066,270)	(2,101,386)	(2,136,503)	(2,171,620)	(2,206,736)	(2,241,853)	(2,276,970)
Annual Running Costs:	E : 000	000.000	0.40,000	040 540	050.044	055 070	050.000	000 500	007.004	070 404	070.000
	Engine O&M GCS O&M	238,023 79,341	242,286 80,762	246,548 82,183	250,811 83,604	255,073 85,024	259,336 86,445	263,599 87,866	267,861 89,287	272,124 90,708	276,386 92,129
	Natural Gas Purchased - Dryer	186,835	186,836	186,837	186,838	186,839	186,840	186,841	186,842	186,843	186,844
	Total running costs	504,199	509,884	515,568	521,253	526,937	532,622	538,306	543,990	549,675	555,359
Net Benefit/(cost)		1,543,280	(1,486,152)	(1,515,585)	(1,545,017)	(1,574,449)	(1,603,881)	(1,633,314)	(1,662,746)	(1,692,178)	(1,721,610)
Expressed in escalated dollars of Capital Outlays	with sensitivity adjustments Gas Conditioning - 650 scfm 0 0	3,000,000 0 0	0 0 0	0 0	0 0	0 0 0	0 0 0	0 0	0 0	0 0 0	000000000000000000000000000000000000000
	Total capital outlays (Pvs)	3,000,000	0	0	0	0	0	0	0	0	0
Benefits:											
	0 Power Savings	0 1,960,919	0 2,035,957	0 2,113,211	0 2,192,742	0 2,274,608	0 2,358,872	0 2,445,596	0 2,534,846	0 2,626,688	0 2,721,190
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	Total benefits Discounted Benefits (in 2020\$)	(1,960,919) (1,960,919)	(2,035,957) (1,986,299)	(2,113,211) (2,011,385)	(2,192,742) (2,036,179)	(2,274,608) (2,060,683)	(2,358,872) (2,084,899)	(2,445,596) (2,108,830)	(2,534,846) (2,132,478)	(2,626,688) (2,155,845)	(2,721,190) (2,178,934)
Annual Running Costs:											
-	Engine O&M GCS O&M	238,023 79,341	247,131 82,377	256,509 85,503	266,163 88,721	276,100 92,033	286,328 95,443	296,855 98,952	307,688 102,563	318,836 106,279	330,307 110,102
	0003 0 AM	0	0	0	0	0	0	0	0	0	0
	0 Natural Gas Purchased - Dryer	0 186,835	0 190,573	0 194,385	0 198,274	0 202,241	0 206,287	0 210,413	0 214,623	0 218,917	0 223,296
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
	Total running costs Discounted Running Costs (in 2020\$)	504,199 504,199	520,081 507,397	536,397 510,551	553,158 513,662	570,374 516,730	588,057 519,757	606,220 522,742	624,874 525,685	644,032 528,587	663,706 531,448
			0								
Net escalated benefit/(cost)		1,543,280	(1,515,875)	(1,576,814)	(1,639,584)	(1,704,234)	(1,770,815)	(1,839,376)	(1,909,972)	(1,982,656)	(2,057,484)
Net escalated benefit/(cost) Life cycle cost analysis		1,543,280	(1,515,875)	(1,576,814)	(1,639,584)	(1,704,234)	(1,770,815)	(1,839,376)	(1,909,972)	(1,982,656)	(2,057,484)
		1,543,280 1,543,280	(1,515,875) (1,478,903)	(1,576,814)	(1,639,584)	(1,704,234)	(1,770,815) (1,565,142)	(1,839,376)	(1,909,972) (1,606,793)	(1,982,656)	(2,057,484)

 PVs in 2020
 1,543,280
 (1,476,903)
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 (1,522,517)
 (1,543,952)
 (1,565,142)
 (1,586,088)
 (1,607,738)
 (1,647,486)

 Cumulative Benefits Payback
 1,543,280
 64,377
 (1,436,457)
 (2,958,974)
 (4,502,927)
 (6,068,069)
 (7,654,157)
 (9,260,950)
 (10,888,209)
 (12,535,694)

 NPV as of 2020
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Alternative 1 Results

	Year of analysis Escalation rate Discount rate	R 2020 2.00% 2.50%	isk adjustments (·	⊧/- percent): Benefits Capital costs Running costs	0% 0% 0%			Alternative Study Alternativ ernative Cost An			
Expressed in 2020 dollars, une	secolated dollars	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Capital Outlays											
Capital Outlays	BUS 500 scfm Standby Boiler	13,000,000 500,000									
	HSW Receiving Facility Dig 1&3 Improvements	000,000									
	Total capital outlays	13,500,000	0	0	0	0	0	0	0	0	0
Benefits:			0.010.510	0.000 205	0.005.001	0 700 0 10	0 = 11 000				
	D3 RINs	2,614,137	2,642,543	2,669,795	2,695,894	2,720,840	2,744,633	2,767,272	2,788,759	2,809,092	2,828,271
	LCFS Natural Gas Sale	713,315 328,475	721,068 335,503	728,506 342,531	735,621 349,559	742,430 356,587	748,924 363,615	755,103 370,643	760,961 377,671	766,511 384,699	771,746 391,727
	HSW Tipping Fee Total benefits	0 (3,655,927)	0 (3,699,113)	(3,740,832)	0 (3,781,075)	0 (3,819,857)	(3,857,172)	0 (3,893,019)	0 (3,927,391)	(3,960,302)	(3,991,745)
Annual Running Costs:		(0,000,000)	(0,000,000)	(0,000)	(-)),/	(0,000,000)	(0,000,000)	(0,000,000)	(0,0-0,000.)	(0,000,000)	(0,000,007)
Annual Running Costs.	Engine O&M	0	0	0	0	0	0	0	0	0	0
	BUS Labor Biogas/GCS Upgrading O&M	125,000 245,183	125,000 250,429	125,000 255,675	125,000 260,921	125,000 266,167	125,000 271,413	125,000 276,659	125,000 281,905	125,000 287,151	125,000 292,396
	NG - Digester Heat Natural Gas Purchased - Dryer	96,633 186,835	98,684 186,836	100,735 186,837	102,785 186,838	104,836 186,839	106,886 186,840	108,937 186,841	110,987 186,842	113,038 186,843	115,089 186,844
	BUS Power	200,223	204,507	208,791	213,075	217,358	221,642	225,926	230,210	234,494	238,778
	Boiler O&M	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
	Total running costs	868,874	880,456	892,037	903,619	915,200	926,782	938,363	949,945	961,526	973,108
Net Benefit/(cost)	·	10,712,948	(2,818,657)	(2,848,795)	(2,877,456)	(2,904,657)	(2,930,391)	(2,954,656)	(2,977,446)	(2,998,775)	(3,018,637)
Expressed in escalated dollars	with sensitivity adjustments										
Expressed in escalated dollars	s with sensitivity adjustments										
	BUS 500 scfm	13,000,000	0	0	0	0	0	0	0	0	0
	BUS 500 scfm Standby Boiler Dig 1&3 Improvements	500,000 0	0	0	0	0	0	0	0	0	0
•	BUS 500 scfm Standby Boiler	500,000	0	Ő	0	0	0	0	0	0	0
	BUS 500 scfm Standby Boller Dig 183 Improvements Total capital outlays (Pvs)	500,000 0 13,500,000	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
Capital Outlays	BUS 500 scfm Standby Boller Dig 183 Improvements Total capital outlays (Pvs) D3 RINs	500,000 0 13,500,000 2,614,137 0	0 0 2,695,394 0	0 0 0 2,777,655 0	0 0 2,860,905 0	0 0 0 2,945,125 0	0 0 0 3,030,297 0	0 0 0 3,116,398 0	0 0 3,203,407 0	0 0 0 3,291,298 0	0 0 0 3,380,046 0
Capital Outlays	BUS 500 scfm Standby Boller Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale	500,000 0 13,500,000 2,614,137 0 713,315 328,475	0 0 2,695,394 0 735,489 342,213	2,777,655 0 757,937 356,369	0 0 2,860,905 0 780,647 370,955	0 0 2,945,125 0 803,630 385,981	0 0 3,030,297 0 826,873 401,460	0 0 0 3,116,398 0 850,369 417,404	0 0 3,203,407 0 874,105 433,826	0 0 3,291,298 0 898,089 450,737	3,380,046 0 922,308 468,150
Capital Outlays	BUS 500 scfm Standby Boler Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS	500,000 0 13,500,000 2,614,137 0 713,315	0 0 2,695,394 0 735,489	0 0 0 2,777,655 0 757,937	0 0 2,860,905 0 780,647	0 0 2,945,125 0 803,630	0 0 3,030,297 0 826,873	0 0 0 3,116,398 0 850,369	0 0 3,203,407 0 874,105	0 0 3,291,298 0 898,089	0 0 0 3,380,046 0 922,308
Capital Outlays	BUS 500 scfm Standby Boller Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee	500,000 0 13,500,000 2,614,137 0 713,315 328,475 0	0 0 2,695,394 0 735,489 342,213 0	2,777,655 0 757,937 356,369 0	0 0 2,860,905 0 780,647 370,955 0	0 0 2,945,125 0 803,630 385,981 0	0 0 3,030,297 0 826,873 401,460 0	0 0 0 3,116,398 0 850,369 417,404 0	0 0 3,203,407 0 874,105 433,826 0	0 0 3,291,298 0 898,089 450,737 0	3,380,046 0 922,308 468,150 0
Capital Outlays	BUS 500 scfm Standby Boller Dig 1&3 improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$)	500,000 0 13,500,000 2,614,137 0 713,315 328,475 0 (3,655,927) (3,655,927)	0 0 0 735,489 342,213 0 (3,773,095) (3,681,069)	0 0 0 2,777,655 0 757,937 356,369 0 (3,891,961) (3,704,425)	0 0 0 780,647 370,955 0 (4,012,507) (3,726,011)	0 0 0 803,630 385,981 0 (4,134,737) (3,745,867)	0 0 0 826,873 401,460 0 (4,258,630) (3,764,008)	0 0 3,116,398 0 850,369 417,404 0 (4,384,172) (3,780,457)	0 0 3,203,407 0 874,105 433,826 0 0 (4,511,337) (3,795,231)	0 0 0 3,291,298 0 98,089 450,737 0 0 (4,640,124) (3,808,366)	0 0 0 3,380,046 0 922,308 468,150 0 0 (4,770,504) (3,819,878)
Capital Outlays Benefits:	BUS 500 scfm Standby Boiler Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits	500,000 13,500,000 2,614,137 0 713,315 328,475 0 (3,655,927)	0 0 0 2,695,394 0 735,489 342,213 0 (3,773,095)	0 0 0 2,777,655 0 757,937 356,369 0 (3,891,961)	0 0 2,860,905 0 780,647 370,955 0 (4,012,507)	0 0 0 2,945,125 0 803,630 385,981 0 (4,134,737)	0 0 3,030,297 0 826,873 401,460 0 (4,258,630)	0 0 0 3,116,398 0 850,369 417,404 0 (4,384,172)	0 0 3,203,407 0 874,105 433,826 0 (4,511,337)	0 0 3,291,298 0 898,089 450,737 0 (4,640,124)	3,380,046 0 922,308 468,150 0 (4,770,504)
Capital Outlays Benefits:	BUS 500 scfm Standby Boiler Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M BUS Labor Biogas/GCS Upgrading 0&M	500.000 0 13,500,000 2,614,137 0 713,315 328,475 (3,655,927) (3,655,927) (3,655,927) 0 125,000 245,183	0 0 0 735,489 342,213 0 (3,773,095) (3,681,069) 0 127,500 255,438	0 0 0 757,937 356,369 0 (3,891,961) (3,704,425) 0 130,050 266,004	0 0 0 2,860,905 0 780,647 370,955 0 (4,012,507) (3,726,011) 0 132,651 276,891	0 0 0 2,945,125 0 803,630 385,981 0 (4,134,737) (3,745,867) 0 (4,134,737) (3,745,867)	0 0 0 826 873 401,460 0 (4,258,630) (3,764,008) 0 138,010 299,662	0 0 0 8 850,369 417,404 0 (4,384,172) (3,780,457) 0 140,770 0 140,770	0 0 0 874,105 433,826 0 (4,511,337) (3,795,231) 0 143,586 23,3,820	0 0 0 3.291.298 0 808.089 450.737 0 (4.640,124) (3.808.366) 0 146.457 336.443	0 0 0 922,308 468,150 0 (4,770,504) (3,819,870) (3,819,870) 0 149,387 349,441
Capital Outlays Benefits:	BUS 500 scfm Standby Boller Dig 183 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M NG – Digester Heat Natural Gas Purchased - Dryer	500.000 0 13,500,000 13,500,000 13,500,000 713,315 328,475 328,475 (3,655,927) (3,655,927) (3,655,927) 0 125,000 245,183 96,633 186,635	0 0 0 735,495 342,213 0 (3,773,095) (3,681,069) 0 0 127,500	0 0 0 757.937 356.369 0 (3.891.961) (3.704.425) 0 130.050 266.004 104.804 194.385	0 0 0 2.860,905 0 780,647 370,955 0 (4,012,667) (3,726,011) 0 132,651 109,076 198,274	0 0 2,945,125 0 803,630 335,591 0 (4,134,737) (3,745,867) 0 135,304 288,107 113,478 202,241	0 0 0 226,873 401,460 (4,258,630) (3,764,008) 0 133,010 299,662 118,011 206,287	0 0 0 850,369 417,404 (4,384,172) (3,780,457) 0 (4,384,172) (3,780,457) 0 140,770 311,563 122,681 210,413	0 0 3,203,407 0 874,105 433,826 (4,511,337) (3,795,231) 0 143,586 323,820 127,490 214,623	0 0 3,291,298 600 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 922,308 468,150 0 (4,770,504) (3,819,878) 349,847 349,841 137,542 223,296
Capital Outlays Benefits:	BUS 500 scfm Standby Bolier Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M BUS Labor Biogas/GCS Upgrading 0&M NG - Digester Heat Natural Gas Purchased - Dryer BUS Power	500,000 0 13,500,000 2,614,137 0 713,315 328,475 0 (3,655,927) (3,655,927) 0 125,000 245,183 96,633 186,835 200,223	0 0 2,695,394 0 735,489 342,213 0 (3,773,945) (3,681,069) 0 127,500 255,438 100,659 190,573 208,597	0 0 0 757,937 355,369 0 (3,81961) (3,704,425) 0 130,050 266,004 104,804 134,385 217,226	0 0 0 2.860.905 0 780.847 370.955 0 0.4.012.807] (3.726.011) 0.132.651 109.076 198.274 226.116	0 0 2,945,125 0 803,630 0 (4,134,737) (3,745,867) 0 135,304 288,107 113,478 202,241 235,276	0 0 3,030,297 0 826,873 401,460 0 (4,258,630) (3,764,008) 0 138,010 299,662 118,011 206,287 244,711	0 0 0 850,369 417,404 0 (4,384,172) (3,780,457) 0 140,770 311,653 112,2681 220,413 224,430	0 0 3,203,407 0 874,105 433,826 0 (4,511,337] (3,795,231) 0 143,586 323,820 143,586 323,820 127,490 214,623 264,439	0 0 3,291,298 0 990,089 0 450,737 0 (4,640,124) (3,808,366) 0 146,457 336,443 132,442 218,917 274,747	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits:	BUS 500 scfm Standby Boller Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINs LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M NG – Digester Heat Natural Gas Purchased - Dryer	500.000 0 13,500,000 13,500,000 13,500,000 713,315 328,475 328,475 (3,655,927) (3,655,927) (3,655,927) 0 125,000 245,183 96,633 186,635	0 0 0 735,489 342,213 0 0 (3,773,095) (3,681,069) 0 127,500 255,438 100,658	0 0 0 757.937 356.369 0 (3.891.961) (3.704.425) 0 130.050 266.004 104.804 194.385	0 0 0 2.860,905 0 780,647 370,955 0 (4,012,667) (3,726,011) 0 132,651 109,076 198,274	0 0 2,945,125 0 803,630 335,591 0 (4,134,737) (3,745,867) 0 135,304 288,107 113,478 202,241	0 0 0 226,873 401,460 (4,258,630) (3,764,008) 0 133,010 299,662 118,011 206,287	0 0 0 850,369 417,404 (4,384,172) (3,780,457) 0 (4,384,172) (3,780,457) 0 140,770 311,563 122,681 210,413	0 0 3,203,407 0 874,105 433,826 (4,511,337) (3,795,231) 0 143,586 323,820 127,490 214,623	0 0 3,291,298 600 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 922,308 468,150 0 (4,770,504) (3,819,878) 349,847 349,841 137,542 223,296
Capital Outlays Benefits:	BUS 500 scfm Standby Bolier Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M BUS Labor Biogas/GCS Upgrading 0&M NG - Digester Heat Natural Gas Purchased - Dryer BUS Power	500,000 0 13,500,000 2,614,137 0 713,315 328,475 0 (3,655,927) (3,655,927) 0 125,000 245,183 96,633 186,835 200,223	0 0 2,695,394 0 735,489 342,213 0 (3,773,945) (3,681,069) 0 127,500 255,438 100,659 190,573 208,597	0 0 0 757,937 355,369 0 (3,81961) (3,704,425) 0 130,050 266,004 104,804 134,385 217,226	0 0 0 2.860.905 0 780.847 370.955 0 0.4.012.807] (3.726.011) 0.132.651 109.076 198.274 226.116	0 0 2,945,125 0 803,630 0 (4,134,737) (3,745,867) 0 135,304 288,107 113,478 202,241 235,276	0 0 3,030,297 0 826,873 401,460 0 (4,258,630) (3,764,008) 0 138,010 299,662 118,011 206,287 244,711	0 0 0 850,369 417,404 0 (4,384,172) (3,780,457) 0 140,770 311,653 112,2681 220,413 224,430	0 0 3,203,407 0 874,105 433,826 0 (4,511,337] (3,795,231) 0 143,586 323,820 143,586 323,820 127,490 214,623 264,439	0 0 3,291,298 0 990,089 0 450,737 0 (4,640,124) (3,808,366) 0 146,457 336,443 132,442 218,917 274,747	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits:	BUS 500 scfm Standby Bolier Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discontende Benefits (in 2020\$) Engine 0&M BUS Labor Biogas/GCS Upgrading 0&M NG - Digester Heat Natural Gas Purchased - Dryer BUS Power Bolier 0&M	500,000 0 13,500,000 2,614,137 0 713,315 328,475 0 (3,655,927) (3,655,927) 0 125,000 245,183 96,633 186,633 200,223 15,000	0 0 0 2,695,394 0 735,489 342,213 0 3(3,773,995) (3,681,069) 0 127,500 255,438 100,658 190,573 208,573 15,300	0 0 0 0 757,937 355,369 0 0 (3,8961) (3,704,425) 0 130,050 266,004 104,804 194,385 217,226 15,606	0 0 0 2.860.905 0 780.647 370.955 0 (4,012,507) (3,726,011) 0 102,2651 109,274 198,274 198,274 198,274 15,918	0 0 2.945,125 0 803,630 0 (4,134,737) (3,745,867) 0 113,478 202,241 228,107 113,478 202,241 16,236 16,236	0 0 3.030 297 0 826.873 401.460 0 (4.258.630) (3.764,008) 0 118.010 299.662 118.011 206.287 244.711 16.561	0 0 0 860,369 417,404 0 (4,384,172) (3,780,457) 140,770 140,770 311,563 122,061 2210,413 210,413 16,892	0 0 3,203,407 0 874,105 433,826 0 (4,511,337] (3,795,231) 0 143,586 323,827 14,623 214,625 214,62	0 0 3,291,298 0 898,089 450,737 0 (4,640,124) (3,808,366) 0 146,457 336,443 132,442 218,917 17,578 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits:	BUS 500 scfm Standby Bolier Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M BUS Labor Biogas/GCS Upgrading 0&M NG - Digester Heat Natural Gas Purchased - Dryer BUS Power	500.000 0 13,500,000 13,500,000 13,500,000 713,315 328,475 328,475 328,475 (3,655,927) (3,655,927) (3,655,927) (3,655,927) 0 125,000 245,183 186,835 200,223 15,000 868,874	0 0 2.695,394 0 735,489 342,213 0 (3,773,095) (3,681,069) 0 127,500 255,438 100,658 190,573 208,597 15,300 898,065 896,065	0 0 0 757,937 355,369 0 (3,81961) (3,704,425) 0 130,050 266,004 104,804 134,385 217,226	0 0 0 2.860.905 0 780.847 370.955 0 0.4.012.807] (3.726.011) 0.132.651 109.076 198.274 226.116	0 0 2,945,125 0 803,630 0 (4,134,737) (3,745,867) 0 135,304 288,107 113,478 202,241 235,276	0 0 3,030,297 0 826,873 401,460 0 (4,258,630) (3,764,008) 0 138,010 299,662 118,011 206,287 244,711	0 0 0 850,369 417,404 0 (4,384,172) (3,780,457) 0 140,770 311,653 1122,681 220,413 224,430	0 0 3,203,407 0 874,105 433,826 0 (4,511,337] (3,795,231) 0 143,586 323,820 143,586 323,820 127,490 214,623 264,439	0 0 3,291,298 0 990,089 0 450,737 0 (4,640,124) (3,808,366) 0 146,457 336,443 132,442 218,917 274,747	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits:	BUS 500 schr Standby Boller Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Discounted Benefi	500.000 0 13,500,000 13,500,000 13,500,000 713,315 328,475 328,475 328,475 (3,655,927) (3,655,927) (3,655,927) (3,655,927) 0 125,000 245,183 186,835 200,223 15,000 868,874	0 0 0 735,489 342,213 342,213 0 (3,773,095) (3,681,069) 0 127,500 0 127,500 0 0,573 190,573 190,573 190,573 15,300	0 0 0 767,937 356,369 0 (3,891,961) (3,704,425) 0 130,055 266,004 104,804 104,804 104,804 115,606 15,606	0 0 2.860,905 780,647 370,955 (4,012,507) (3,726,011) 0 132,651 109,076 198,274 226,116 15,918 15,918 958,927	0 0 2,945,125 0 803,630 385,981 0 (4,134,737) (3,745,867) 0 135,5304 0 135,5304 228,107 113,478 202,241 235,276 16,236 16,256 16,26	0 0 3.030.297 0 20.673 401.460 (4.258.630) (3.784.008) 0 138.010 299.662 118.011 206.287 244.711 16.561 1,023.242	0 0 0 0 8 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 17,404 17,404 17,20 (3,780.457) 1,4384,172) (3,780.457) 1,22681 1,2567 1	0 0 3,203,407 0 874,105 433,826 433,826 (4,511,337) (3,795,231) 143,586 0 143,586 127,490 124,663 224,623 17,230 17,230 1,091,188	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits: Annual Running Costs:	BUS 500 schr Standby Boller Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Discounted Benefi	500.000 0 13,500,000 2,614,137 0,713,315 328,475 328,475 0 (3,665,927) (3,665,927) 0 125,000 245,183 186,835 200,223 15,000 5,	0 0 0 735,489 342,213 0 (3,773,085) (3,681,069) 0 127,500 255,438 100,658 190,573 208,597 15,300 15,300	0 0 0 767,937 366,369 0 (3,891,961) (3,704,425) 0 130,055 266,004 104,804 104,804 104,804 114,385 217,226 15,606 928,076 883,356	0 0 2.860,905 780,647 370,955 0 (4,912,507) (3,726,011) 0 132,651 109,076 138,274 226,116 15,918 15,918 15,918 958,927 890,459	0 0 2,945,125 0 803,630 385,981 0 (4,134,737) (3,745,867) 0 (4,134,737) (3,745,867) 0 (14,124,73) (15,766) (16,236) (1	0 0 3.030.297 0 826.873 401.460 (4.258.630) (3.764.008) 0 138.010 299.662 118.011 206.287 244.711 16.561 1.6.561 1.023.242 904.397	0 0 0 0 8 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 17,404 0 (3,780.457) (3,780.457) 122,681 124,682 124,682 125,6749 122,881 122,881 124,685 124,	0 0 3,203,407 0 87,405 433,826 433,826 (3,795,231) (3,795,231) 0 143,586 323,820 127,490 214,623 264,439 17,230 17,230 17,230 1,091,188 917,978	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0
Capital Outlays Benefits: Annual Running Costs: Net escalated benefit/(cost)	BUS 500 schr Standby Boller Dig 1&3 Improvements Total capital outlays (Pvs) D3 RINS LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Discounted Benefi	500.000 0 13,500,000 2,614,137 0,713,315 328,475 328,475 0 (3,665,927) (3,665,927) 0 125,000 245,183 186,835 200,223 15,000 5,	0 0 0 735,489 342,213 0 (3,773,085) (3,681,069) 0 127,500 255,438 100,658 190,573 208,597 15,300 15,300	0 0 0 767,937 366,369 0 (3,891,961) (3,704,425) 0 130,055 266,004 104,804 104,804 104,804 114,385 217,226 15,606 928,076 883,356	0 0 2.860,905 780,647 370,955 0 (4,912,507) (3,726,011) 0 132,651 109,076 138,274 226,116 15,918 15,918 15,918 958,927 890,459	0 0 2,945,125 0 803,630 385,981 0 (4,134,737) (3,745,867) 0 (4,134,737) (3,745,867) 0 (14,124,73) (15,766) (16,236) (1	0 0 3.030.297 0 826.873 401.460 (4.258.630) (3.764.008) 0 138.010 299.662 118.011 206.287 244.711 16.561 1.6.561 1.023.242 904.397	0 0 0 0 8 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 0 8 17,404 0 (3,780.457) (3,780.457) 122,681 124,682 124,682 125,6749 122,881 122,881 124,685 124,	0 0 3,203,407 0 87,405 433,826 433,826 (3,795,231) (3,795,231) 0 143,586 323,820 127,490 214,623 264,439 17,230 17,230 17,230 1,091,188 917,978	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0

Alternative 2 Results

	Year of analysis Escalation rate	2020 2.00%	isk adjustments (+	/- percent): Benefits Capital costs	0% 0%		HSW	Alternative Study Alternative ernative Cost A			
	Discount rate	2.50%		Running costs	0%						
		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Expressed in 2020 dollars, une	scalated dollars										
Capital Outlays	BUS 500 scfm	13,000,000									
	_										
	Total capital outlays	13,000,000	0	0	0	0	0	0	0	0	0
Benefits:	-						·				
	D3 RINs Power Savings	2,410,450 446,969	2,436,000 446,969	2,477,125 446,969	2,500,400 446,969	2,522,625 446,969	2,559,900 446,969	2,579,850 446,969	2,598,750 446,969	2,616,600 446,969	2,648,800 446,969
	LCFS	852,234	858,555	864,561	870,252	875,621	880,683	885,430	889,862	893,973	897,776
	Natural Gas Sale HSW Tipping Fee	392,447	399,475	406,503	413,531	420,559	427,587	434,616	441,644	448,672	455,700
	Total benefits	(4,102,101)	(4,140,999)	(4,195,158)	(4,231,153)	(4,265,775)	(4,315,140)	(4,346,865)	(4,377,225)	(4,406,214)	(4,449,245
Annual Running Costs:											
	Engine O&M BUS Labor	90,424 125,000	90,424 125,000	90,424 125,000	90,424 125,000	90,424 125,000	90,424 125,000	90,424 125,000	90,424 125,000	90,424 125,000	90,424 125,000
	Biogas/GCS Upgrading O&M	226,163	231,409	236,655	241,901	247,147	252,393	257,639	262,884	268,130	273,376
	Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer	47,788 186,835	49,754 186,836	51,721 186,837	53,688 186,838	55,654 186,839	57,621 186,840	59,588 186,841	61,555 186,842	63,521 186,843	65,488 186,844
	BUS Power	239,217	243,501	247,785	252,069	256,353	260,637	264,921	269,205	273,489	277,773
	-										
			0	0	0	0	0	0	0	0	0
	Total running costs	915,427	0 926,925	0 938,422	0 949,920	0 961,418	0 972,915	0 984,413	0 995,910	0 1,007,408	0
No. (Dour - (1) // 1)	· · · · · · · · · · · · · · · · · · ·				(3,281,233)				(3,381,315)		
Net Benefit/(cost)	Ľ	9,813,327	(3,214,075)	(3,256,736)	(3,281,233)	(3,304,357)	(3,342,224)	(3,362,452)	(3,361,315)	(3,398,806)	(3,430,339
Expressed in escalated dollars	with sensitivity adjustments										
Capital Outlays											
Capital Outlays	_										
	BUS 500 scfm	13,000,000	0	0	0	0	0	0	0	0	0
	BUS 500 scfm 0 0	0	0	0	0	0	0	0	0	0	0
	BUS 500 scfm 0 0 Total capital outlays (Pvs)		0 0 0 0	0 0 0	0 0 0	0 0 0 0			0 0 0 0	0 0 0 0	
Benefits:	0 0	0	0	0	0	0	0	0 0 0	0	0	0 0 0
Benefits:	0 Total capital outlays (Pvs) D3 RINs	0 0 13,000,000 2,410,450	0 0 0 2,484,720	0 0 0 2,577,201	0 0 0 2,653,444	0 0 0 2,730,570	0 0 0 2,826,336	0 0 0 2,905,330	0 0 0 2,985,147	0 0 0 3,065,764	0 0 0 3,165,561
Benefits:	0 Total capital outlays (Pvs) D3 RINs Power Savings LCFS	0 0 13,000,000 2,410,450 446,969 852,234	0 0 2,484,720 455,909 875,726	0 0 2,577,201 465,027 899,489	0 0 2,653,444 474,327 923,518	0 0 2,730,570 483,814 947,800	0 0 2,826,336 493,490 972,345	0 0 2,905,330 503,360 997,138	0 0 2,985,147 513,427 1,022,172	0 0 3,065,764 523,696 1,047,432	0 0 3,165,561 534,170 1,072,925
Benefits:	0 Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale	0 0 13,000,000 2,410,450 446,969	0 0 2,484,720 455,909	0 0 2,577,201 465,027 899,489 422,926	0 0 2,653,444 474,327 923,518 438,843	0 0 2,730,570 483,814	0 0 2,826,336 493,490 972,345 472,091	0 0 2,905,330 503,360 997,138 489,448	0 0 2,985,147 513,427	0 0 3,065,764 523,696 1,047,432 525,690	0 0 3,165,561 534,170 1,072,925 544,603
Benefits:	0 Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101)	0 0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819)	0 0 2,577,201 465,027 899,489 422,926 0 (4,364,643)	0 0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133)	0 0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412)	0 0 2,826,336 493,490 972,345 472,091 0 (4,764,263)	0 0 2,905,330 503,360 997,138 489,448 0 (4,895,276)	0 0 2,985,147 513,427 1,022,172 507,310 0 (5,028,056)	0 0 3,065,764 523,696 1,047,432 525,690 0 (5,162,582)	0 0 3,165,561 534,170 1,072,925 544,603 0 (5,317,260
Benefits:	0 Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0	0 0 2,484,720 455,909 875,726 407,465 0	0 0 2,577,201 465,027 899,489 422,926 0	0 0 2,653,444 474,327 923,518 438,843 0	0 0 2,730,570 483,814 947,800 455,227 0	0 0 2,826,336 493,490 972,345 472,091 0	0 0 2,905,330 503,360 997,138 489,448 0	0 0 2,985,147 513,427 1,022,172 507,310 0	0 0 3,065,764 523,696 1,047,432 525,690 0	0 0 3,165,561 534,170 1,072,925 544,603 0
Benefits: Annual Running Costs:	0 Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$)	0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101)	0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799)	0 0 2,577,201 465,027 899,489 422,926 0 (4,364,643) (4,154,330)	0 0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133) (4,169,535)	0 0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412) (4,183,147)	0 0 2,826,336 493,490 972,345 472,091 0 (4,764,263) (4,210,914)	0 0 0 503,360 997,138 489,448 0 (4,895,276) (4,221,181)	0 0 0 2,985,147 513,427 1,022,172 507,310 0 (5,028,056) (4,229,929)	0 0 3,065,764 523,699 1,047,432 525,690 0 (5,162,582) (4,237,171)	0 0 0 3,165,561 534,170 1,072,925 544,603 0 (5,317,260 (4,257,680
	0 Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101)	0 0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819)	0 0 2,577,201 465,027 899,489 422,926 0 (4,364,643)	0 0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133)	0 0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412)	0 0 2,826,336 493,490 972,345 472,091 0 (4,764,263)	0 0 2,905,330 503,360 997,138 489,448 0 (4,895,276)	0 0 2,985,147 513,427 1,022,172 507,310 0 (5,028,056)	0 0 3.065.764 523.696 1.047.432 525.690 (5.162.582) (4.237.171) 105.947 146.457	0 0 0 3,165,561 534,170 1,072,925 544,603 0 (5,317,260 (4,257,680 108,066
	D3 RINs D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUG32/GCS Upgrading O&M	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) 90,424 125,000 226,163	0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799) 32,233 127,500 226,037	0 0 2,577,201 465,027 899,489 422,926 0 (4,364,643) (4,154,330) 94,078 130,050 246,216	0 0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133) (4,169,535) 132,651 256,707	0 0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412) (4,183,147) (4,183,147) 97,878 135,304 267,519	0 0 0 2,826,336 493,490 972,345 472,091 0 (4,764,263) (4,210,914) 99,836 138,010 278,662	0 0 2,905,330 503,360 997,138 489,448 0 (4,895,276) (4,221,181) 101,833 140,770 220,143	0 0 2,985,147 513,427 1,022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,566 301,972	0 0 0 3,065,764 523,696 1,047,432 0 (5,162,582) (4,237,171) 105,947 146,457 314,157	0 0 0 0 0 0 0 0 0 0 0 0 0 0
	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dig Heat	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) (4,102,101) 20,424 125,000 226,163 47,788	0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799) 92,233 127,500 236,037 50,749	0 0 2,577,201 465,027 899,489 422,926 0 (4,364,643) (4,154,330) (4,154,330) 94,078 130,050 246,216 53,811	0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133) (4,169,535) 95,959 132,651 286,707 56,974	0 0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242	0 0 0 2.826.336 493.490 972.345 472.091 0 (4,764.263) (4,210.914) 99.836 138.010 278.662 83.618	0 0 2,905,330 997,138 489,448 0 (4,895,276) (4,221,181) 101,833 140,770 290,143 67,106	0 0 0 2,985,147 1,022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707	0 0 3.065,764 523,696 1.047,432 525,690 0 (5.162,582) (4,237,171) 105,947 146,457 314,157 314,157	0 0 0 3,165,561 534,170 1,072,925 544,603 0 (5,317,260 (4,257,680 108,066 149,387 326,710 78,264
	D3 RINs D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUG32/GCS Upgrading O&M	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) 90,424 125,000 226,163	0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799) 32,233 127,500 226,037	0 0 2,577,201 465,027 899,489 422,926 0 (4,364,643) (4,154,330) 94,078 130,050 246,216	0 0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133) (4,169,535) 132,651 256,707	0 0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412) (4,183,147) (4,183,147) 97,878 135,304 267,519	0 0 0 2,826,336 493,490 972,345 472,091 0 (4,764,263) (4,210,914) 99,836 138,010 278,662	0 0 2,905,330 503,360 997,138 489,448 0 (4,895,276) (4,221,181) 101,833 140,770 220,143	0 0 2,985,147 513,427 1,022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,566 301,972	0 0 0 3,065,764 523,696 1,047,432 0 (5,162,582) (4,237,171) 105,947 146,457 314,157	0 0 0 0 3,165,561 534,170 1,072,925 544,603 0 0 (5,317,260 (4,257,680 108,066 149,387 326,710
	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dyper	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) (4,102,101) 205,163 47,788 186,835 186,835 239,217 0	0 0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799) (4,120,799) 92,233 127,500 236,037 50,749 190,573 248,371 0	0 0 0 2,577,201 465,027 899,489 422,926 422,926 0 (4,364,643) (4,154,330) 94,078 130,050 246,216 53,811 194,385 257,796 0	0 0 0 2,653,444 474,327 923,518 438,843 438,843 0 (4,490,133) (4,169,535) 95,959 132,651 256,707 56,974 198,274 198,274 95,7498 0	0 0 0 2,730,570 483,814 947,800 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242 202,241 277,485 0	0 0 0 0 972,345 472,091 472,091 (4,764,263) (4,210,914) 99,836 138,010 278,662 63,618 206,287 267,764	0 0 2.905,330 503,360 997,138 489,448 489,448 (4,895,276) (4,221,161) (4,221,161) 101,833 140,770 290,143 67,106	0 0 2.985,147 513,427 1.022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707 70,707 244,623 309,232	0 0 0 3.065,764 523,696 1.047,432 525,690 (5,162,582) (4,237,171) 105,947 146,457 314,157 74,425 218,917 320,436 0	0 0 0 0 0 0 0 0 1,072,925 544,603 0 0 (5,317,260 (4,257,680 (4,257,680 (4,257,680 149,387 326,710 78,264 223,296 331,964
	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dyper	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) 90,424 125,000 226,163 47,788 47,788 186,835 239,217 0 0 0	0 0 2.484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,739) 92,233 127,500 228,037 50,749 190,573 248,371 0 0 0	0 0 0 2,577,201 465,027 899,489 422,926 0 0 (4,364,643) (4,154,330) 44,078 130,050 246,216 53,811 194,385 257,796 0 0	0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133) (4,169,535) 95,959 132,651 256,707 56,974 198,274 267,498 0 0 0	0 0 2,730,570 483,814 947,800 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242 202,241 277,485 0 0 0	0 0 0 2.826.336 493.490 972.345 472.091 (4.764,263) (4.764,263) (4.210,914) 99.836 138.010 276.662 63.618 206.287 267.764 287.764 0 0	0 0 2,905,330 503,360 997,138 489,448 0 (4,295,276) (4,221,181) 101,833 140,770 290,143 67,106 210,413 298,344 0 0 0	0 0 2.985,147 513,427 1.022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707 214,623 309,232 0 0 0	0 0 0 3.065,764 523,696 1.047,432 525,690 0 (5,162,582) (4,237,171) (4,237,171) 1.05,947 1.16,457 3.14,157 7.47,425 2.18,917 3.20,436 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0
	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dyper	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) (4,102,101) 205,163 47,788 186,835 186,835 239,217 0	0 0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799) (4,120,799) 92,233 127,500 236,037 50,749 190,573 248,371 0	0 0 0 2,577,201 465,027 899,489 422,926 422,926 0 (4,364,643) (4,154,330) 94,078 130,050 246,216 53,811 194,385 257,796 0	0 0 0 2,653,444 474,327 923,518 438,843 438,843 0 (4,490,133) (4,169,535) 95,959 132,651 256,707 56,974 198,274 198,274 95,7498 0	0 0 0 2,730,570 483,814 947,800 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242 202,241 277,485 0	0 0 0 0 972,345 472,091 472,091 (4,764,263) (4,210,914) 99,836 138,010 278,662 63,618 206,287 267,764	0 0 0 2.905,330 503,360 997,138 489,448 489,448 0 (4.895,276) (4,221,181) 101,833 140,770 220,143 67,106 210,413 298,344 0	0 0 2.985,147 513,427 1.022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707 70,707 244,623 309,232	0 0 0 3.065,764 523,696 1.047,432 525,690 (5,162,582) (4,237,171) 105,947 146,457 314,157 74,425 218,917 320,436 0	0 0 0 0 0 0 0 0 1,072,925 544,603 0 0 (5,317,260 (4,257,680 (4,257,680 (4,257,680 149,387 326,710 78,264 223,296 331,964
	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas(CSC Upgrading O&M Natural Gas Purchased - Diryer BUS Power 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) (4,102,101) 90,424 125,000 226,163 47,788 186,835 186,835 186,835 186,835 186,835 186,835 196,835 10,000 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,494,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799) (4,120,799) 92,233 127,500 236,037 50,749 190,573 1248,371 0 0 0 0 0 0 945,463	0 0 0 2,577,201 465,027 899,489 422,926 422,926 0 (4,364,643) (4,154,330) 94,078 130,050 246,216 53,811 194,385 257,796 0 0 0 0 0 9 976,335	0 0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133) (4,169,535) 95,959 132,651 256,707 56,974 198,274 267,498 0 0 0 0 0 0 0 0 0	0 0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242 202,241 277,485 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.826,336 493,490 972,345 472,091 0 (4,764,263) (4,210,914) 99,836 138,010 278,662 63,618 206,287 287,764 0 0 0 0 0 0	0 0 0 2.905,330 503,360 997,138 489,448 0 (4.895,276) (4.221,181) 101,833 140,770 200,143 67,106 210,413 298,344 0 0 0 0 0 1,108,609	0 0 0 2,985,147 1,022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707 70,707 214,623 309,232 0 0 0 0 0 0 0 0	0 0 0 3.065,764 523,696 1.047,432 525,690 (5,162,582) (4,237,171) 105,947 146,457 314,157 74,425 218,917 320,436 0 0 0 0 0 0 1,180,339	0 0 0 0 3,165,561 534,170 1,072,925 544,603 (4,257,680 (4,257,680 (4,257,680 149,387 326,710 78,264 223,296 331,964 0 0 0 0 0 0 0 0
	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine 0&M BUS Labor Biogas/GCS Upgrading 0&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer BUS Power 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) (4,102,101) 226,163 47,788 186,835 186,835 186,835 186,835 186,835 193,217 0 0 0 0 9 15,427 915,427 915,427	0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799) 223,037 127,500 236,037 50,749 190,573 248,371 0 0 0 0	0 0 2,577,201 465,027 899,489 422,926 0 (4,364,643) (4,154,330) 94,078 100,050 246,216 53,811 194,385 257,796 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.653.444 474.327 923.518 438.643 438.643 0 (4.490.133) (4.169.535) 95.959 132.651 256.707 56.974 138.274 138.274 98.274 98.274 98.274 98.274 90 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242 202,241 277,485 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,826,336 493,490 972,345 472,091 0 (4,764,263) (4,210,914) 99,836 138,010 278,662 63,618 206,287 287,764 0 0 0 0	0 0 0 2,905,330 503,360 997,138 489,448 0 (4,895,276) (4,221,181) 101,833 140,770 290,143 67,106 210,413 298,344 0 0 0 0 0	0 0 0 2,985,147 1,022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707 244,623 309,232 0 0 0 0 0 0 0 0 0 0 0	0 0 0 3,065,764 523,696 1,047,432 525,690 0 (5,162,582) (4,237,171) 105,947 146,457 74,425 218,917 320,436 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1 0 1072 925 544,603 0 (5,317,260 (4,257,680 (4,257,680 108,066 149,387 326,710 78,264 223,296 331,964 0 0 0 0 0 0 0
	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas(CSC Upgrading O&M Natural Gas Purchased - Diryer BUS Power 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) (4,102,101) 90,424 125,000 226,163 47,788 186,835 186,835 186,835 186,835 186,835 186,835 196,835 10,000 0 0 0 0 0 0 0 0 0 0 0 0	0 0 2,484,720 455,909 875,726 407,465 0 (4,223,819) (4,120,799) 4,120,799) 4,120,799) 127,500 236,037 50,749 190,573 248,371 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,577,201 465,027 899,489 422,926 422,926 0 (4,364,643) (4,154,330) 94,078 130,050 246,216 53,811 194,385 257,796 0 0 0 0 0 9 976,335	0 0 0 2,653,444 474,327 923,518 438,843 0 (4,490,133) (4,169,535) 95,959 132,651 256,707 56,974 198,274 267,498 0 0 0 0 0 0 0 0 0	0 0 0 2,730,570 483,814 947,800 455,227 0 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242 202,241 277,485 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.826,336 493,490 972,345 472,091 0 (4,764,263) (4,210,914) 99,836 138,010 278,662 63,618 206,287 287,764 0 0 0 0 0 0	0 0 0 2.905,330 503,360 997,138 489,448 0 (4.895,276) (4.221,181) 101,833 140,770 200,143 67,106 210,413 298,344 0 0 0 0 0 1,108,609	0 0 0 2,985,147 1,022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707 70,707 214,623 309,232 0 0 0 0 0 0 0 0	0 0 0 3.065,764 523,696 1.047,432 525,690 (5,162,582) (4,237,171) 105,947 146,457 314,157 74,425 218,917 320,436 0 0 0 0 0 0 1,180,339	0 0 0 0 3,165,561 534,170 1,072,925 544,603 (4,257,680 (4,257,680 (4,257,680 149,387 326,710 78,264 223,296 331,964 0 0 0 0 0 0 0 0
Annual Running Costs: Net escalated benefit/(cost)	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas(CSC Upgrading O&M Natural Gas Purchased - Diryer BUS Power 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) (4,102,101) 226,163 47,788 186,835 186,835 186,835 186,835 186,835 193,217 0 0 0 0 9 15,427 915,427 915,427	0 0 0 455,909 875,726 407,465 0 (4,223,819) (4,120,799) (4,120,799) 92,233 127,500 236,037 50,749 109,573 248,371 0 0 0 0 0 0 0 945,463 92,2403 92,403 92,403 92,403 92,403 92,403 92,403 92,403 92,403 92,403 92,403 90 945,463 92,403 90 90 945,463 90 90 90 90 90 90 90 90 90 90 90 90 90	0 0 2,577,201 465,027 899,499 422,926 422,926 422,926 4,364,643) (4,154,330) 94,078 130,050 246,216 53,811 194,385 257,796 0 0 0 0 0 0 0 9 976,335 929,289	0 0 0 2.653.444 474.327 923.518 438.643 438.643 0 (4.490.133) (4.169.535) 95.959 132.651 256.707 56.974 138.274 138.274 98.274 98.274 98.274 98.274 90 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 2.730,570 483,814 947,800 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242 202,241 277,485 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.905,330 503,360 997,138 489,448 489,448 0 (4,895,276) (4,221,181) 101,833 140,770 (4,221,181) 101,833 140,770 (290,143 67,106 210,413 298,344 0 0 0 0 0 0 0 1,108,609 955,550	0 0 0 2,985,147 1,022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707 244,623 309,232 0 0 0 0 0 0 0 0 0 0 0	0 0 0 3,065,764 523,696 1,047,432 525,690 0 (5,162,582) (4,237,171) 105,947 146,457 74,425 218,917 320,436 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 1,072,925 544,603 0 (5,317,260 (4,257,680 (4,257,680 (4,257,680 108,066 149,387 326,710 78,264 223,296 331,964 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Annual Running Costs:	Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas(CSC Upgrading O&M Natural Gas Purchased - Diryer BUS Power 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 13,000,000 2,410,450 446,969 852,234 392,447 0 (4,102,101) (4,102,101) (4,102,101) 226,163 47,788 186,835 186,835 186,835 186,835 186,835 193,217 0 0 0 0 9 15,427 915,427 915,427	0 0 0 455,909 875,726 407,465 0 (4,223,819) (4,120,799) (4,120,799) 92,233 127,500 236,037 50,749 109,573 248,371 0 0 0 0 0 0 0 945,463 92,2403 92,403 92,403 92,403 92,403 92,403 92,403 92,403 92,403 92,403 92,403 90 945,463 92,403 90 90 945,463 90 90 90 90 90 90 90 90 90 90 90 90 90	0 0 2,577,201 465,027 899,499 422,926 422,926 422,926 4,364,643) (4,154,330) 94,078 130,050 246,216 53,811 194,385 257,796 0 0 0 0 0 0 0 9 976,335 929,289	0 0 0 2.653.444 474.327 923.518 438.643 438.643 0 (4.490.133) (4.169.535) 95.959 132.651 256.707 56.974 138.274 138.274 98.274 98.274 98.274 98.274 90 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 2.730,570 483,814 947,800 (4,617,412) (4,183,147) 97,878 135,304 267,519 60,242 202,241 277,485 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.905,330 503,360 997,138 489,448 489,448 0 (4,895,276) (4,221,181) 101,833 140,770 (4,221,181) 101,833 140,770 220,143 67,106 210,413 298,344 0 0 0 0 0 0 0 1,108,609 955,550	0 0 0 2,985,147 1,022,172 507,310 0 (5,028,056) (4,229,929) 103,869 143,586 301,972 70,707 244,623 309,232 0 0 0 0 0 0 0 0 0 0 0	0 0 0 3,065,764 523,696 1,047,432 525,690 0 (5,162,582) (4,237,171) 105,947 146,457 74,425 218,917 320,436 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 1,072,925 544,603 0 (5,317,260 (4,257,680 (4,257,680 (4,257,680 108,066 149,387 326,710 78,264 223,296 331,964 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Cumulative Benefits Payback NPV as of 2020

9,813,327	(3,198,396)	(3,225,040)	(3,233,448)	(3,240,352)	(3,261,498)	(3,205,231)	(3,267,531)	(3,268,412)	(3,282,644)
9,813,327	6,614,930	3,389,890	156,442	(3,083,910)	(6,345,408)	(9,610,640)	(12,878,171)	(16,146,583)	(19,429,227)
(19,429,227)									

Alternative 3 Results

	Year of analysi Escalation rate Discount rate	s 2020 e 2.00%	isk adjustments (+/- percent): Benefits Capital costs Running costs	0% 0% 0%		HSW	Alternative Study Alternati ernative Cost A			
Expressed in 2020 dollars, une	scalated dollare	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
	scalated donars										
Capital Outlays	BUS 500 scfm	13,000,000									
	SCR HSW Receiving Facility										
	Small Dig Improvements										
	Total capital outlays	13,000,000	0	0	0	0	0	0	0	0	0
Benefits:	D3 RINs	0.011.150	2.637.600	2.676.625	2.697.800	2.717.925	2.737.000	2.770.950	2,787,750	2.803.500	2.833.600
	D3 RINs Power Savings	2,614,150 481,326	481,326	481,326	481,326	2,717,925 481,326	481,326	481,326	481,326	2,803,500 481,326	2,833,600 481,326
	LCFS	1,188,790	1,208,460	1,228,130	1,247,800	1,267,470 452,917	1,287,130	1,306,800	1,326,470	1,346,140	1,365,800
	Natural Gas Sale HSW Tipping Fee	424,805	431,833	438,861	445,889	452,917	459,945	466,973	474,001	481,029	488,057
	Total benefits	(4,709,071)	(4,759,219)	(4,824,942)	(4,872,815)	(4,919,638)	(4,965,401)	(5,026,049)	(5,069,547)	(5,111,995)	(5,168,783
Annual Running Costs:											
	Engine O&M BUS Labor	97,375 125,000	97,375 125,000	97,375 125,000	97,375 125,000	97,375 125,000	97,375 125,000	97,375 125,000	97,375 125,000	97,375 125,000	97,375 125,000
	Biogas/GCS Upgrading O&M	245,183	250,429	255,675	260,921	266,167	271,413	276,659	281,905	287,151	292,396
	Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer	45,439 186,835	47,406 186,836	49,372 186,837	51,339 186,838	53,306 186,839	55,272 186,840	57,239 186,841	59,206 186,842	61,172 186,843	<u>63,139</u> 186,844
	BUS Power	258,941	263,225	267,509	271,793	276,077	280,361	284,644	288,928	293,212	297,496
	Total running costs	958,773	970,270	981,768	993,265	1,004,763	1,016,261	1,027,758	1,039,256	1,050,754	1,062,251
			, .								
Net Benefit/(cost) Expressed in escalated dollars		9,249,702	(3,788,948)	(3,843,174)	(3,879,549)	(3,914,875)	(3,949,140)	(3,998,291)	(4,030,291)	(4,061,242)	(4,106,532
	with sensitivity adjustments BUS 500 scfm SCR	9,249,702	(3,788,948) 0	(3,843,174) 0	0	0	0	0	0	0	0
Expressed in escalated dollars	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements	9,249,702	(3,788,948) 0 0 0	(3,843,174) 0 0	0 0 0 0	0 0 0	0	0 0 0	0 0 0	0	000000000000000000000000000000000000000
Expressed in escalated dollars Capital Outlays	with sensitivity adjustments BUS 500 scfm SCR	9,249,702	(3,788,948) 0	(3,843,174) 0	0	0	0	0	0	0	000000000000000000000000000000000000000
Expressed in escalated dollars	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements	9,249,702	(3,788,948) 0 0 0	(3,843,174) 0 0	0 0 0 0	0 0 0	0	0 0 0	0 0 0	0	0 0 0 0
Expressed in escalated dollars Capital Outlays	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326	(3,788,948) 0 0 0 0 2,690,352 490,952	(3,843,174) 0 0 0 0 0 2,784,761 500,772	0 0 0 2,862,927 510,787	0 0 0 2,941,969 521,003	0 0 0 3,021,869 531,423	0 0 0 3,120,540 542,051	0 0 0 3,202,248 552,892	0 0 0 3,284,747 563,950	0 0 0 3,386,414 575,229
Expressed in escalated dollars Capital Outlays	with sensitivity adjustments BUS 500 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINs	9,249,702 13,000,000 0 13,000,000 2,614,150	(3,788,948) 0 0 0 2,690,352	(3,843,174) 0 0 2,784,761	0 0 0 0 2,862,927	0 0 0 0 2,941,969	0 0 0 0 3,021,869	0 0 0 3,120,540	0 0 0 3,202,248	0 0 0 0 3,284,747	0 0 0 3,386,414 575,229 1,632,257
Expressed in escalated dollars Capital Outlays	with sensitivity adjustments BUS 500 sofm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee	9,249,702 13,000,000 0 0 13,000,000 2,614,150 481,326 1,188,790 422,805 0	(3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 2.862,927 510,787 1,324,175 473,181 0	0 0 0 2.941,969 521,003 1,371,950 490,252 0	0 0 0 3.021.869 531.423 1.421.086 507.816 0 0	0 0 0 3,120,540 542,051 1,471,669 525,887 0	0 0 0 3.202,248 552,892 1,523,697 544,478 0	0 0 0 3.284,747 563.950 1.577.218 563.602 0	0 0 0 3,386,414 575,229 1,632,257 583,273 0
Expressed in escalated dollars Capital Outlays	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805	(3,788,948) 0 0 0 2,690,352 490,952 1,232,629 440,469	(3,843,174) 0 0 0 0 2,784,761 500,772 1,277,746 456,591	0 0 0 2.862,927 510,787 1,324,175 473,181	0 0 0 2.941,969 521,003 1,371,950 490,252	0 0 0 3,021,869 531,423 1,421,096 507,816	0 0 0 3,120,540 542,051 1,471,669 525,887	0 0 0 3.202,248 552,892 1,522,697 544,478	0 0 0 3.284,747 563.950 1,577,218 563.602	(4,106,532) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 (4,709,071)	(3,788,948) 0 0 0 2,690,352 400,952 1,232,629 440,469 0 0 448,44,403)	(3,843,174) 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2.862.927 510.787 1.324.175 473.181 0 (5.171.070)	0 0 0 2,941,969 521,003 1,371,950 490,252 0 (5,325,174)	0 0 0 3,021,869 531,423 1,421,096 507,816 0 0 (5,482,204)	0 0 0 3,120,540 542,051 1,471,669 525,687 0 5(5,660,147)	0 0 0 3,202,248 552,892 1,522,697 544,478 0 544,478 0 5,523,316)	0 0 0 3.284.747 563.950 1.577.218 563.602 0 553.602 0 5,599.517	0 0 0 3,386,414 575,229 1,632,257 583,273 0 (6,177,174)
Expressed in escalated dollars Capital Outlays	with sensitivity adjustments BUS 500 sofm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M	9,249,702 13,000,000 0 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 (4,709,071) (4,709,071) 97,375	(3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 0 (2,784,761 500,772 1,277,746 466,591 0 (5,019,869) (4,777,984) 101,309	0 0 0 0 2,862,927 510,787 1,324,175 473,181 0 (5,171,070) (4,801,853) 103,335	0 0 0 2.941.969 521.003 1.371.950 490.252 0 (5.325.174) (4.824.345) 105.402	0 0 0 3.021,869 531,423 1.421,986 507,816 0 (5,482,204) (4,845,469) 107,510	0 0 0 3.120.540 542.051 1.471.669 525.887 0 (5.660.147) (4.880.727) 109.660	0 0 0 0 3.202,248 552,892 1.523,697 544,478 0 (5,823,316) (4,898,953) 111,853	0 0 0 3.284,747 563.950 1.577.218 563.602 0 (5.989.517) (4.915.876) 114,090	0 0 0 0 3,386,414 575,229 1,632,257 583,273 0 (6,177,174) (4,946,239) 116,372
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Cas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 424,805 0 424,805 0 427,90,071) (4,709,071) 97,375 125,000	(3,788,948) 0 0 0 0 2,690,352 490,952 1,232,629 440,469 0 0 (4,854,403) (4,736,003)	(3,843,174) (3,843,174) 0 0 0 0 2,784,761 500,772 1,277,746 456,591 0 (5,019,869) (4,777,984)	0 0 0 2,862,927 510,787 1,324,175 473,181 0 (5,171,070) (4,801,853)	0 0 0 2.941,969 521,003 1,371,960 490,252 0 (5,325,174) (4,824,345)	0 0 0 3,021,869 531,423 1,421,096 507,816 0 0 (5,482,204) (4,845,469)	0 0 0 3.120.540 542.051 1.471.669 525.887 0 (5.660.147) (4.880,727)	0 0 0 0 3,202,248 552,892 1,523,697 544,478 0 (5,823,316) (4,898,953)	0 0 0 3.284,747 563,950 1.577,218 553,602 0 (5,989,517) (4,915,876)	0 0 0 0 3,386,414 575,229 1,632,257 5,83,273 0 0 (6,177,174) (4,946,239) 116,372 116,372 149,387
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINS Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dig Heat	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439	(3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 2,784,761 500,772 1,277,746 456,591 0 (5,019,869) (4,777,984) 101,309 130,050 266,004 51,367	0 0 0 2,862,927 510,787 1,324,175 473,181 (5,177,1070) (4,801,853) 103,335 132,651 132,651 276,891 54,481	0 0 0 2,941,969 521,003 1,371,950 490,252 0 (5,325,174) (4,824,345) 105,402 135,304 288,107 57,700	0 0 0 3,021,869 531,423 1,421,096 507,816 507,816 (5,482,204) (4,845,469) 107,510 138,010 299,662 61,025	0 0 0 3,120,540 542,051 1.471,669 525,887 0 (5,660,147) (4,880,727) 109,660 140,770 311,563 64,460	0 0 0 0 3,202,248 552,892 1,523,697 544,478 0 (4,898,953) 111,853 143,586 323,820 68,009	0 0 0 3,284,747 563,950 1,577,218 563,602 0 0 (5,989,517) (4,915,876) 114,090 146,457 336,443 71,1673	0 0 0 0 3,386,414 575,229 1,632,267 583,273 0 0 (6,177,174 (4,946,239 116,372 149,387 349,441 75,457
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Cas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439 186,835	(3,788,948) (3,788,948) 0 0 0 0 0 2,690,352 490,952 1,232,629 0 0 (4,736,003) (4,736,003) 99,323 127,500 255,438 48,384 49,357 190,573	(3,843,174) (3,843,174) 0 0 0 0 0 2,784,761 500,772 1,277,746 456,591 0 (5,019,869) (4,777,984) (4,777,984) 101,309 103,050 266,004 51,367 194,385	0 0 0 0 2,862,927 510,787 1,324,175 473,181 0 (5,171,070) (5,171,070) (4,801,853) 103,335 103,355 10,355 10,355 10,355 10,355	0 0 0 0 2,941,969 521,003 1,371,960 490,252 0 (5,325,174) (4,824,345) (4,824,345) 105,402 135,304 288,107 57,700 202,241	0 0 0 0 3.021,869 531,423 1.421,096 507,816 0 0 (5,482,204) (4,845,469) 107,510 138,010 299,662 61,025 61,025	0 0 0 0 3.120,540 542,051 1.471,669 525,887 0 (5,660,147) (4,880,727) 109,660 140,770 311,563 64,460 210,413	0 0 0 0 3,202,248 552,892 1,523,697 544,478 0 (4,898,953) (4,898,953) 111,853 143,586 322,320 68,009 214,623	0 0 0 0 3.284,747 563,950 1.577,218 553,602 0 (5,989,517) (4,915,876) 114,090 1164,657 336,443 71,673 71,673 218,917	0 0 0 0 3,386,414 575,229 1,632,257 583,273 0 (6,177,174) (4,946,239) 116,372 116,372 149,387 349,441 75,457 223,296
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engline 0&M BUS Labor Biogas/GCS Upgrading 0&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dig Heat	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 424,805 0 424,805 0 424,805 0 424,805 0 425,000 245,183 45,439 186,835 258,941	(3,788,948) (3,788,948) 0 0 0 0 2,690,352 490,952 1,232,629 0 0 (4,854,403) (4,736,003) 127,500 225,438 48,354 190,573 268,489	(3,843,174) (3,843,174) 0 0 0 0 2,784,761 500,772 1,277,746 456,591 0 (5,019,869) (4,777,984) 101,309 130,050 266,004 51,367 194,385 278,316	0 0 0 2.862,927 510,787 1,324,175 473,181 0 (5,171,070) (4,801,853) 103,335 132,651 276,891 54,481 54,481 198,274 288,428	0 0 0 0 2.941,969 521,003 1,371,950 490,252 0 5(3.25 ,174) (4.824,345) 105,402 135,304 288,107 57,700 57,700 202,241 298,834	0 0 0 0 3,021,869 531,423 1,421,096 507,816 0 507,816 0 (4,845,469) 107,510 138,010 299,662 61,025 61,025 61,025 61,025	0 0 0 0 3.120.540 542.051 1.471.669 525.887 0 (5.660.147) (4.880,727) 109.660 140,770 311.563 64.460 210.413 320.556	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 3.284,747 563,950 1,577,218 563,662 0 5,598,5477 (4,915,876) 114,090 146,457 336,443 71,673 218,917 343,545	0 0 0 0 3,386,414 575,229 1,632,257 583,273 0 0 (6,177,174) (4,946,239) 116,372 149,387 349,441 75,457 7,23,296 355,536
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engline 0&M BUS Labor Biogas/GCS Upgrading 0&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dig Heat	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439 186,835	(3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 2,784,761 500,772 1,277,746 456,591 0 (5,019,869) (4,777,984) (4,777,984) 101,309 103,050 266,004 51,367 194,385	0 0 0 0 2.862.927 510.787 1.324.75 473.181 0 (5.171,070) (4.801,853) 103,335 132,651 276,891 35,4481 198,274 288,428 0 0	0 0 0 0 2,941,969 521,003 1,371,960 490,252 0 (5,325,174) (4,824,345) (4,824,345) 105,402 135,304 288,107 57,700 202,241	0 0 0 0 3.021,869 531,423 1.421,096 507,816 0 0 (5,482,204) (4,845,469) 107,510 138,010 299,662 61,025 61,025	0 0 0 0 3.120.540 5.42.051 1.471.669 5.25.887 0 (5.660.147) (4.880,727) 109.660 140,770 311.563 64.460 210.413 320.556 0 0	0 0 0 0 3,202,248 552,892 1,523,697 544,478 0 (4,898,953) (4,898,953) 111,853 143,586 322,320 68,009 214,623	0 0 0 0 3.284.747 563.950 1.577.218 563.602 0 5.598.5177 (4.915.876) 114.090 146.457 336.443 71.643 71.643 71.643 218.917 343.545 0 0	0 0 0 0 3,386,414 575,229 1,632,257 5,683,273 0 0 (6,177,174) (4,946,239) 116,372 149,387 349,441 75,457 223,296 355,536 0 0
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engline 0&M BUS Labor Biogas/GCS Upgrading 0&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dig Heat	9,249,702 13,000,000 0 13,000,000 2,614,150 441,326 1,188,790 424,805 0,4,709,071) (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439 186,835 258,941 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,788,948) (3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 1,2784,761 500,772 1,277,746 456,591 0 (5,019,869) (4,777,984) 101,309 130,050 266,004 51,387 194,385 278,316 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,862,927 510,787 473,181 0 (5,171,070) (4,801,853) 103,335 102,651 102,651 276,891 54,481 198,274 288,428 0 0 0 0	0 0 0 0 2,941,969 521,003 1,371,950 490,252 0 0 (5,325,174) (4,824,345) (4,824,345) (4,824,345) 105,402 135,304 288,107 57,700 202,241 298,834 0 0 0 0	0 0 0 0 3,021,889 531,423 1,421,096 507,816 0 0 (5,482,204) (4,845,469) 107,510 138,010 299,662 61,025 206,287 309,541 0 0 0	0 0 0 0 3,120,540 542,051 1,471,669 525,887 0 (5,660,147) (4,880,727) 109,660 140,770 311,563 64,460 210,413 320,556 0 0 0 0	0 0 0 0 3,202,248 552,892 1,523,697 544,478 0 (4,898,953) (4,898,953) 111,853 143,596 323,820 68,009 214,623 331,888 0 0 0 0 0	0 0 0 0 3.284,747 563,950 1,577,218 563,602 0 563,602 0 (5 ,989,517) (4 ,915,876) 114,090 1164,647 336,443 71,673 218,917 343,545 0 0 0 0	0 0 0 0 3,386,414 575,229 1,632,257 583,273 0 (6,177,174) (4,946,239 116,372 149,387 349,441 75,457 223,296 355,536 0 0 0 0 0
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINS Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Disconted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer BUS Power	9,249,702 13,000,000 0 13,000,000 2,614,150 461,326 1,188,790 (4,709,071) (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439 186,835 258,941 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,788,948) (3,788,948) 0 0 0 0 2,690,352 490,952 1,232,629 0 0 (4,736,003) (4,736,003) 127,500 125,438 48,384 49,354 127,500 255,438 48,384 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 2,784,761 500,772 1,277,746 456,591 456,591 (4,777,984) 101,309 130,050 266,004 51,367 194,385 278,316 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 2,862,927 510,787 1,324,175 473,181 0 (4,801,853) 103,335 132,651 276,891 54,481 54,481 198,274 288,428 0 0 0 0	0 0 0 0 2,941,969 521,003 1,371,960 490,252 0 (5,325,174) (4,824,345) (4,824,345) 105,402 135,304 288,107 57,700 202,241 298,834 0 0 0 0 0 0	0 0 0 0 3,021,869 531,423 1,421,096 507,816 0 (4,845,469) (4,845,469) 107,510 138,010 299,662 61,025 206,287 309,541 0 0 0 0 0	0 0 0 0 3.120.540 542,051 1.471,669 525.887 0 (5,660,147) (4,880,727) (4,880,727) (4,880,727) 109,660 140,770 311,563 64,460 210,413 320,556 0 0 0 0 0 0	0 0 0 0 3,202,248 552,892 1,523,697 544,478 0 (4,888,953) 111,853 143,586 323,820 68,009 214,623 331,888 0 0 0 0 0 0	0 0 0 0 3.284,747 563,950 1,577,218 563,602 0 (4,915,876) 114,090 146,457 336,443 71,673 71,673 71,673 71,673 71,673 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 3,386,414 575,229 1,632,257 583,273 0 0 (6,177,174) (4,946,239) 116,372 149,387 349,441 75,457 223,296 3355,536 0 0 0 0 0 0 0 0 0
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm ScR Small Dig Improvements Total capital outlays (Pvs) D3 RINS Power Savings CDS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer BUS Power	9,249,702 13,000,000 0 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439 186,835 258,941 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,788,948) (3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 1 2,784,761 500,772 1,277,746 456,591 0 (5,019,869) (4,777,984) 101,309 130,050 266,004 51,387 278,316 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 2,862,927 510,787 473,181 0 (5,171,070) (4,801,853) 103,335 102,651 102,651 276,891 54,481 198,274 288,428 0 0 0 0	0 0 0 0 2,941,969 521,003 1,371,950 490,252 0 0 (5,325,174) (4,824,345) (4,824,345) (4,824,345) 105,402 135,304 288,107 57,700 202,241 298,834 0 0 0 0	0 0 0 0 3,021,889 531,423 1,421,096 507,816 0 0 (5,482,204) (4,845,469) 107,510 138,010 299,662 61,025 206,287 309,541 0 0 0	0 0 0 0 3,120,540 542,051 1,471,669 525,887 0 (5,660,147) (4,880,727) 109,660 140,770 311,563 64,460 210,413 320,556 0 0 0 0	0 0 0 0 3,202,248 552,892 1,523,697 544,478 0 (4,898,953) (4,898,953) 111,853 143,596 323,820 68,009 214,623 331,888 0 0 0 0 0	0 0 0 0 3.284,747 563,950 1,577,218 563,602 0 563,602 0 (5 ,989,517) (4 ,915,876) 114,090 1164,647 336,443 71,673 218,917 343,545 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Expressed in escalated dollars Capital Outlays Benefits:	with sensitivity adjustments BUS 500 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINS Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Disconted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer BUS Power	9,249,702 13,000,000 0 0 13,000,000 2,614,150 481,326 1,188,790 424,805 0 (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439 186,835 258,941 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 2,784,761 500,772 1,277,746 456,591 0 0 (5,019,869) (4,777,984) 101,309 130,050 266,004 51,367 194,385 278,316 0 0 0 0 0 0 1,021,431	0 0 0 0 2.862,927 510,787 1.324,175 473,181 473,181 473,181 473,181 473,184 103,335 1132,651 103,335 1132,651 103,335 1132,651 108,274 108,275 100,275	0 0 0 2.941,969 521,003 1.371,950 490,252 490,252 0 (5,325,174) (4,824,345) 105,402 135,304 288,107 57,700 202,241 298,834 298,834 298,834 200 0 0 0 0 0	0 0 0 3.021,869 531,423 1.421,096 507,816 507,816 507,816 507,816 507,816 1.485,469 107,510 138,010 299,662 61,025 206,287 206,287 309,541 309,541 0 0 0 0 0 1,122,034	0 0 0 3,120,540 542,051 1,471,669 (5,660,147) (4,880,727) 109,660 140,770 311,563 64,460 210,413 320,556 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 3.202,248 552,892 1.523,697 544,478 144,586 144,586 144,586 323,820 68,009 214,623 331,888 331,888 0 0 0 0 1,93,778	0 0 0 0 3.284.747 563.950 1.577.218 563.602 (5.989,517) (4.915.876) 114.090 146.457 336.443 218.917 343.545 343.545 0 0 0 0 0 0 0 0	0 0 0 0 0 1,3386,414 575,229 1,632,287 583,273 0 0 (6,177,174 (4,946,239 116,372 149,387 349,441 75,457 223,296 335,536 335,536 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Expressed in escalated dollars Capital Outlays Benefits: Annual Running Costs:	with sensitivity adjustments BUS 500 scfm ScR Small Dig Improvements Total capital outlays (Pvs) D3 RINS Power Savings CDS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer BUS Power	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805 424,805 (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439 186,835 258,941 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,788,948) (3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 1 2,784,761 500,772 1,277,746 456,591 4,777,984) 101,309 101,309 130,050 130,050 130,050 226,004 0 0 0 0 0 10,005 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 100,050 130,050 100,050 1	0 0 0 0 2,862,927 1,324,175 473,181 0 (5,171,070) (4,801,853) 103,335 132,651 103,335 132,651 198,274 198,274 198,274 198,274 198,274 198,274 198,274 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 2.941.969 521.003 1.371.969 490.252 0 (5.325,174) (4.824.345) (4.824.345) 105.402 135.304 208.834 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 3.021,869 531,423 1.421,096 507,816 0 (5,482,204) (4,845,469) 107,510 138,010 299,662 61,025 206,287 206,287 309,541 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 3,120,540 542,051 1,471,669 525,887 0 (5,660,147) (4,880,727) 109,660 140,770 311,563 64,460 210,413 320,556 0 0 0 0 0 0 0 0 1,57,423 998,042	0 0 0 0 3.202,248 552,892 1.523,697 544,478 0 (4,898,953) 111,853 143,586 233,820 244,623 214,623 233,880 0 0 0 1,193,778 1,004,284	0 0 0 0 3.284,747 563.950 1.577,218 563.602 0 (5.989,517) (4.915,876) 114.090 146.457 336,443 336,443 336,443 336,443 336,443 0 0 0 0 1,677,218 1,071,218 1,071,218 1,071,218 1,071,218 1,071,218 1,071,218 1,091,218 1,091,218 1,010,412 1,010,445 1,010,445 1,010,445 1,010,445 1,010,445	0 0 0 0 3,396,414 575,229 1,632,257 583,273 0 (6,177,174 (4,946,239 (4,946,239 116,372 149,387 349,441 75,457 223,296 355,536 0 0 0 0 0
Expressed in escalated dollars Capital Outlays Benefits: Annual Running Costs: Net escalated benefit/(cost)	with sensitivity adjustments BUS 500 scfm ScR Small Dig Improvements Total capital outlays (Pvs) D3 RINS Power Savings CDS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dryer BUS Power	9,249,702 13,000,000 0 13,000,000 2,614,150 481,326 1,188,790 424,805 424,805 (4,709,071) (4,709,071) 97,375 125,000 245,183 45,439 186,835 258,941 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,788,948) (3,788,948) 0 0 0 0 0 0 0 0 0 0 0 0 0	(3,843,174) (3,843,174) 0 0 0 0 0 1 2,784,761 500,772 1,277,746 456,591 4,777,984) 101,309 101,309 130,050 130,050 130,050 226,004 0 0 0 0 0 10,005 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 130,050 100,050 130,050 100,050 1	0 0 0 0 2,862,927 1,324,175 473,181 0 (5,171,070) (4,801,853) 103,335 132,651 103,335 132,651 198,274 198,274 198,274 198,274 198,274 198,274 198,274 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 2.941.969 521.003 1.371.969 490.252 0 (5.325,174) (4.824.345) (4.824.345) 105.402 135.304 208.834 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 3.021,869 531,423 1.421,096 507,816 0 (5,482,204) (4,845,469) 107,510 138,010 299,662 61,025 206,287 206,287 309,541 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 3,120,540 542,051 1,471,669 525,887 0 (5,660,147) (4,880,727) 109,660 140,770 311,563 64,460 210,413 320,556 0 0 0 0 0 0 0 0 1,57,423 998,042	0 0 0 0 3.202,248 552,892 1.523,697 544,478 0 (4,898,953) 111,853 143,586 233,820 244,623 214,623 233,880 0 0 0 1,193,778 1,004,284	0 0 0 0 3.284,747 563.950 1.577,218 563.602 0 (5.989,517) (4.915,876) 114.090 146.457 336,443 336,443 336,443 336,443 336,443 0 0 0 0 1,677,218 1,071,218 1,071,218 1,071,218 1,071,218 1,071,218 1,071,218 1,091,218 1,091,218 1,010,412 1,010,445 1,010,445 1,010,445 1,010,445 1,010,445	0 0 0 0 0 1,3386,414 575,229 1,632,287 583,273 0 0 (6,177,174 (4,946,239 116,372 149,387 349,441 75,457 223,296 335,536 335,536 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Alternative 4 Results

	Year of analysis Escalation rate Discount rate	2020 2.00% 2.50%		nts (+/- percent) Benefits Capital costs Junning costs	0% 0% 0%			Alternative Study Altern ernative Cos	ative t Analysis (\$)	
Expressed in 2020 dollars, unesc	alated dollars	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Capital Outlays											
ouplui ouliays	BUS 400 scfm	12,000,000									
	SCR HSW Receiving Facility										
	Small Dig Improvements Total capital outlays	12,000,000	0	0	0	0	0	0	0	0	0
Benefits:											
	D3 RINs Power Savings	1,663,550 913,929	1,646,400 949,046	1,629,250 984,162	1,612,100 1,019,279	1,594,950 1,054,396	1,577,800 1,089,512	1,560,650 1,124,629	1,543,500 1,159,746	1,526,350 1,194,862	1,509,200 1,229,979
	LCFS Natural Gas Sale	852,234 392,447	858,555 399,475	864,561 406,503	870,252 413,531	875,621 420,559	880,683 427,587	885,430 434,616	889,862 441,644	893,973 448,672	897,776 455,700
	HSW Tipping Fee										
	Total benefits	(3,822,160)	(3,853,476)	(3,884,476)	(3,915,162)	(3,945,526)	(3,975,583)	(4,005,325)	(4,034,752)	(4,063,857)	(4,092,655)
Annual Running Costs:	Engine O&M	184,893	191,997	199,102	206,206	213,310	220,415	227,519	234,623	241,728	248,832
	BUS Labor Biogas/GCS Upgrading O&M	125,000 156,406	125,000 156,406	125,000 156,406	125,000 156,406	125,000 156,406	125,000 156,406	125,000 156,406	125,000 156,406	125,000 156,406	125,000 156,406
	Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer	0	0 186,837	0 186,838	0 186,839	0 186,840	0 186,841	0 186,842	0 186,843	0 186,844	0 186,845
	BUS Power	239,217	243,501	247,785	252,069	256,353	260,637	264,921	269,205	273,489	277,773
	Total running costs	892,352	903,741	915,131	926,520	937,909	949,298	960,688	972,077	983,466	994,855
Net Benefit/(cost)		9,070,192	(2,949,734)	(2,969,346)	(2,988,643)	(3,007,617)	(3,026,284)	(3,044,637)	(3,062,675)	(3,080,391)	(3,097,799)
Expressed in escalated dollars w	ith consitivity adjustments										
	iti sensitivity aujustments										
Capital Outlays		10.000.000									
Capital Outlays	BUS 400 scfm SCR	12,000,000	0	0	0	0	0	0	0	0	0
Capital Outlays	BUS 400 scfm										
	BUS 400 scfm SCR Small Dig Improvements	0	0	0	0	0	0	0	0	0 0	0
Capital Outlays Benefits:	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs	0 0 12,000,000 1,663,550	0 0 1,679,328	0 0 0 1,695,072	0 0 1,710,773	0 0 1,726,425	0 0 1,742,019	0 0 1,757,545	0 0 1,772,996	0 0 1,788,362	0 0 1,803,634
	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs)	0 0 12,000,000 1,663,550 913,929 852,234	0 0 0 1,679,328 968,026 875,726	0 0 1,695,072 1,023,922 899,489	0 0 1,710,773 1,081,667 923,518	0 0 1,726,425 1,141,312 947,800	0 0 1,742,019 1,202,910 972,345	0 0 1,757,545 1,266,515 997,138	0 0 1,772,996 1,332,183 1,022,172	0 0 0 1,788,362 1,399,972 1,047,432	0 0 0 1,803,634 1,469,939 1,072,925
	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale	0 0 12,000,000 1,663,550 913,929 852,234 392,447	0 0 1,679,328 968,026 875,726 407,465	0 0 1,695,072 1,023,922	0 0 1,710,773 1,081,667	0 0 1,726,425 1,141,312 947,800 455,227	0 0 1,742,019 1,202,910 972,345 472,091	0 0 1,757,545 1,266,515	0 0 1,772,996 1,332,183	0 0 1,788,362 1,399,972 1,047,432 525,690	0 0 1,803,634 1,469,939
	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits	0 0 12,000,000 1,663,550 913,929 852,234 392,447 0 (3,822,160)	0 0 1,679,328 968,026 875,726 407,465 0 (3,930,545)	0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409)	0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802)	0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764)	0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365)	0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646)	0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661)	0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456)	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101)
Benefits:	BUS 400 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee	0 0 12,000,000 1,663,550 913,929 852,234 392,447 0	0 0 1,679,328 968,026 875,726 407,465 0	0 0 1,695,072 1,023,922 899,489 422,926 0	0 0 1,710,773 1,081,667 923,518 438,843 0	0 0 1,726,425 1,141,312 947,800 455,227 0	0 0 1,742,019 1,202,910 972,345 472,091 0	0 0 1,757,545 1,266,515 997,138 489,448 0	0 0 1,772,996 1,332,183 1,022,172 507,310 0	0 0 1,788,362 1,399,972 1,047,432 525,690 0	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0
	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits	0 0 12,000,000 1,663,550 913,929 852,234 392,447 0 (3,822,160)	0 0 1,679,328 968,026 875,726 407,465 0 (3,930,545)	0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409)	0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802)	0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764)	0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365)	0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646)	0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661)	0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456)	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101)
Benefits:	BUS 400 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor	0 0 12,000,000 13,000,000 1663,550 913,929 852,234 392,447 0 (3,822,160) (3,822,160) (3,822,160) 184,893 125,000	0 0 0 1,679,328 968,026 875,726 407,465 0 (3,930,545) (3,834,678) 195,837 127,500	0 0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409) (3,846,671) 207,145 130,050	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,661	0 0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764) (3,869,102) 230,894 135,304	0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) 243,356 138,010	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 256,223 140,770	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661) (3,898,980) 269,508 143,586	0 0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456) (3,907,949) 283,222 146,457	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 297,377 149,387
Benefits:	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/GCS Upgrading O&M Natural Gas Purchased - Dig Heat	0 0 12,000,000 13,000,000 13,029 852,234 392,447 0 (3,822,160) (3,822,160) (3,822,160) 184,893 125,000 156,406 0 0	0 0 0 1,679,328 988,026 875,726 407,465 0 (3,930,545) (3,834,678) 195,837 127,500 159,534 0 0	0 0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724 0 0	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,651 165,979 0 0	0 0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764) (3,869,102) 230,894 135,304 169,299 0 0	0 0 0 1,742,019 1,202,910 972,345 472,091 0 0 (4,389,365) (3,879,559) 243,356 138,010 172,684 0	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 256,223 140,770 176,138 0	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 0 (4,634,661) (3,898,980) 269,508 143,586 179,661 0 0	0 0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456) (3,907,949) 283,222 146,457 183,254 0 0	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 297,377 149,387 186,919 0 0
Benefits:	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engline O&M BUS Labor Biogas/CCS Upgrading O&M	0 0 12,000,000 13,029 852,234 392,447 0 (3,822,160) (3,822,160) (3,822,160) 184,893 125,000 156,406	0 0 0 1,679,328 968,026 875,726 407,465 0 (3,930,545) (3,834,678) 195,837 127,500 159,534	0 0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,651 165,979	0 0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764) (3,869,102) 230,894 135,304 169,299	0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) 243,356 243,356 138,010 172,684	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 2566,223 140,770 176,138	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661) (3,898,980) 269,508 143,586 179,661	0 0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456) (3,907,949) 283,222 146,457 183,254	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 297,377 149,387
Benefits:	BUS 400 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/CGS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Diyer	0 0 12,000,000 12,000,000 13,029 852,234 392,447 0 (3,822,160) (3,822,160) (3,822,160) (3,822,160) 156,406 0 156,406 0 0 186,836 239,217 0	0 0 0 1,679,328 968,026 875,726 407,465 0 (3,930,545) (3,834,678) 195,837 127,500 199,534 0 190,574 248,371 0	0 0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724 0 0 194,386 257,796 0 0	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,651 165,979 0 0 198,275 267,498 0	0 0 0 1,726,425 1,141,312 947,800 (4,270,764) (3,869,102) 230,894 135,304 169,299 0 0 202,242 277,485	0 0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) (3,879,559) 243,356 138,010 172,684 283,356 0 206,288 287,764	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 256,223 140,770 176,138 0 0 210,415 298,344	0 0 0 1,772,996 1,332,183 1,022,172 0 0 (4,634,661) (3,898,980) 269,508 143,586 179,661 179,661 0 214,624 309,232 0	0 0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456) (3,907,949) 283,222 146,457 183,254 0 0 218,918 320,436	0 0 0 1,803,634 1,469,939 1,072,925 44,603 0 (4,891,101) (3,916,444) 297,377 149,387 186,919 0 0 223,297 331,964 0 0
Benefits:	BUS 400 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/CGS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Diyer	0 0 12,000,000 13,000,000 152,234 392,447 0 (3,822,160) (3,822,160) (3,822,160) 184,893 125,000 156,406 0 186,836 239,217	0 0 0 1,679,328 998,026 875,726 407,465 0 (3,930,545) (3,834,678) 195,837 127,500 159,534 0 190,574 248,371	0 0 0 1,695,072 1,023,922 899,483 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724 0 194,386 257,796	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,651 165,979 0 198,275 267,498	0 0 0 1,726,425 1,141,312 947,800 445,227 0 (4,270,764) (3,869,102) 230,894 135,304 169,299 0 202,242 277,485	0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) 243,356 138,010 172,684 0 206,288 287,764	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 256,223 140,770 176,138 0 210,415 298,344	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661) (3,898,980) 269,508 143,586 179,661 0 214,624 309,232	0 0 0 1,788,362 1,399,972 1,047,432 525,690 0 0 (4,761,456) (3,907,949) 283,222 146,457 183,254 0 218,918 320,436	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 297,377 149,387 186,919 0 223,297 331,964
Benefits:	BUS 400 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/CGS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Diyer	0 0 12,000,000 13,029 852,234 392,447 0 (3,822,160) (3,822,160) (3,822,160) 184,893 125,000 186,836 0 186,836 0 186,838 0 0 186,832 0 0 0 186,832 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1,679,328 968,026 875,726 407,465 0 (3,930,545) (3,834,678) 195,837 127,500 159,534 0 190,574 248,371 248,371 0 0	0 0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724 0 194,386 257,796 0 0	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,651 165,979 0 198,275 267,498 0 0	0 0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764) (3,869,102) 230,894 135,304 169,299 0 202,242 277,485 277,485 0 0	0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) 243,356 138,010 172,684 0 206,288 287,764 0 0 0	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 2256,223 140,770 176,138 0 210,415 298,344 0 0	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661) (3,898,980) 269,508 143,586 179,661 0 0 214,624 309,232 0 0 0	0 0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456) (3,907,949) 283,222 146,457 183,254 0 218,918 320,436 320,436	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 297,377 149,387 186,919 0 223,297 331,964 0 0 0
Benefits:	BUS 400 scfm SCR Smail Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/CGS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Diyer	0 0 12,000,000 13,000,000 15,000,000 13,822,14 0 (3,822,160) (3,822,17) (3,822,1	0 0 0 1,679,328 968,026 875,726 407,465 0 (3,930,545) (3,834,678) 195,837 127,500 159,534 0 0 190,574 248,371 248,371 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1,695,072 1,023,922 899,483 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724 0 194,386 257,796 0 0 0	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,661 165,979 0 198,275 267,498 0 0 0 0 0	0 0 0 1,726,425 1,141,312 947,800 445,227 0 (4,270,764) (3,869,102) 230,894 135,304 135,304 135,304 135,304 202,242 277,485 0 0 0 0 0 0	0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) 243,356 138,010 172,684 0 206,288 287,764 0 0 0 0 0	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 256,223 140,770 176,138 0 210,415 298,344 0 0 0 0	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661) (3,898,980) 269,508 143,586 179,661 0 214,624 309,232 0 0 0 0	0 0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456) (3,907,949) 283,222 146,457 183,254 0 218,918 320,436 0 0 0 0	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 2297,377 149,387 186,919 0 223,297 331,964 0 0 0 0 0 0 0 0
Benefits:	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/CCS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer BUS Power	0 0 12,000,000 13,000,000 15,000,000 13,822,14 0 (3,822,160) (3,822,17) (3,822,1	0 0 0 1,679,328 968,026 875,726 407,465 0 (3,930,545) (3,930,545) (3,834,678) 195,837 127,500 159,534 0 190,574 248,371 248,371 0 0 0 0 0 0 0 0	0 0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724 0 194,386 257,796 0 0 0 0 0 0 0 952,102	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,651 165,979 0 198,275 267,498 0 0 0 0 0 983,230	0 0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764) (3,869,102) 230,894 135,304 135,304 135,304 0 0,202,242 277,485 277,485 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) 243,356 138,010 172,684 0 206,288 287,764 0 0 0 0 0 0 0 0	0 0 0 1,757,545 1,266,515 997,138 449,448 0 (4,510,646) (3,889,516) 2266,223 140,770 176,138 0 210,415 298,344 0 0 0 0 0 0 0 0	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661) (3,898,980) 269,508 143,586 179,661 79,661 0 214,624 309,232 0 0 0 0 0 0 0	0 0 0 1,788,362 1,399,972 1,047,432 525,690 0 (4,761,456) (3,907,949) 283,222 146,457 183,254 0 218,918 320,436 0 0 0 0 0 0 0 0 0 0	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 297,377 149,387 186,919 0 223,297 331,964 0 0 0 0 0 0 0 0 0 0
Benefits: Annual Running Costs:	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/CCS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer BUS Power	0 0 12,000,000 13,029 852,234 392,447 0 (3,822,160) (3,822,160) (3,822,160) 186,803 125,000 156,406 0 186,803 239,217 0 0 0 0 0 892,352 892,352	0 0 0 1,679,328 968,026 875,726 407,465 (3,930,545) (3,834,678) (3,834,678) 195,837 127,500 159,534 0 190,574 248,371 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724 0 162,724 0 194,386 257,796 0 0 0 0 0 9952,102 906,224	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,651 165,979 0 198,275 267,498 0 0 0 0 9188,275	0 0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764) (3,869,102) 230,894 135,304 169,299 0 0 222,242 277,485 0 0 0 0 0 1,015,223 919,742	0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) 243,356 138,010 172,684 0 0 206,288 287,764 0 0 0 0 0 0 0 0 0 0	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 256,223 140,770 176,138 0 2204,515 298,344 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661) (3,898,980) 269,508 143,586 179,661 0 0 214,624 309,232 0 0 0 0 0 1,116,611 939,366	0 0 0 1,788,362 1,399,972 1,047,432 525,690 (4,761,456) (3,907,949) 283,222 146,457 183,254 0 218,918 320,436 0 0 0 0 1,152,287 945,736	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 297,377 149,387 186,919 0 223,297 331,964 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Benefits: Annual Running Costs:	BUS 400 scfm SCR Small Dig Improvements Total capital outlays (Pvs) D3 RINs Power Savings LCFS Natural Gas Sale HSW Tipping Fee Total benefits Discounted Benefits (in 2020\$) Engine O&M BUS Labor Biogas/CCS Upgrading O&M Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dig Heat Natural Gas Purchased - Dryer BUS Power	0 0 12,000,000 13,029 852,234 392,447 0 (3,822,160) (3,822,160) (3,822,160) 186,803 125,000 156,406 0 186,803 239,217 0 0 0 0 0 892,352 892,352	0 0 0 1,679,328 968,026 875,726 407,465 (3,930,545) (3,834,678) (3,834,678) 195,837 127,500 159,534 0 190,574 248,371 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1,695,072 1,023,922 899,489 422,926 0 (4,041,409) (3,846,671) 207,145 130,050 162,724 0 162,724 0 194,386 257,796 0 0 0 0 0 9952,102 906,224	0 0 0 1,710,773 1,081,667 923,518 438,843 0 (4,154,802) (3,858,146) 218,827 132,651 165,979 0 198,275 267,498 0 0 0 0 9188,275	0 0 0 1,726,425 1,141,312 947,800 455,227 0 (4,270,764) (3,869,102) 230,894 135,304 169,299 0 0 222,242 277,485 0 0 0 0 0 1,015,223 919,742	0 0 0 1,742,019 1,202,910 972,345 472,091 0 (4,389,365) (3,879,559) 243,356 138,010 172,684 0 0 206,288 287,764 0 0 0 0 0 0 0 0 0 0	0 0 0 1,757,545 1,266,515 997,138 489,448 0 (4,510,646) (3,889,516) 256,223 140,770 176,138 0 2204,515 298,344 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 1,772,996 1,332,183 1,022,172 507,310 0 (4,634,661) (3,898,980) 269,508 143,586 179,661 0 0 214,624 309,232 0 0 0 0 0 1,116,611 939,366	0 0 0 1,788,362 1,399,972 1,047,432 525,690 (4,761,456) (3,907,949) 283,222 146,457 183,254 0 218,918 320,436 0 0 0 0 1,152,287 945,736	0 0 0 1,803,634 1,469,939 1,072,925 544,603 0 (4,891,101) (3,916,444) 297,377 149,387 186,919 0 223,297 331,964 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0