APPENDIX A

WPCP Schematic Flow Diagram

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HEADWORKS

The inlet control and overflow structures route sewage to Headworks 1 or Headworks 2, both of which are equipped with large bar screens to remove debris (e.g., rags, sticks, and rocks) that could clog machinery. After passing through the bar screens, flow enters the grit removal systems, which mechanically separate grit from water and organic matter. Grit and debris are trucked to a landfill.

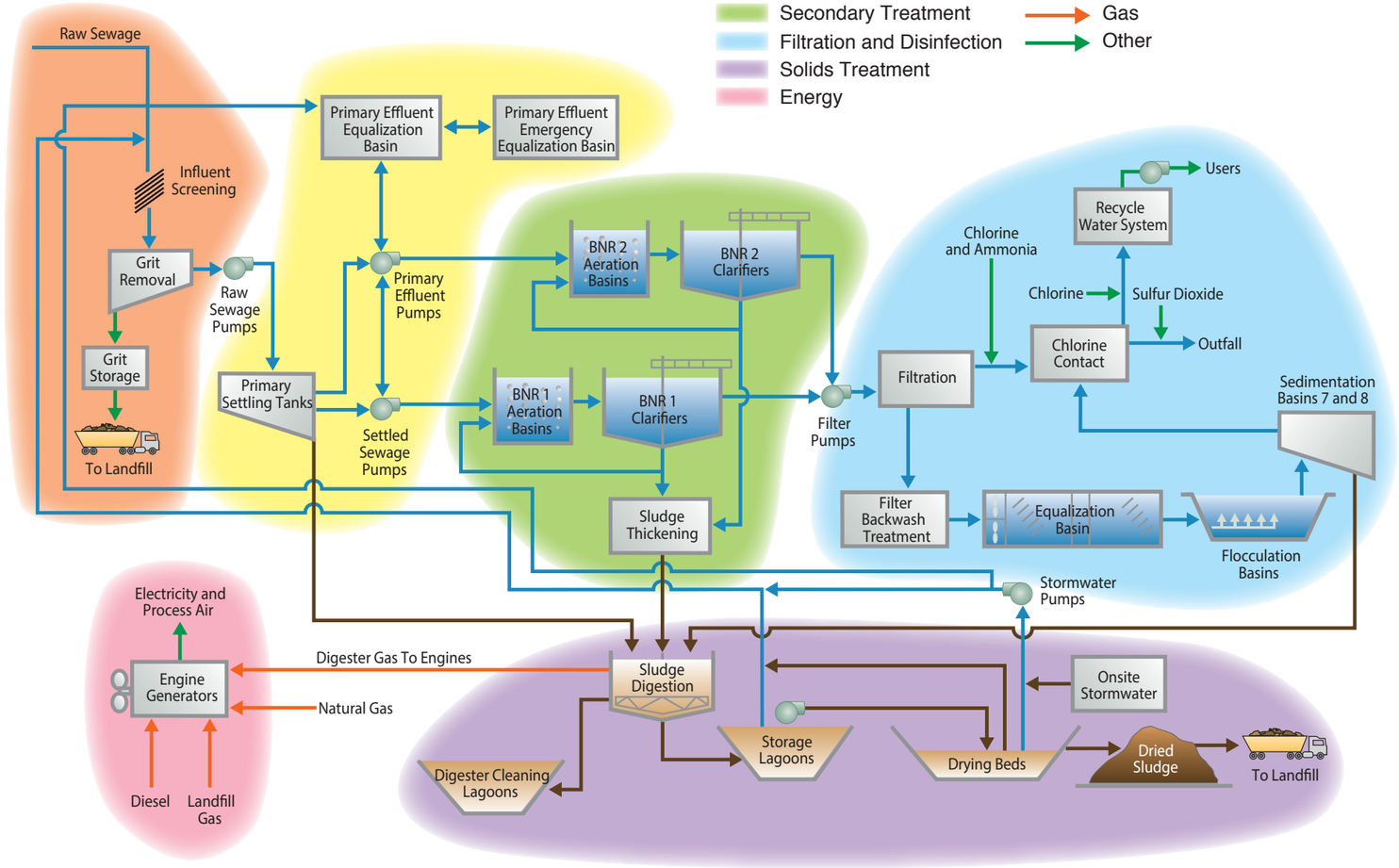
PRIMARY TREATMENT

Influent is pumped from the Headworks to settling tanks (referred to as the East and West Primaries) where larger particles (solids) are settled out of the wastewater over a 1.7-hour period, resulting in the removal of about 50 percent of contaminants. Within each tank, fiberglass bars called "flights" skim fats, oils and grease (scum) off the surface of the liquid and gradually rotate to the bottom of the tank. Settled solids are conveyed to the digesters. To reduce peak flows between primary and secondary treatment, plant operators pump primary effluent to the Primary Effluent Equalization Basin for temporary storage.

SECONDARY TREATMENT

Primary effluent is pumped to one of two biological nutrient removal (BNR) systems to remove biological oxygen demand, suspended solids, and some dissolved solids through a biological conversion of these materials into settlable forms. Each BNR system consists of aeration tanks and clarifiers:

- In the **aeration tanks**, air is pumped into the flow; the oxygen-rich environment nutures the growth of naturally occurring aerobic bacteria that remove organic pollutants in the water by attaching to suspended solids in the wastewater through flocculation.
- After aeration, the effluent is piped into **clarifiers** where the aerobic bacteria settle to the bottom. Vacuum-like rotating collectors withdraw the settled sludge, some of which is returned to the aeration tank to assist with treatment.



ENERGY

The WPCP uses digester gas (composed primarily of methane and carbon dioxide), landfill gas from nearby Newby Island Sanitary Landfill, and natural gas from Pacific Gas and Electric to meet the Plant's heat and power needs. The Plant's cogeneration system produces electricity and heat that is recovered and used for the digesters. Most of the energy consumed at the WPCP is for pumping and aeration (secondary treatment), which uses a combination of electric- and gas-driven blowers.

FILTRATION AND DISINFECTION

Filtration (or tertiary treatment) involves passing secondary effluent through filters containing layers of silica gravel, silica sand, and anthracite coal supported by an under-drain. The filters provide additional removal of biological oxygen demand and suspended solids.

Disinfection. Water treatment chemicals used in the disinfection process (chlorine and ammonia) are added to the filtered water, which drains into chlorine contact tanks beneath the filters. The chlorine contact tanks provide disinfection contact time between free chlorine (sodium hypochlorite) and water, and allows for additional removal of organics through sedimentation. Filtered disinfected water goes to the outfall at Artesian Slough or is diverted to the South Bay Water Recycling System.

Filter Backwash Treatment.The filters are periodically backwashed to flush out particles and prevent the filters from clogging. The filter backwash undergoes flocculation and sedimentation, whereby smaller particles combine into larger particles are settled out.

SOLIDS TREATMENT

Digestion. Solids are pumped to digester tanks (sludge from the BNR systems undergoes a thickening step first). The digesters use a biological process that relies on anerobic bactieria to reduce volatile solids (which are converted to digester gas) and kill pathogens. Each digester consists of a cover, gas mixing system and pumped heating loops, which transfer heat to the sludge to enhance the process.

Residual Solids Management. After 25 to 30 days digested sludge is pumped to clay-lined storage lagoons for further stabilization and capped with water for odor control. After 3 years settled solids are dredged, pumped into drying beds and actively dried for up to 6 months. The dried "biosolids" are trucked to the landfill for use as daily cover.

SOURCES: Carollo et al., 2009; ESA/J&S.

Figure 2-3
WPCP Schematic Flow Diagram

APPENDIX B

Biosolids Transition Strategy Report

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Biosolids Transition Strategy Report

San José/Santa Clara Regional Wastewater Facility

San José-Santa Clara Regional Wastewater Facility

December 2014 | CIP Program

Prepared by **Brown and Caldwell**

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Biosolids Transition Strategy Report

San José/Santa Clara Regional Wastewater Facility

December 23, 2014 | Project No.: 145119

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Limitations:

This document was prepared solely for City of San José in accordance with professional standards at the time the services were performed and in accordance with the contract between City of San José and Brown and Caldwell dated October, 21, 2013. This document is governed by the specific scope of work authorized by City of San José; 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 City of San José and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Biosolids Transition Strategy Report

San José/Santa Clara Regional Wastewater Facility

Introduction

Background

The cities of San José and Santa Clara jointly own the San José-Santa Clara Regional Wastewater Facility (RWF) which serves six other South Bay cities in part, through four special districts. The RWF is the largest advanced wastewater treatment facility in the western United States and treats an average of 110 million gallons of wastewater each day. Having been in operation since 1956, most of the RWF's infrastructure is now more than 50 years old and has exceeded its useful life, with repairs needed to every process area.

In 2008, San José embarked on a master planning process to provide overall direction for rehabilitating and upgrading its facilities including potential process changes. The Plant Master Plan (PMP) used an extensive community engagement process to develop overarching environmental, economic, social, and operational goals. One area of focus for the master planning process was biosolids management since treating wastewater at the RWF produces about 85 dry tons of solids each day.

Current Biosolids Management at the RWF

The RWF's current biosolids management practices produce a Class A biosolids product and include:

- **Mesophilic Digestion –** where solids remaining from the wastewater treatment process are biologically treated or "digested" in enclosed tanks designed to create a moderate temperature, low oxygen environment.
- **Lagoon Stabilization –** where digested solids are stored for about 3 years in open-air lagoons allowing further biological treatment and concentration of the solids.
- **Drying –** where stabilized biosolids are allowed to air dry in a series of drying beds.
- **Disposition at Newby Island Landfill –** where the dried and stabilized biosolids are used as daily cover in landfill operations.

Chronology of Changes

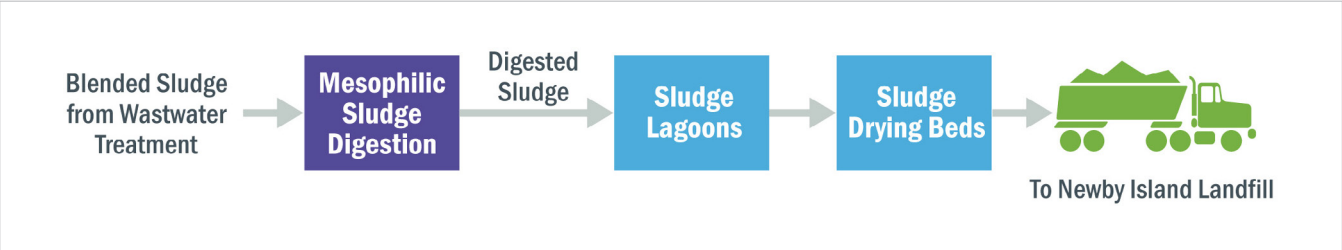
Although the PMP was officially adopted in 2013, the technical component of the PMP was completed in 2010. During the three-year environmental review process that occurred between 2010 and 2013, there were a number of changes in conditions potentially affecting the assumptions, recommendations, and implementation strategy recommended in the PMP. These changes included:

In May 2011, in response to community concerns about odors emanating from the lagoons and drying beds, the San José City Council directed acceleration of the transition to the new biosolids management system and specifically called for the RWF to cease discharging biosolids to the existing lagoons by 2018, followed by emptying the lagoons and drying beds by 2024. The PMP had envisioned a three phase approach that would have decommissioned the lagoons and drying beds by 2030.

During the EIR process for the PMP, it was determined that the planned location for recommended future biosolids facilities contained potential wetlands and habitat. Siting facilities in the recommended location would likely trigger extensive environmental mitigation and a lengthy permitting process. The resulting schedule delays would push completion of those new facilities required to cease discharge to the existing lagoons well beyond the 2018 target date, therefore, alternative sites needed to be evaluated.

In April 2014, TPAC provided feedback to staff to evaluate the possibility of producing Class A instead of Class B biosolids.

In early 2014, the RWF's Capital Improvement Program team conducted a detailed project validation review process of all projects recommended in the PMP. This validation effort led to a change in assumption from a large, open biosolids storage area near the lagoons (sized for 180 days of storage) to a managed, enclosed four-day storage facility located at the Biosolids Dewatering Facility, which is more in line with best practices in the wastewater industry.



Existing Biosolids Practices at the RWF

PMP Biosolids Recommendations

This current system is land intensive and has historically been one source of odors in the area. Because of these issues and because of the planned closure of Newby Island Landfill in 2025, the PMP recommended a new Biosolids Management Program involving a variety of enclosed, odor controlled treatment processes with the resulting treated biosolids used in a variety of off-site processing and beneficial reuse applications.

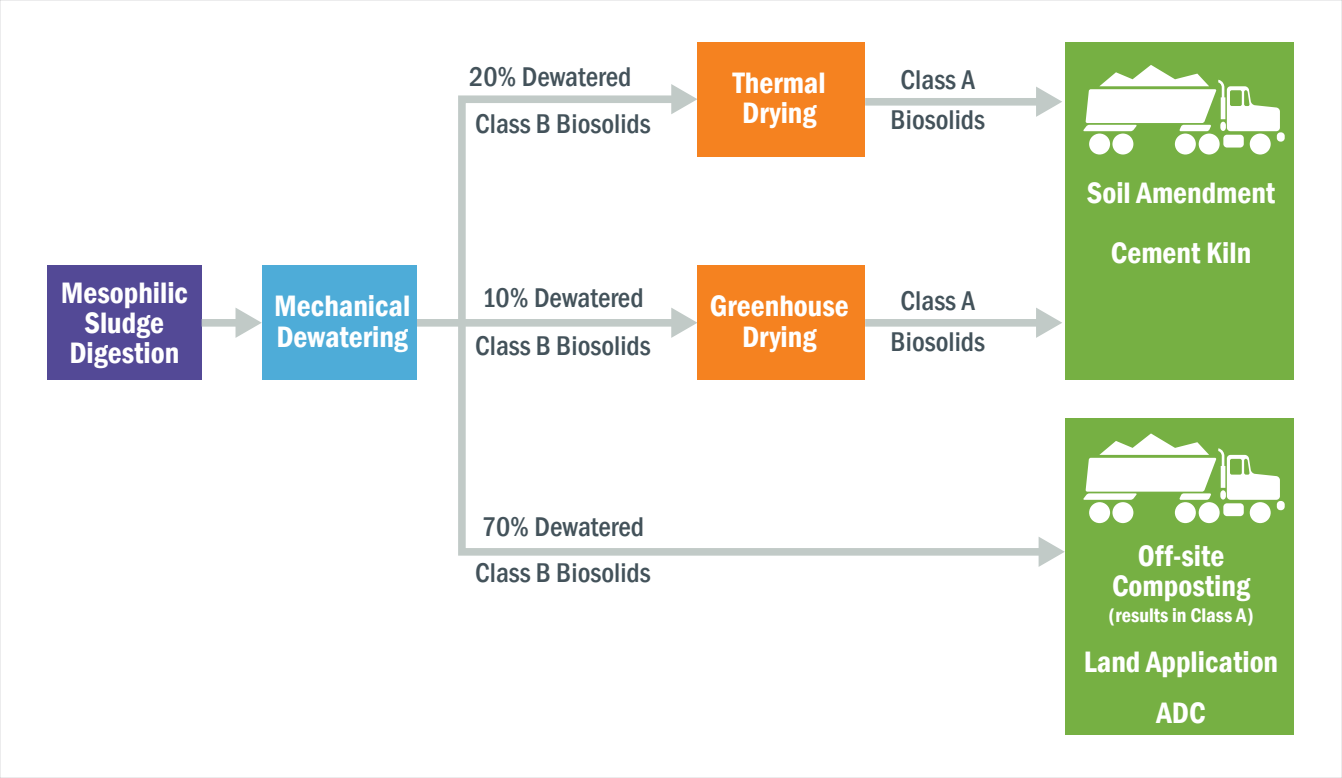
The PMP envisioned a program that produced a mix of Class A and Class B biosolids products. Specific PMP recommendations related to the future Biosolids Management Program included:

- Rehabilitation of the existing thickening facilities and mesophilic digesters and an evaluation of whether or not a different type of digestion process should be implemented.
- Mechanical dewatering for all biosolids in an enclosed, odor-controlled facility to concentrate digested biosolids which reduces the volume and weight of material requiring transport to off-site processing and beneficial re-use locations.
- Drying a portion of the dewatered biosolids using both thermal drying in an enclosed facility (20% of the biosolids) utilizing waste heat from a planned cogeneration facility and solar drying in enclosed green houses (10% of the biosolids).
- Decommissioning the existing open sludge lagoons and drying beds.
- Additional processing and beneficial re-use at off-site composting facilities, land application sites and landfills.

Class A vs. Class B Biosolids

Class A and Class B designations for biosolids relate to the level of pathogen reduction in the end product. Class B biosolids are considered stabilized sufficiently to reduce odors and attraction of 'vectors' (flies, birds, and rodents) that could transmit pathogens and diseases resulting from contact with the material.

Management practices such as limiting crop type and preventing immediate public access to Class B application sites are considered protective of public health. Class A biosolids are essentially pathogen free. Risks associated with contacting or handling Class A biosolids are considered minimal so there are fewer restrictions on product use.



Recommended Biosolids Management System: Plant Master Plan (PMP with Mesophilic Digestion)

Biosolids Transition Study

This Biosolids Transition Strategy Report addresses certain specific issues regarding implementation of the transition from the current biosolids management system to the PMP's recommended system considering changes that have occurred since the technical aspects of the PMP were developed. It includes both near-term and long-term recommendations for the Biosolids Transition Strategy, taking into consideration the goals identified in PMP. The Biosolids Transition Study focused on answering several key questions related to the transition including:

- Should San José change from its current practice of mesophilic digestion to a temperature phased anaerobic digestion (TPAD) process in order to optimize solids stabilization and increase biogas production?
- Should San José accelerate the on-line date for planned thermal drying and greenhouse drying facilities and add a blending facility to take maximum advantage of low disposition costs at Newby Island Landfill until it closes?
- Should San José focus on installing treatment processes to achieve Class B biosolids at this time while preserving the ability in the future to achieve Class A biosolids?
- Should San José preserve the potential for other on-site biosolids processing should it be warranted by future industry, market, and regulatory conditions?
- What areas should be reserved for biosolids processing facilities?
- Can the 2018 target date for ceasing discharge to the lagoons be met? And if not, what can be done about that?

Evaluation Process

Development of the Biosolids Transition Strategy involved an in-depth evaluation covering five overall topics:

- **Background Investigations** including information gathering and technical reviews as well as site visits to help assess certain technologies and the practices of other utilities employing biosolids management systems like those recommended by the PMP.
- **Market Investigations** to assess issues such as the demand for Class A and dried biosolids, prices paid by other agencies for off-site processing and disposition, available market interest in providing off-site processing and beneficial reuse service, and interest in participating in the development of on-site facilities.
- **Evaluation of Alternatives** including development and screening of alternatives as well as Triple Bottom Line Plus and economic evaluation of the "short listed" alternatives.
- **Site Evaluations** to determine the preferred location or locations for biosolids facilities recommended in the PMP.
- **Project Delivery Evaluation** primarily focused on the potential for mobile dewatering or design-build delivery to accelerate the on-line date for the dewatering facility.

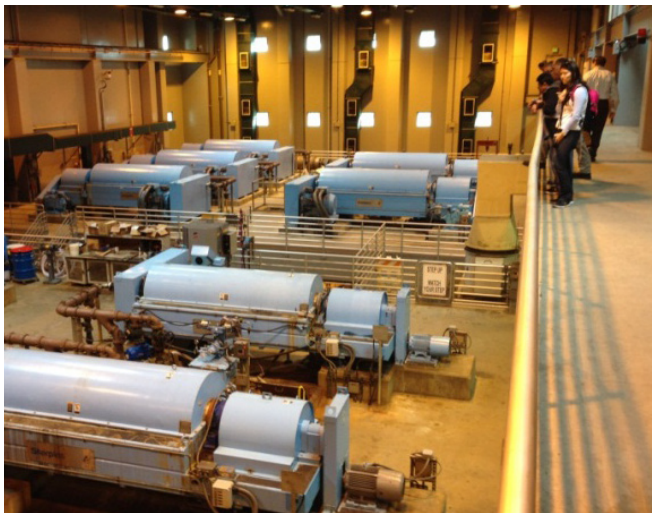
Technical Study Summary of Findings	
TM # 1 Biosolids Hauling and Disposition	• Unit prices for offsite disposition are generally higher than the current Newby Island LF option. • Land application and landfill disposal are approximately $35/ton; offsite composting is approximately $51/ton.
TM # 2 Solids-Water-Energy Tool (SWET)	• Alternatives that include thermal drying have a high annual energy cost, some of which can be avoided through heat recovery from cogeneration. • TPAD and mesophilic digestion were comparable in cost. • TPAD preserves the option for Class A digestion with the addition of batch tanks. • Options involving 100% thermal drying and 100% composting were not recommended for further evaluation due to cost and lack of product diversification.
TM # 3 Site Visits	• Centrifuge dewatering – maintenance and operation require specialized training and initial tech support. • Thermal drying has a very high operational cost. • Disposition contract procurement should consider qualifications in addition to price.
TM # 4 Sidestream Treatment	• Sidestream treatment is feasible and will require about 43,000 sf. • Pilot testing and additional modeling are recommended if it appears this will need to be implemented in the future.
TM # 5 Request for Expressions of Interest	• Numerous responses indicate a viable and competitive market for contract hauling and disposition of biosolids. • Pricing submitted was somewhat higher than previous surveys therefore sensitivity analysis for disposition costs is recommended during the BCE analysis.
TM # 6 Heat Recovery	• High grade waste heat can be conveyed from the cogeneration facility to a thermal dryer using steam. • If feasible, thermal drying should be located as close as possible to cogeneration to facilitate heat transfer. • Approximately 18 percent of biosolids production could be dried with waste heat.
TM # 7 Site Evaluation	• Site A is recommended for near-term and longer-term biosolids processing facilities because it has sufficient space and environmental resources can generally be avoided, resulting in more streamlined CEQA and environmental permitting processes. • Site C may be preferable for thermal drying due to proximity to the planned cogeneration facility, but has significant permitting uncertainty and jurisdiction issues that would need to be resolved. Permitting at this site would require significant time. • Site B (within the WRF footprint) has limited space (could only accommodate dewatering) and was not recommended due to other constraints such as the need to demolish and relocate existing facilities, construction conflicts with other planned projects, and long-term traffic congestion. However, other potential sites for dewatering that are close to the digesters should be considered during design due to operational efficiency. • Site D also entails significant permitting and jurisdictional uncertainty; reserving this site for any future sidestream treatment (which is unlikely to be required in the near term) is recommended.
TM # 8 Business Case Evaluation (BCE)	• TPAD and mesophilic digestion are comparable in life-cycle cost, but TPAD provides additional solids stabilization, enhances gas production, and preserves the option to upgrade to a Class A process if needed in the future. • Alternatives with additional processing like thermal drying and solar drying are more costly. • Accelerating the on-line dates of drying technologies and adding blending to take maximum advantage of low costs at Newby Island Landfill has a lower life-cycle cost than the Base Case (PMP) but benefits are highly sensitive to any delay. • Focusing initial projects on TPAD and dewatering while deferring drying technologies can significantly reduce costs while achieving goals to decommission sludge lagoons and drying beds. Market feedback indicates end product diversification goals can be met through multiple biosolids disposition contracts.

Background Investigations

Evaluation activities included facility tours as well as technical investigations of sidestream treatment and waste heat utilization in thermal drying.

Site Tours

Site tours of comparable facilities in the Bay Area, Southern California, and the Pacific Northwest offered the opportunity for staff and consultants to see process equipment first-hand and to discuss key features and issues with facility operators. Facility elements of particular interest included thermophilic digestion, temperature-phased anaerobic digestion (TPAD), centrifuge dewatering and thermal drying. Details are provided in TM#3.



Site Tour: Centrifuges at the San Deigo Metro Biosolids Center

Sidestream Treatment

Mechanical dewatering results in a high strength side stream that requires treatment. Preliminary indications are that the RWF liquid stream treatment processes will have adequate capacity to handle this. However, future regulatory limits could make separate sidestream treatment a necessity. The consultant team assessed the space requirements for any future sidestream treatment facility based on the DEMON process – which is the most commonly used process at this time. If implemented, capital cost would be in the $35 million range and the system footprint would be approximately 43,000 square feet. If it begins to appear that sidestream treatment will be required, modifying existing aeration basins should be evaluated and pilot testing is recommended.

Waste Heat Recovery

Waste heat recovery from the planned cogeneration system has long been considered as an energy source to reduce thermal drying cost at the RWF. The evaluation (TM#6) determined that high grade heat from engine exhaust would be best transferred as steam to a thermal drying system. Either a belt dryer system (convective heat) or paddle dryer (indirect heat) could be used in conjunction with waste heat recovery. The amount of recoverable heat was determined to be insufficient for drying 20% of biosolids production (only 16-18% of annual biosolids production could be dried), but would contribute significantly to reducing operating costs for alternatives that include thermal drying. Supplemental heat from natural gas could be used to make up the difference.

Summary of Site Tours

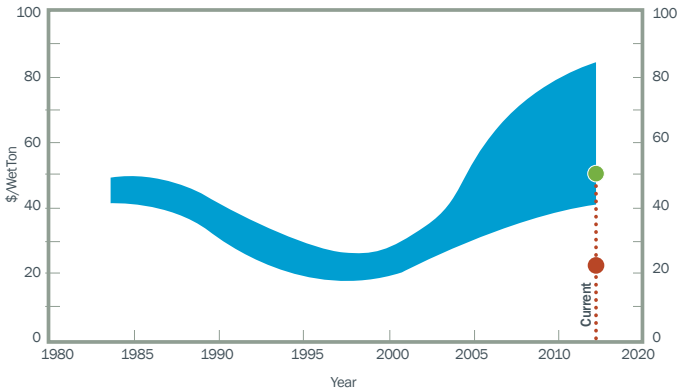
Location	Feature	Lessons
San Diego	Transition from drying beds to centrifuge dewatering	Train in-house staff rather than rely on manufacturers for service Avoid or minimize cake pumping
City of Los Angeles	Thermophilic digestion, centrifuge dewatering, nutrient removal pilot	Keeping biosolids hot was their key to maintaining Class A status
Orange County Sanitation	Mesophilic digestion with contract land application or composting	Issue RFPs for contract services rather than accept low bids to avoid problems in reuse program
Green Acres Farm	5,000 acre farm in Kern County owned by the City of Los Angeles for biosolids land application	City-owned land provides a reliable land application option but subject to political and legal challenges
South Kern Composting	Contract operated aerated pile compost facility operated by Synagro	Composting is more expensive than land application due to extensive processing required, but produces a Class A product
Sacramento Regional WWTP	Thermal drying for 7300 dry tons of biosolids per year (contract operated)	Operating costs are very high and the facility will likely not be used when the current DBO contract expires
Pierce County, WA	Thermal drying for 2400 dry tons/year owner-operated), nutrient removal system	Agency is backing away from a retail product marketing effort because of administrative costs; dryer O&M costs also high
City of Tacoma	DAFT thickening, ATAD, soil manufacturing	Manufactured soil is successfully marketed by City staff at a net cost comparable to land application Avoid centrifuge dewatering for this application due to physical properties
King County	Mesophilic digestion, 100% contract land application	Odor control performance in all process areas was remarkably good

Market Investigations

Market investigations included a review of literature and published surveys related to costs paid by Bay Area agencies for off-site processing and reuse of dewatered and dried biosolids products. A survey of biosolids disposition alternatives and cost was conducted as part of the original PMP effort; findings from the PMP review were comparable to a more recent market survey conducted by the San Francisco Public Utilities Commission. Options for biosolids disposition include land application (Class A or B) on agricultural land, landfill disposal and alternative daily cover, and contract composting. Past surveys showed that costs for biosolids disposition will likely increase significantly for the RWF. Newby Island Landfill currently charges $23/ wet ton, requires a minimum of 50% dry solids and may close by 2025. Unit costs for other biosolids disposition options ranged from $35 to $51/ wet ton.

The figure to the right illustrates trends and current costs for biosolids disposition. The red dot shows the current cost at Newby Island Landfill while the green dot shows the mid-range for other options. Unit costs and biosolids quantities were an important consideration for projecting future program operations costs.

Following this initial literature review, San José conducted its own market research by issuing a **Request for Expressions of Interest.** The Request asked potential service providers to answer a number of questions related to the types of off-site processing



California Price Range for Class A/B Cake Trucking and Use/Disposal

Summary of Biosolids Market RFI Responses

Respondent	Proposed Technology	Technology Status	Type of Reuse	Acceptable Biosolids	Type of Contract	Disposition Cost [1]
CH2M HILL	Thermal Drying	Proven	Pelletized Fuel Soil Enhancement/Fertilizer	Class A or B	N/A	N/A
NEFCO	Thermal Drying	Proven	Pelletized Fuel Fertilizer	Class A or B	Service & Disposition	$60-$70
USG	Belt Dryer	Proven	Alternative Fuel Land Application	Class A or B	Service only	$30-$50
Liberty	Composting	Proven	Compost	Class A or B	Service & Disposition	$20-$30
Synagro	Land Application Composting	Proven	Land Application Compost ADC	Class A or B	Service & Disposition	$30-$40
Terra Renewal	Land Application Composting	Proven	Land Application ADC	Class A or B	Service & Disposition	$20-$30
Degremont	N/A		N/A	Class A or B	N/A	N/A
Lystec	Hydrolysis Land Application	Emerging	Liquid Fertilizer for Land Application	Class A or B	Service & Disposition	$50-$60
VitAg	Fertilizer	Emerging	Class A Fertilizer	Class A or B	Service & Disposition	$20-$60
Biogas Equity 2	Gasification	Non-Commercial Proven	Syngas	Class A or B	Service & Disposition	N/A
Gate 5 Energy	Dryer Combustion Energy Recovery	Non-Commercial Proven	Renewable Electricity	Class A or B	Service & Disposition	$40-$85

Notes: *1. Disposition cost is per wet ton based on 25% solids. Transportation is not included in the disposition cost.*

and re-use services they could provide, the typical costs for providing such services, the number of permitted sites available, and the types of contract terms that they would require. The Request also asked potential service providers to describe on- and off-site biosolids processing facilities that they would be willing or interested in providing or helping to develop. The majority of responses were for proven technologies with useful information about service providers and potential contract features. Results included:

- Multiple providers who were interested in providing off-site processing and disposition. A 5-year minimum contract term appeared agreeable to these providers.
- Reported costs for off-site processing and disposition were somewhat higher than previously assumed in the PMP and than shown in the SPFUC survey, although this would ultimately depend on market conditions and competition. As a result, it was recommended that the evaluation of alternatives consider sensitivity cases with higher disposition costs .
- Multiple providers indicated interest in dryer and dewatering under a design-build-operate type arrangement.
- Some emerging but promising technologies were identified in the responses, indicating that options for processing may increase in the future .

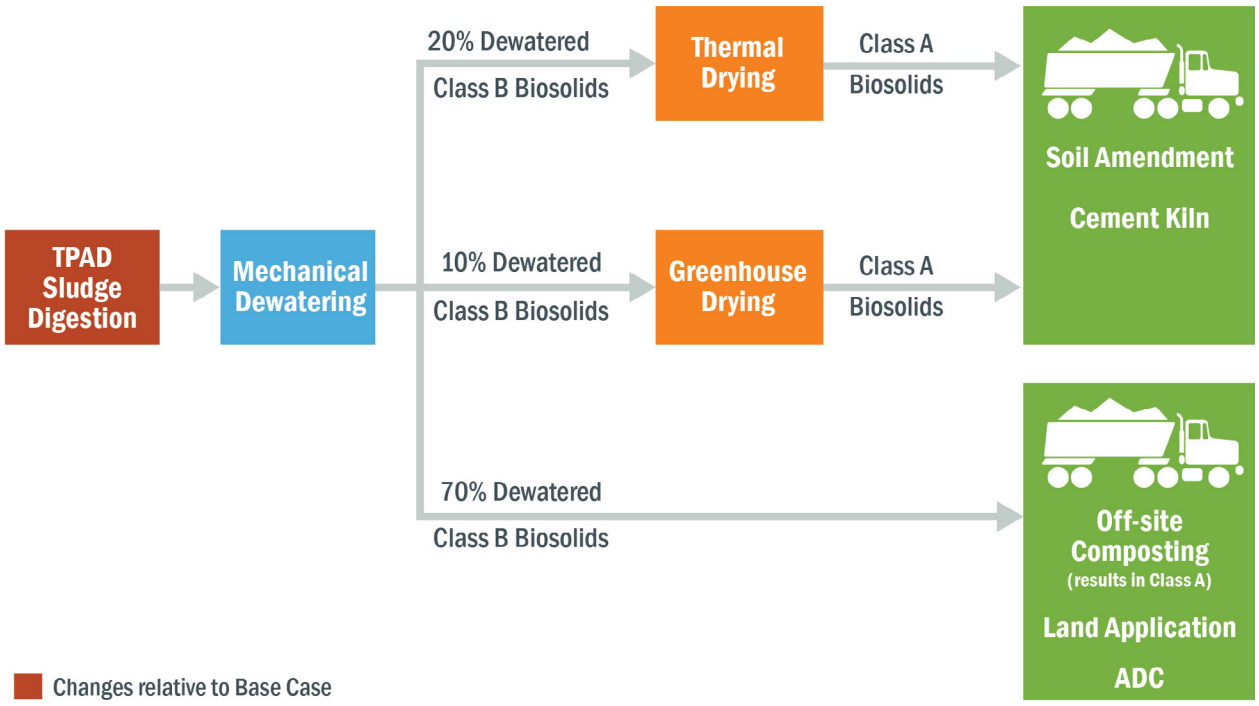
Evaluation of Alternatives

The evaluation of alternatives entailed a two-step process. First, the Solids-Water-Energy Tool (SWET) model was used to help screen out less favorable alternatives. For example, based on the SWET analysis, alternatives involving 100% thermal drying and 100% composting were eliminated.

Team workshops were then conducted to select and refine three alternatives for comparison against the recommendations in the PMP. The alternatives were developed considering the PMP's objective of providing a cost-effective program with diverse outlets for biosolids and included:

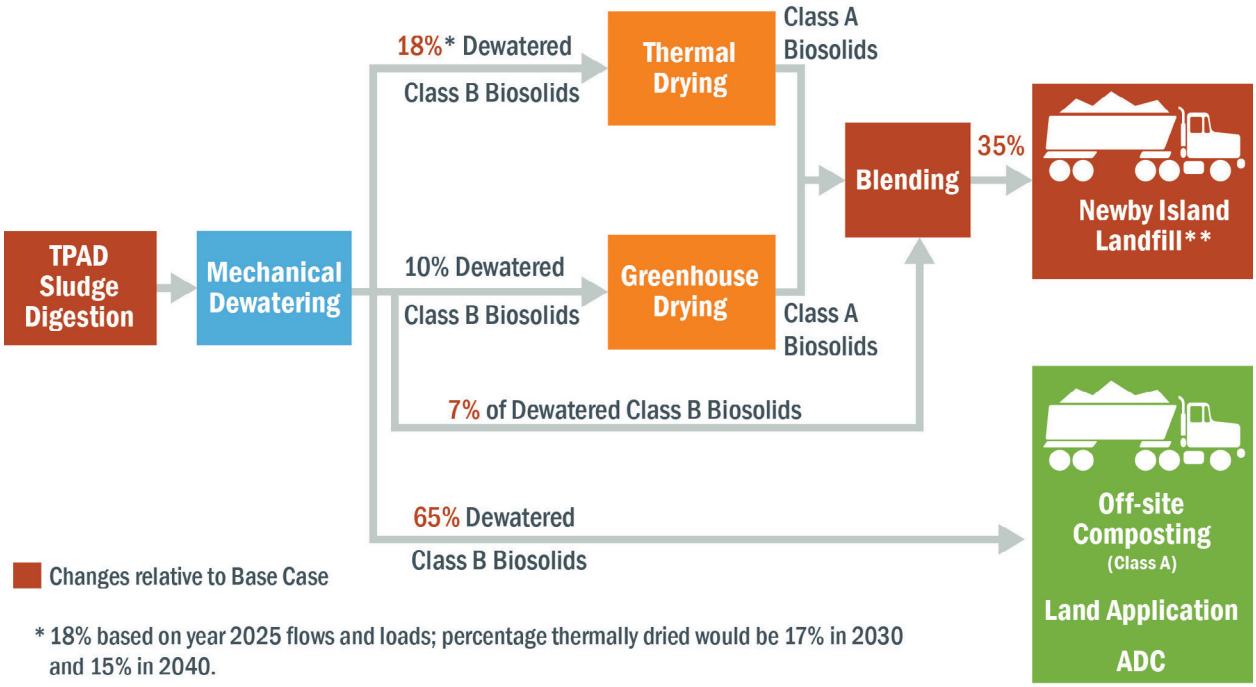
Alternative 1: Modified Base Case with TPAD

20% thermal drying, 10% solar drying and TPAD digestion to improve solids stabilization and increase gas production.



Alternative 2: Base Case with a Blending Option

Accelerated on-line date for drying technologies, smaller thermal dryer, and added blending facility to allow dried biosolids to be blended with dewatered biosolids in order to maximize benefits of low disposition costs at Newby Island Landfill until it closes in 2025.

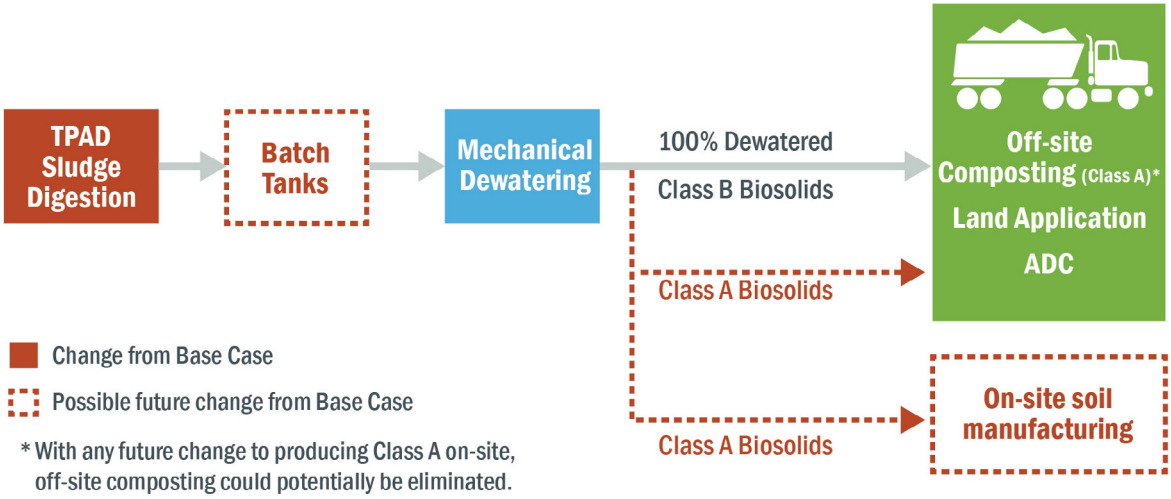


* 18% based on year 2025 flows and loads; percentage thermally dried would be 17% in 2030 and 15% in 2040.

** Newby Landfill scheduled to close 2025. After 2025, material from thermal and greenhouse drying would be suitable for Class A soil amendment.

Alternative 3: TPAD with Future Batch Tanks

Limit facilities to TPAD and mechanical dewatering while providing future flexibility to achieve Class A biosolids through the addition of batch tanks.



* With any future change to producing Class A on-site, off-site composting could potentially be eliminated.

The alternatives were then reviewed and refined in a series of comprehensive and interactive workshops which involved program management, engineering and O&M staff. Alternatives were evaluated in terms of economic considerations and a Triple Bottom Line Plus (TBL+) evaluation that also considered non-economic factors. Results for each alternative include a TBL+ "Performance Score" and a "Value Score."

The final BCE results for each alternative are summarized in the tables below. Details of the economic and TBL+ evaluations as well as sensitivity tests are provided in TM 8, which describes the BCE for alternatives developed in this study.

Triple Bottom Line Plus Criteria	
Category	Criteria
O&M and Safety	Process Reliability Flexibility and Simplicity Safety Regulatory Risk/Adaptability
Social	Visual, Noise and Odor Impacts Public Acceptability and Policy
Economic	Percent Value Life Cycle Costs Rate Impact Cost/Schedule Uncertainty
Environmental	Environmental Footprint and Sustainability Beneficial Use: In-plant, Energy, or End Products

Alternative 1 (Modified Base Case with TPAD) had TBL+ Performance and Value Scores that were comparable to the Base Case. Present Value Life Cycle Costs (PV LCC) were also equivalent. These results suggested that TPAD is comparable to mesophilic digestion. TPAD is recommended because it also provides a pathway to Class A biosolids via future addition of batch tanks, and because it results in enhanced solids stabilization and biogas production.

Parameter	Base Case: PMP with Mesophilic Digestion	Alternative 1: Modified Base Case with TPAD
PV Life Cycle Cost	$520 M	$520 M
Capital Cost	$298 M	$306 M
O&M Cost	$14.5 M	$14.1 M
TBL+ Performance Score	5.3	5.4
Value Score	0.12	0.13

Alternative 2 (Base Case with a Blending Option) had a higher TBL+ Performance and Value Scores than the Base Case and would result in PV LCC savings. However, any potential savings would be highly schedule-dependent and there was substantial risk that this alternative could not be implemented soon enough to capture all savings.

Parameter	Base Case: PMP with Mesophilic Digestion	Alternative 2: Base Case with a Blending Option
PV Life Cycle Costs	$520 M	$490 M
Capital Cost	$298 M	$270 M
O&M Cost	$14.5 M	$14.1 M
TBL+ Performance Score	5.3	6.3
Value Score	0.12	0.14

Alternative 3 (TPAD with Future Batch Tanks) showed significantly higher TBL+ Performance and Value Scores compared with the Base Case, as well as substantial PV LCC savings ($140 M). Product diversity goals with this alternative would be met through multiple biosolids disposition contracts including off-site composting (Class A product), land application, and landfill disposal or ADC. Choosing Alternative 3 keeps options open for future process additions including Class A batch tanks, soil blending, partial thermal drying, and partial solar drying.

Parameter	Base Case: PMP with Mesophilic Digestion	Alternative 3: TPAD with Flexibility for Future Batch Tanks
PV Life Cycle Costs	$520 M	$380 M
Capital Cost	$298 M	$166 M
O&M Cost	$14.5 M	$12.3 M
TBL Score	5.3	8.5
Value Score	0.12	0.21

If batch tanks were installed in the future, PV LCC for Alternative 3 there would be no significant impact on PV LCC. If a soil manufacturing facility was also installed, PV LCC would be the same as if only batch tanks were installed. This is because the additional capital costs of soil manufacturing would be off-set by savings in disposition costs and by the revenue generated from the sale of manufactured soil. If manufactured soil was "given away" rather than sold, PV LCC for Alternative 3 would increase by $20 million.

Parameter	Alternative 3 if Batch Tanks Added in Future	Alternative 3 if Soil Manufacturing also Added in Future	Alternative 3 if Soil Manufacturing also Added in Future but no Revenue from Sale of Soil
PV Life Cycle Cost	$380 M	$380 M	$400 M
Capital Cost	$177 M	$204 M	$204 M
O&M Cost	$11.9 M	$10.5 M	$11.7 M

Based on the comparisons included in the evaluation of alternatives, proceeding with TPAD and dewatering is recommended at this time with use of a variety of disposition contracts to achieve the PMP's diversification goals. Installation of additional on-site processing facilities to achieve Class A biosolids should be deferred pending market or regulatory need for Class A biosolids. Multiple disposition contracts need to be developed, negotiated, procured and potentially renewed to meet the PMP multiple end product and contract diversification goals. This will require 1 FTE to develop and procure contracts and to monitor performance over the long run. Because these contracts will need to be integrated with other biosolids management facilities, operations, and programs, we recommend that the City establish a biosolids management team (BMT) to prepare and manage the disposition contracts. In addition, the BMT will monitor and track future conditions to enable the RWF to respond to changing regulatory and market changes and emerging technologies.

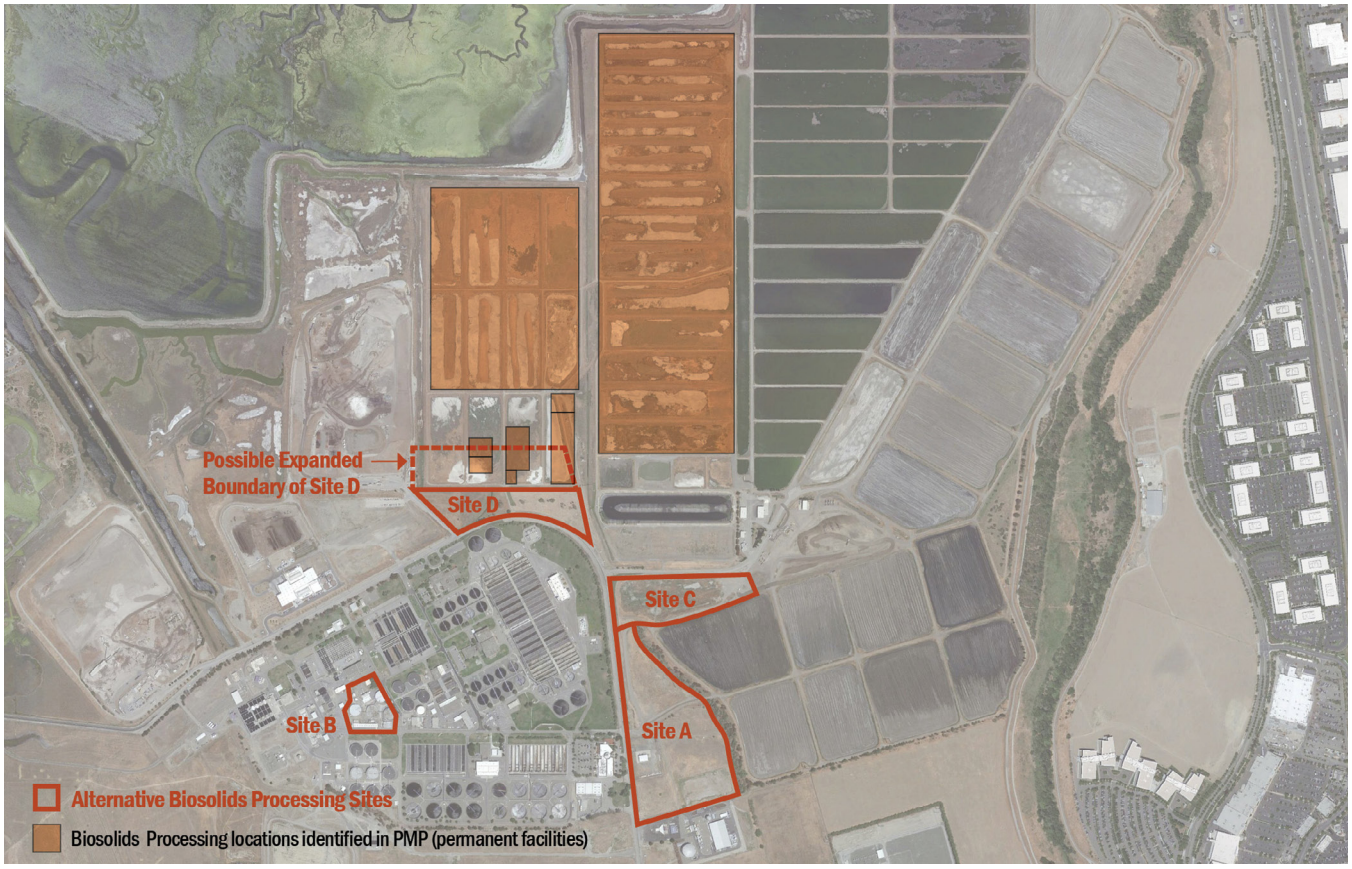
Site Evaluations

The Biosolids Transition Study also included a review of four potential new sites for locating biosolids processing facilities since CEQA review of the locations recommended in the PMP revealed significant environmental permitting challenges at those locations.

The site evaluation considered a number of factors including the ability of sites to accommodate various biosolids processing facilities, efficiency of operations as indicated by proximity to related facilities, conflicts with existing facilities and utilities, access and traffic issues, and environmental / permitting limitations.

The evaluation identified **Site A** as the preferred site to be reserved for near-term and potential future biosolids processing facilities because it has sufficient space, and environmental resources can generally be avoided at this location.

Site C was identified as a potentially preferred location for any future thermal drying facility due to its relative proximity to the planned cogeneration facility, unless future design.



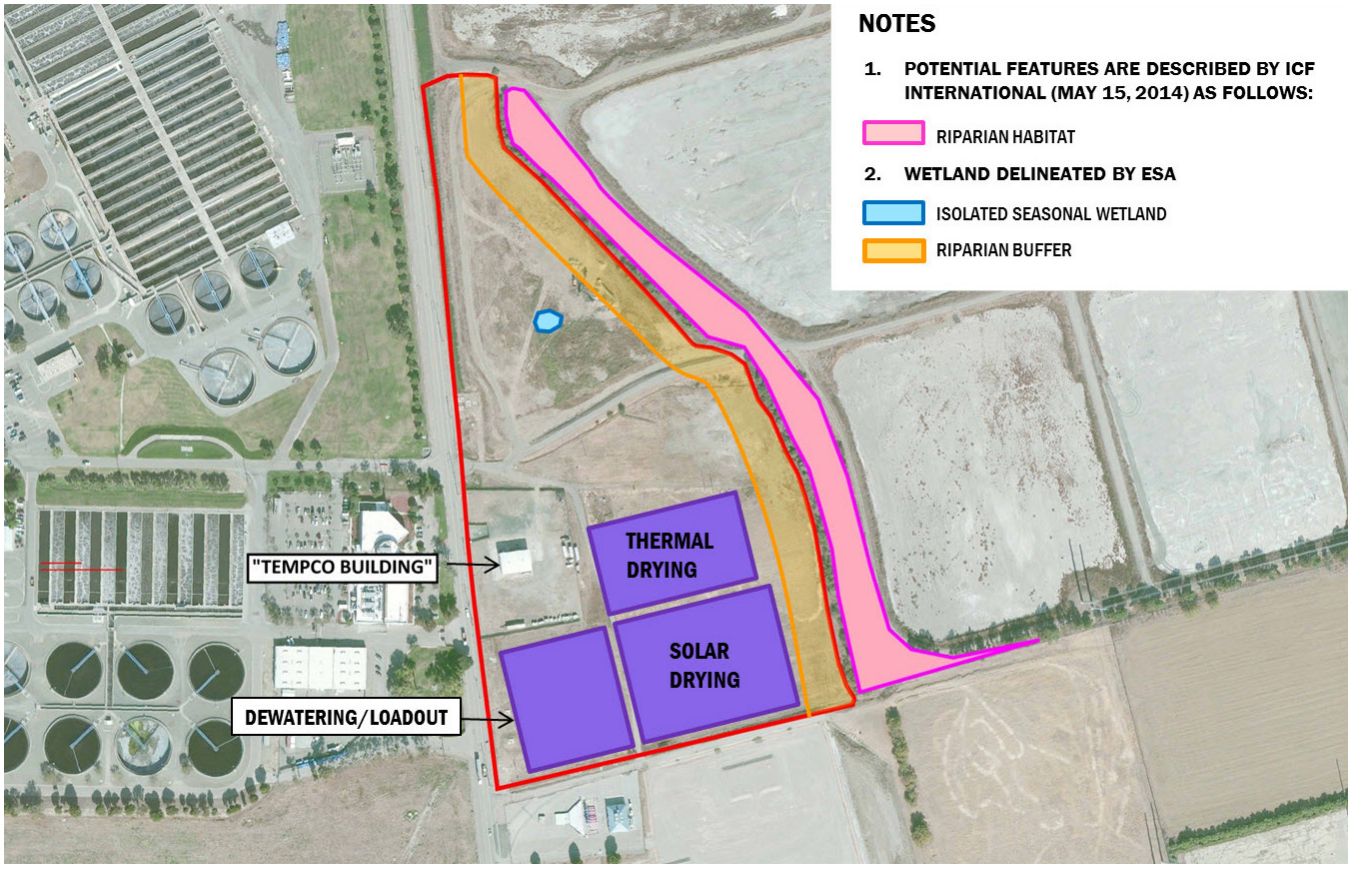
Alternative Sites Evaluated as Part of Biosolids Transition Study

Site Evaluation Criteria

work concludes that there would be sufficient space immediately adjacent to cogeneration. However, there is considerable uncertainty at Site C with respect to permitting jurisdiction and wetlands. These issues would need to be resolved before this site could be definitively selected, which would take considerable time. Therefore, we recommend initiating actions to resolve these issues well before final site selection for thermal drying.

Site D has similar issues to Site C; therefore Site D is recommended for future sidestream treatment since that facility, if ever needed, would be required over a much longer time frame.

Site B would only have sufficient space for dewatering and was not recommended due to other constraints such as the need to demolish and relocate existing facilities, construction conflicts with other planned projects, and long-term traffic congestion. However, other potential sites for dewatering that are close to the digesters, if available, should be considered during design due to the potential to enhance operational efficiency, reduce pipeline length, and mitigate deposition of struvite within the pipeline.



Site A: Preferred Location for Future Biosolids Processing Facilities

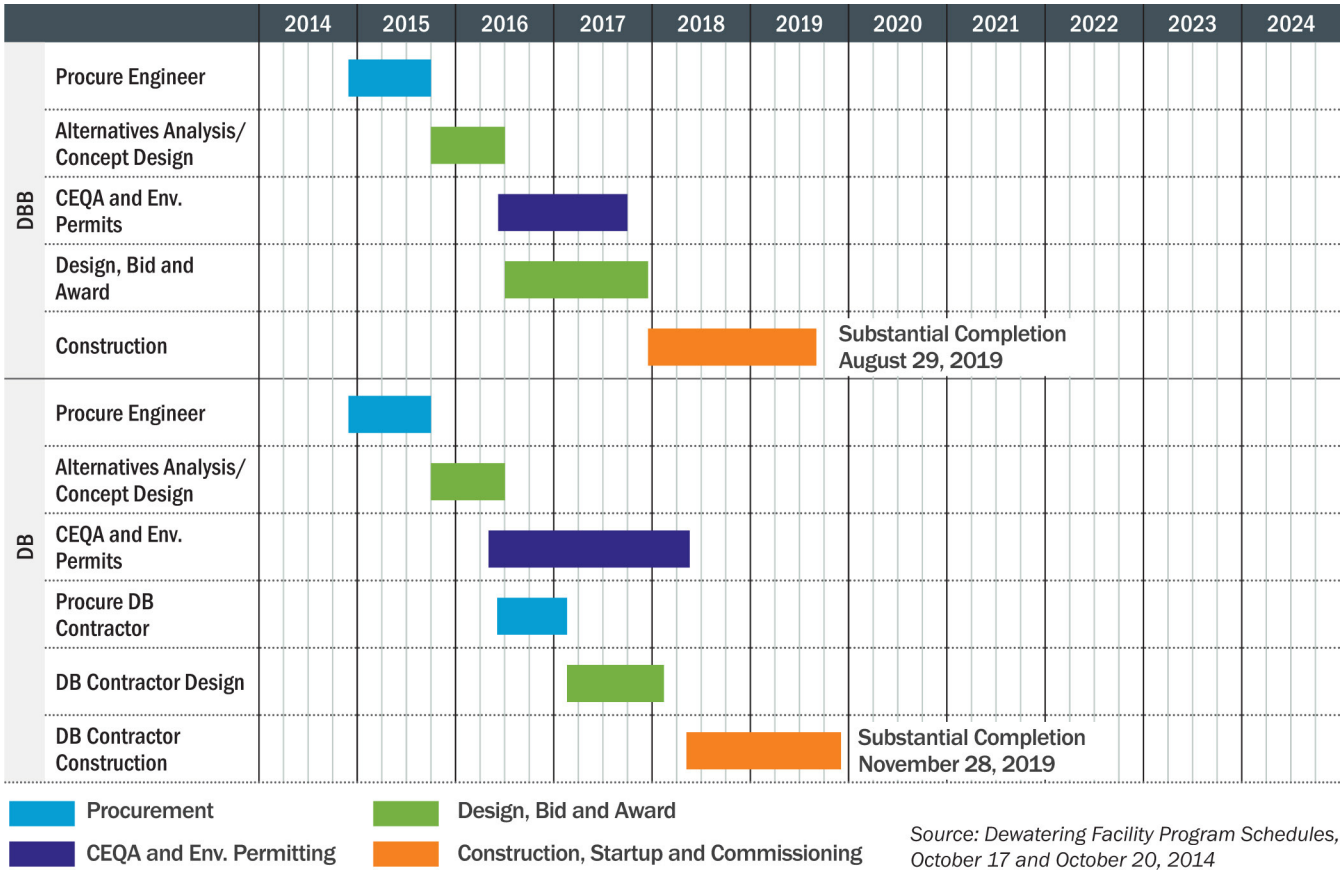
Implementation and Project Delivery

The current program schedule shows dewatering expected to be on-line in 2019, resulting in a delay for ceasing discharge to the lagoons. Mobile dewatering could be used prior to the on-line date for a permanent dewatering facility. Preliminary discussions with potential vendors indicate such a system could be mobilized within 3 to 6 months following procurement and selection, but the overall time required could be 2 to 3 years including procurement, contract negotiation, mobilization, and installation of temporary piping and power. Further, mobile dewatering would be expensive (approximately $14M per year). It would involve vendor costs, costs for support facilities, and increased disposition costs because dewatered material would not meet the minimum requirements for use of Newby Island Landfill. In addition, mobile dewatering would not be equipped with odor control and may be subject to some of the same environmental permitting challenges affecting permanent facilities.

Alternative project delivery methods (specifically fixed price and progressive Design-Build) were also evaluated in terms of their ability to accelerate the project schedule and provide other benefits.

However, based on currently available schedule information developed by the program, Design-Build appears unlikely to accelerate the on-line date for a permanent dewatering facility. While a final decision on project delivery method will occur during conceptual design of the dewatering facility, further schedule analysis should consider the potential to select a Design-Build contractor at an earlier stage. Early procurement of equipment and paralleling design and construction potentially could also help accelerate the schedule.

Potential Benefits of DB Delivery



Source: Dewatering Facility Program Schedules, October 17 and October 20, 2014

Design-Bid-Build vs. Design-Build Schedules

Conclusions and Recommendations

Summary of Conclusions for Biosolids Transition Study

- There is no immediate driver for Class A or thermally dried biosolids.
- Deferring thermal drying results in substantial PV LCC savings.
- TPAD provides a future cost effective path to Class A biosolids via batch tanks; diversification can be achieved through service contracts.
- Site A provides sufficient space for dewatering and future biosolids processing facilities; Site C would be a candidate for future thermal drying due to proximity to cogeneration unless it can be demonstrated during design that there was sufficient space adjacent to the cogeneration facility.
- Based on the current program schedule, permanent dewatering appears unlikely to be on line by 2018 regardless of delivery method. To meet the target date of 2018, one of the options that could be considered would be mobile dewatering; however, this option is expensive, may not mitigate odor issues, and may be subject to permitting uncertainties.
- RFI responses confirm biosolids disposition availability in the Bay Area, with interest in short-term as well as long-term contracts.
- Sidestream treatment is feasible and can fit within the footprint of Site D.
- Waste heat recovery from the cogen facility is suitable for drying between 16 and 18 percent of the facility's annual biosolids production. A belt dryer or indirect dryer (such as a paddle dryer) would be required for practical use of waste heat for thermal drying. Locating the thermal dryer as close as possible to the cogen facility is recommended to reduce the risks associated with conveying high grade heat.

Biosolids Transition Strategy: Near-Term Recommendations

- Proceed with TPAD digestion followed by mechanical dewatering (Alternative 3) at this time and defer a decision on the best way to achieve Class A biosolids to a later date since there is no imminent need for Class A biosolids at this time.
- Defer thermal drying and greenhouse drying at this time for substantial cost savings.
- Further evaluate the potential for DB delivery to accelerate the dewatering on-line date specifically considering the potential to select the DB contractor at an earlier date, procure equipment earlier, and parallel design and construction activities.
- Consider provisions for 1-year O&M training and support for the biosolids dewatering facility.
- Locate dewatering facility at Site A unless further evaluation during conceptual design identifies a suitable location within the plant fence line.
  - Reserve Site A for future biosolids processing facilities.
  - Provide a safe means for O&M staff to access the a mobile dewatering facility at Site A if a suitable site within the fence line is not identified during conceptual design.
  - Reserve Site C for any future thermal drying facility.
  - Initiate resolution of jurisdictional issues at Site C.
- Investigate environmental and permitting issues associated with support facilities for mobile dewatering so that it can be used as a backup strategy in the event of significant delays in bringing a permanent dewatering facility on-line.
- Establish a biosolids management team (BMT) to begin developing and negotiating a diverse portfolio of disposition contracts in terms of end uses, qualified service providers, contract terms, and procurement, and to monitor market, and technology developments. The BMT should consist of one FTE dedicated to the development and management of disposition contracts as well as other participants including the overall biosolids program manager and representatives from operations and maintenance.

Biosolids Transition Strategy: Long-Term Recommendations

- Implement an adaptive management approach with the BMT:
  - Tracking changing industry, regulatory, market and land use conditions, and conducts market research.
  - Conducting market research to better determine local demand and price for end products such as manufactured soil and dried biosolids.
- Implement additional future on-site processing facilities considering conditions at the time.
  - Start small with pilots, demonstrations, and phasing.
  - Potentially participate in regional facilities and emerging technologies.
- Through the BMT or designated biosolids contract manager, proactively oversee contract operations to ensure regulatory and contract compliance.

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Technical Memorandum

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 1, Service Order #5

Subject: Biosolids Hauling and Disposition Cost Projections

Date: August 7, 2014

To: Linda Stewart, Senior Engineer, City of San José

From: Steve Wilson, Chief Scientist, Brown and Caldwell

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Limitations:

This document was prepared solely for City of San José in accordance with professional standards at the time the services were performed and in accordance with the contract between City of San José and Brown and Caldwell dated October 8, 2013. This document is governed by the specific scope of work authorized by City of San José; 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 City of San José 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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Section 1: Purpose and Background

The purpose of this Technical Memorandum No. 1 (TM 1) is to recommend values for cost of biosolids disposition to be used in business case analyses of alternatives for reconfiguration of biosolids management at the San José-Santa Clara Regional Wastewater Facility (SJSCRWF). The current configuration for biosolids management includes mesophilic anaerobic digestion, followed by multi-year stabilization in sludge lagoons. Lagoons are dredged and the dredged biosolids are air-dried before trucking to the Newby Island landfill for use as alternative daily cover (ADC). The City of San José (City) has been directed to stop feeding the lagoons by 2018 and must ultimately decommission the lagoons and drying bed operations. This directive has created the need to determine a new configuration for biosolids management at SJSCRWF that does not rely on lagooning and/or open air drying of biosolids. The new configuration also requires review of disposition alternatives other than the Newby Island landfill because there is currently a minimum 50 percent solids by weight criterion for acceptance there and that facility is nearing the end of its life for accepting materials. As a minimum, the new configuration will very likely involve mechanical dewatering of anaerobically digested sludge.

Understanding the future costs for disposition of biosolids products aids decision-making for upstream processes such as anaerobic digestion. Additional biosolids processing including Class A technologies (thermal drying, composting) and solar drying were recommended in the Plant Master Plan (PMP). Application of these technologies influences both processing costs and product disposition cost. Rational economic analysis of alternatives for reconfiguration requires assumptions regarding the cost of removal and appropriate disposition of biosolids from the SJSCRWF site. These costs are impacted by the quality of the biosolids leaving the site and the ultimate disposition fate for the biosolids. This TM was prepared to review the experience of neighboring California peer facilities in terms of the various disposition outlets and associated costs. This information was then converted into an assumed set of costs that can be applied to economic analysis of alternatives for reconfiguration of the SJSCRWF biosolids management program.

Section 2: Biosolids Quantities for SJSCRWF

Projected quantities of mesophilic anaerobically digested biosolids are shown in Table 2–1.

Table 2-1. Projected Digested Solids Loads

Load Condition	Day 1 TS, dry ton/day	2030 TS, dry ton/day
Annual Average	82	102
Max Month	109	135
Peak 2 week	117	146
Peak week	122	151
Peak Day	126	157

Loads are expressed on a dry solids basis however costs for transport and disposition are based upon the actual wet tonnage of the biosolids. Wet tonnage is derived by dividing the dry tonnage by the decimal equivalent of the percent solids of the biosolids product (e.g. 82 dry tons per day at 25 percent solids is 82/0.25 = 328 wet tons per day). With current operations, after air drying and handling, the biosolids transported to Newby Landfill are approximately 80 percent dry solids by weight. When discharge to the lagoons is ceased, mechanical dewatering will be required and the biosolids cake product will be in the range of 20 to 25 percent dry solids (75 percent water). This increases the volume of product requiring hauling and disposition by a factor of three. Newby Island landfill may not accept the wetter product under the current contract. Alternatives for biosolids management reconfiguration may include transport and disposition of dewatered cake or additional contained-type drying processes (thermal or solar greenhouse) that can reduce the water content and, consequently, the wet tonnage of biosolids for transport and disposition.

Loading projections are in the process of being updated and actual loads may prove to be less than shown above. Loadings described in this report are intended for comparative purposes and preliminary estimates of disposition cost only.

Section 3: Disposition Opportunities

Peer agencies in the Northern California area predominantly seek competitive contractual arrangements for the transport and legally permitted disposition of their biosolids products. Contracts are variable with regard to prescriptive requirements for the final disposition of the biosolids. Table 3-1 presents generic description of the most used disposition methods.

Table 3-1. Generic Description of Disposition Opportunities

Disposition Method	Description
Land Application	Application to agricultural land for beneficial use. Application constrained by weather and jurisdictional limitations. Class B biosolids limited to non-food crops. Class A biosolids have more flexible options for land application use.
Alternative Daily Cover at Landfills	Beneficial use that displaces use of topsoil in the management of active landfill disposal cells. Not typically limited by weather conditions. Class B biosolids usually the threshold quality level.
Composting	Additional aerobic stabilization of biosolids to produce a Class A product suitable for flexible beneficial use. Usually conducted at a site remote from the wastewater treatment facilities. Market in Bay Area incentivized by Solano County requirement that requires diversion of some portion of Class B biosolids to Class A composting as a condition for County's acceptance of Class B biosolids for land application.
Landfill	Non-beneficial disposal of biosolids in active cells of municipal solid waste landfills or dedicated sludge mono-fills. Typically subject to same tipping fees as other forms of refuse received at the landfill.

Class B and Class A designations for biosolids relate to the level of stabilization of the biosolids and the expected content of pathogenic organisms that create risks associated with human contact of the biosolids. Class B biosolids are considered stabilized sufficiently to reduce odors and attraction of 'vectors' (flies, birds, and rodents) that could transmit pathogens and diseases resulting from contact with the sludge. Management practices such as limiting crop type and preventing immediate public access to Class B

application sites are considered protective. Class A biosolids are considered well stabilized and treated to eliminate active pathogenic organisms in the biosolids. Risks associated with contacting or handling Class A biosolids are considered minimal so there are fewer restrictions for product use.

Section 4: Information on Disposition Costs for Other Agencies

Previous studies have identified regional opportunities and costs for biosolids management. This was evaluated initially in Biosolids Treatment Alternatives TM 5.2 (Carollo Eng., Brown and Caldwell, et al, 2011. Task Order 5, TM 2, "Biosolids Treatment Alternatives"). Appendix A of TM 5.2 evaluated biosolids reuse and disposition options. Unit costs were identified and summarized in Table A.4 of the report (Figure 4-1). The annual costs for this table were based on an assumed 2010 annual average biosolids production rate of 67 dry tons per day.

Table A-4 2010 Biosolids Disposition Costs
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

		2010 Disposition Cost		
Product	**Location**	**($/dry ton)**	**($/wet ton)**	**($/yr)[3]**
Current Operation	Newby Landfill	58[(1)]	23	1,420,000
Land App (Local)	Silva Ranch, Herald	50[(2)]	40	1,220,000
Landfill (Local)	Vasco, Livermore	55[(2)]	44	1,350,000
Landfill (Remote)	Salinas	74[(2)]	59	
Landfill (Local)	Manteca	82[(2)]	66	2,010,000
Land App (Local)	Silva Ranch, Herald	160	40	3,910,000
Landfill (Local)	Vasco, Livermore	176	44	4,300,000
Composting (Off-Site)	Synagro, Merced	180	45	4,400,000
Landfill (Remote)	Salinas	235	59	
Landfill (Local)	Manteca	263	66	6,430,000
Composting (On-Site)	SJ/SC WPCP	288	72	7,040,000
Composting (Off-Site)	Synagro, Kern	340	85	8,310,000
Land App (Remote)	Gerlach, NV	340	85	8,310,000

(1) Value calculated based on 80 percent solids dryness and 50 percent of the solids are soil due to current method of removing biosolids from the drying beds.
(2) Value calculated based on 80 percent solids, all other values calculated based on 25 percent solids.
(3) Cost based on all biosolids to this disposition option.

Figure 4-1. Image of Table A-4 from Plant Master Plan TM

Figure 4-2 below illustrates the range of unit costs for all of California as they have varied over the last few decades. This data was presented in Workshop 1 of the Biosolids Feasibility Study project.

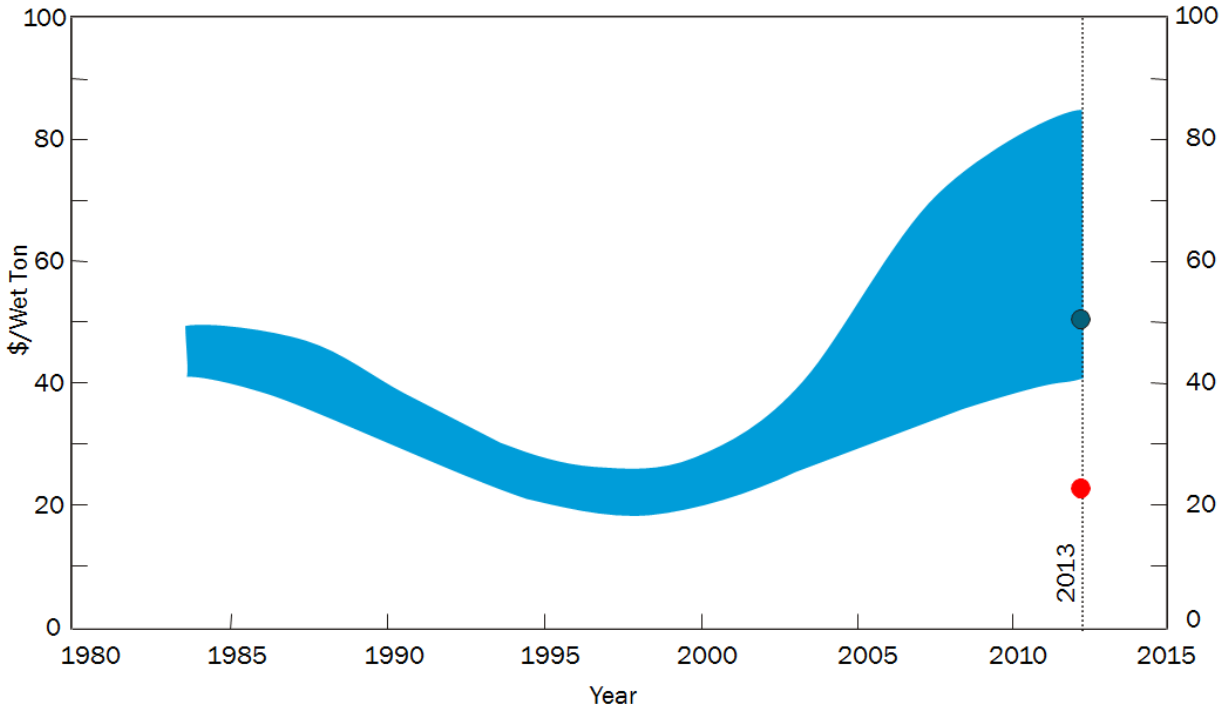

Figure 4-2. California Price Range for Class A/B Cake Trucking and Use/Disposal

The red dot on the slide represented the current cost for Newby Landfill while the green dot represented the midrange of future costs. In the workshop, Brown and Caldwell explained that unit costs may vary for different biosolids products. Class A cake, for example, may have a lower unit cost than Class B cake because of reduced hauling distances and restrictions on use. Most agencies in the Bay Area produce Class B cake so there is a better database for known Class B costs.

The data in Figure 4-2 look at California as a whole however there appears to be a cost differential between southern California agencies and northern California agencies, with northern California seeing lower costs. A survey of other biosolids programs in California was produced for the SFPUC in 2013 (SFPUC Program Management Consultants, 2013. TM 4 “Review of Other Biosolids Programs”). That survey included and differentiated northern and southern CA agencies, one of which produces a significant amount of Class A cake. Data from the survey are summarized in Figure 4-3.

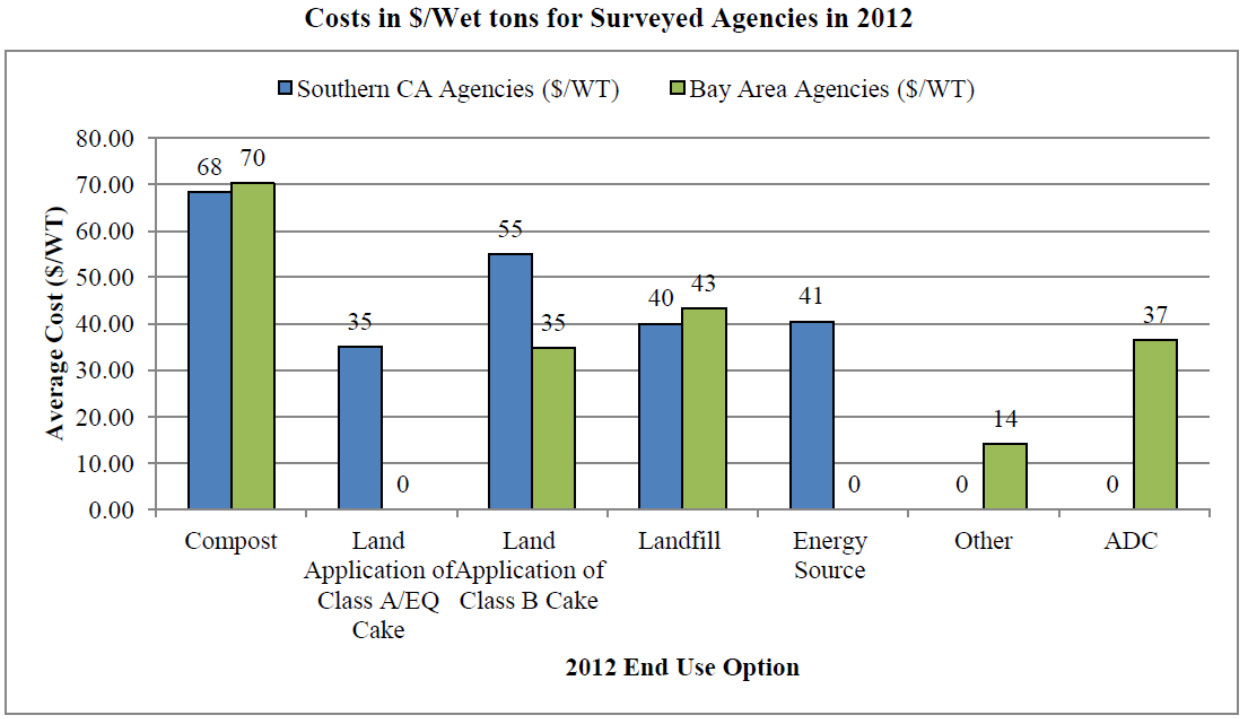

Figure 4-3. 2012 California Survey by SFPUC (Cost Per Wet Ton)

The results support the concept of projecting a lower unit cost for Class A cake. In addition, the figure illustrates that contract composting has a higher unit cost than land application because of additional processing requirements. An assumption that Class A biosolids produced at the wastewater treatment plant site result in a lower disposition cost in northern California is not directly supported from the data because northern California has few facilities producing a recognized Class A biosolids product at the plant site.

Currently, most Bay Area agencies have Class B programs. Calls were made to area biosolids generators to confirm current costs for hauling and disposal or beneficial use of biosolids. Agencies contacted and current prices are summarized in Table 4-1.

Table 4-1. Current Unit Costs for Biosolids Hauling and Disposition in the Bay Area

Agency	Disposition Method / Cost, $/wet ton				Quantity, tons/year
	Compost	Land Application	Landfill	ADC	
Central Marin Sanitation Agency		36		44	
Delta Diablo Sanitation District	46	30	30		
East Bay Municipal Utility District		30		35	70,000
Fairfield-Suisun Sewer District				33	
Millbrae		52			1,500
San Mateo		34			19,000
Santa Rosa[a]	155	34		34	
Union Sanitary District	47	28			20,000
SFPUC	72	35-38	32-41	36	84,000
San Leandro (Class A Biosolids)		29			1,200
Merced proposal to Palo Alto	60				
Sunnyvale WPCP		42	42	42	
San José (Newby Island) (Class A, 80% solids)				23	30,000

[a]*Santa Rosa uses an in-vessel compost system onsite which is expensive to operate and not representative of off-site options; not included in average.*

Section 5: Recommended Assumptions for Disposition Costs in Alternatives Analysis

Brown and Caldwell is evaluating process alternatives and costs by applying a proprietary Solids/Water/Energy Tool (SWET model). Results of this evaluation will be presented in a separate TM. A fundamental input to SWET is the unit cost for biosolids hauling and disposition.

Based on the information in this TM, unit costs in the SWET model were assumed as follows:

- Contract hauling to land application - $35/ton.
- Contract hauling to landfill - $36/ton.
- Contract hauling to Class A composting (off-site) - $51.
- Contract hauling to ADC - $35.
- ADC at Newby Island (minimum 50 percent solids content, before 2025) - $23.

Unit costs for biosolids hauling and disposition may be subject to change in the future due to regulatory changes or other variables. It may be deemed prudent to assume lower disposition costs for biosolids of higher quality to incentivize production of higher quality biosolids as a hedge against changing regulatory and market conditions. Sensitivity tests for the SWET model and/or business case evaluations are under consideration to ensure that the preferred biosolids transition alternatives are viewed from this perspective. Ultimately, costs for biosolids disposition at San José will be determined by the market in response to specific solicitations. When that time comes, contractor qualifications and experience should be considered in addition to price to ensure a reliable program. The City may choose to be prescriptive with regard to disposition methods associated with a contract as a means of achieving various non-economic objectives.

Some agencies have invested in programs to produce biosolids products suitable for local distribution. Examples include the Tacoma TAGRO program and Pierce County's SoundGRO program. Producing a Class A biosolids is essential for consideration of such programs. It would be imprudent to assume that there is an alternative that could immediately direct significant quantities of biosolids in this manner in a short time period. However, maintaining the option to pilot and develop such programs may be a significant non-economic attribute associated with production of higher quality biosolids products from the plant site.

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Technical Memorandum

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 2, Service Order No. 5

Subject: Evaluation of Biosolids Treatment Alternatives using the Solids-Water-Energy Tool (SWET) Model

Date: August 28, 2014

To: Lily Zhu, Senior Engineer, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

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Executive Summary

This Technical Memorandum 2 (TM 2) summarizes the results the initial biosolids processing alternatives analysis for the San José-Santa Clara Regional Wastewater Facility (SJSCRWF). The alternatives analysis utilizes Brown and Caldwell's (BC) Solids-Water-Energy Tool (SWET) model. Process train and biosolids disposition alternatives were developed to compare with the base case proposed in the Plant Master Plan (PMP). The PMP recommended diversity in biosolids processing and disposition. The basic process train included thickening and mesophilic anaerobic digestion, 6 months of storage in covered lagoons, and mechanical dewatering. The PMP recommended that 10 percent of biosolids production be further processed by solar (greenhouse) drying. Thermal drying was proposed for an additional 20 percent of biosolids production. The balance of the dewatered biosolids were to be hauled offsite for a combination of landfill disposal, land application, and composting. This diverse program could provide up to 50 percent Class A product (thermal drying, composting and possibly solar drying) with remaining biosolids being managed as Class B. Class B biosolids management is common for Bay Area agencies at the present time.

The PMP envisioned that the solids process expansion could be located in an area occupied by legacy lagoons. The subsequent Environmental Impact Report (EIR) determined that development of this area could have environmental consequences and significant further study would be required before this could be approved. The covered lagoons, solar drying beds, and other elements of the expansion could have a large footprint that may not be accommodated in the remaining available area. As a result, alternatives to the base case from the PMP need to be considered. Variations to the process train were also considered in development of the alternatives with refinement of capital and operating costs. The results from SWET were used to estimate costs for each treatment alternative and a net present value was calculated based on these costs.

SWET model results demonstrated that significant cost savings could be achieved by modifying the original PMP approach. Using temperature-phased anaerobic digestion (TPAD) for example, can produce a Class A biosolids product at a lower cost than the base case. Mesophilic digestion alone or TPAD without the addition of 10 percent solar drying and 20 percent thermal drying also resulted in savings. To preserve the Class A element of a program alternative with Class B digestion, the model showed that offsite composting would be more cost-effective than thermal drying. Even though thermal drying reduces biosolids volume and disposition costs, additional capital investment and operation costs offset these savings.

Results of this evaluation provide a basis for review and discussion of the best approach for the biosolids transition. Assumptions and alternatives Will be refined in a subsequent Business Case Evaluation (BCE) that will consider scheduling and phasing impacts on cost and feasibility.

Section 1: Introduction

This TM 2 describes an analysis of biosolids treatment options at SJSCRWF. It provides the background for improvements to the current biosolids treatment and disposal processes, identifies treatment process options that are under consideration, and describes the results of the economic model that was used to evaluate the alternatives.

1.1 Objectives of the Study

The objective of this study was to determine the net present value (NPV) for the base case proposed in the PMP along with six different alternative biosolids treatment processes, based on the notion of immediate execution and steady state application of each alternative process configuration. The SWET model was utilized to assess treatment performance in terms of quantities and characteristics of the biosolids at each

step of the treatment process. Unit costs were applied at each step to estimate capital and operating costs, thus allowing economic comparisons to be made between the options.

1.2 Existing Conditions and Approach

The SJSCRWF currently processes biosolids using sludge thickening, mesophilic anaerobic digestion, sludge storage lagoons, and air drying beds. The process produces Class A biosolids. The biosolids are used beneficially as alternative daily cover (ADC) at the Newby Island Landfill.

The current treatment, storage, and final disposition process has been very economical for the City of San José (City) since it was first put into operation nearly 25 years ago. Nonetheless, a number of factors will soon affect the solids processing operation. These factors include the following:

- the aging of the existing sludge thickening and digestion facilities
- the policy direction to reduce odor impacts to neighboring communities
- anticipated changes in future biosolids regulations
- the possible closure of the Newby Island Landfill in 2025
- long-term land use changes for the plant site

The San José City Council has directed the plant to stop feeding digested sludge to the storage lagoons and cease operation of the drying beds by 2018. Ultimately, the lagoons and drying beds will be decommissioned. These changes will require significant changes in biosolids management, thus necessitating implementation of treatment processes that do not rely on storage lagoons and/or open air drying of biosolids. Disposition alternatives other than the Newby Island Landfill also must be developed and evaluated as the landfill has threshold biosolids dryness requirements (>50 percent solids) and is nearing the end of its life for accepting materials.

The PMP set forth recommended changes to the biosolids management program that will address new conditions. Conditions have changed even further as the result of the PMP EIR. Alternatives have now been developed and analyzed using the SWET model. The model allowed consideration of variations from the PMP's recommended approach. Results allow the project team to identify the approach that offers the best solution to meet project objectives. Results are intended to allow selection of the best approach for the City's program and focus on refinements to the preferred alternative(s).

The SWET tool estimates the water content and quantities of solids for each unit process in a treatment train. The energy consumed or produced in each unit process is also estimated by the tool. This type of analysis provides basic insight into the fundamental material and energy flows that are the foundation for understanding comparative life cycle costs among alternatives. When these results are combined with capital costs and annual operating costs for each unit process, the NPV can be calculated for each alternative. The development of SWET, how it is applied, and the results from the model are more completely described in Section 3 of this TM.

1.3 Basis for Cost Assumptions

Estimates of capital and O&M costs and estimates of the costs related to disposition of the processed biosolids were developed using information from a variety of sources.

1.3.1 Capital Costs

Capital costs used in the SWET model are adopted from the City's PMO Package Cost Estimate dated January 15, 2014. The cost estimate is divided into seven contracts:

- PS-01: Digester and Thickener Facility Upgrades (Digesters 5 to 8 and dissolved air flotation thickeners [DAFT])
- PS-02: Additional Digester Facility Upgrades
- PS-03: Digested Sludge Dewatering Facility
- PS-04: Fats, Oil, and Grease (FOG) Receiving
- PS-05: Thermal Drying Facility (for 100 percent of biosolids treatment)
- PS-06: Greenhouse Demonstration – Solids Drying
- PS-07: Lagoons and Drying Beds Retirement

Contract PS-01 costs are for mesophilic digestion upgrades. To estimate the cost increase for the TPAD alternatives, the percent difference between the mesophilic and thermophilic options in the original BC 2010 business case evaluation was applied to the PMO capital costs in Contract PS-01. Refinement of thermophilic digestion and TPAD costs is being conducted with conceptual design of the Digesters and Thickening Improvements project and the latest information on that work has been included in this analysis.

1.3.2 Disposition Costs

Costs related to hauling and disposition of the biosolids were developed based on information and experience from neighboring California peer facilities. This information was converted into costs that can be applied to economic analysis of the available alternatives and reported in TM 1 (attached). These unit costs are identified in Section 3.2 in this TM.

Section 2: Biosolids Treatment Processes

Biosolids process train alternatives were developed based on the disposition options for the final material. Disposition options define the desired or required products and treatment options that were developed to produce those products. The level of treatment that is needed to produce the class of biosolids that is required for each disposition alternative is achieved through the combination of pre-processing of raw sludge, digestion, and post-processing of digested sludge. The PMP outlines the treatment requirements and basic process train.

2.1 PMP Biosolids Treatment Criteria

Biosolids treatment requirements were developed in the planning phase of the project. Plant-wide alternatives described in Project Memorandum No. 2, *Biosolids Treatment Alternatives*, were developed based on the following screening criteria:

- Anaerobic digestion will be used and existing facilities will be part of the process.
- Lagoon storage of 180 days will be provided for all alternatives.
- Mechanical dewatering using centrifuges will be provided for all of the biosolids in each of the alternatives.
- Heat drying facilities will be provided for 20 percent of the solids.
- Greenhouse facilities will be provided for 10 percent of the solids.

- The balance of dewatered biosolids should be managed by a combination of landfill disposal, land application, and offsite composting.
- Individual contracts for offsite utilization or disposal should have capacity to handle additional material if any one contract should fail.

2.1.1 Sludge Thickening Technologies

Thickening options considered in the PMP include the following:

- primary sludge (PS) thickened in the primary clarifiers
- gravity belt thickeners
- DAFTs
- centrifuges
- gravity thickeners
- rotary drum thickeners
- membrane thickeners

The capacity of the existing DAFTs exceeded the projected 2040 needs for waste activated sludge (WAS) thickening and for co-thickening WAS and PS. Therefore, the DAFT process was recommended to be retained for WAS thickening and all biosolids treatment alternatives will assume co-thickening in the DAFTs. BC's analysis assumes that the DAFTs will produce thickened sludge at a solids concentration of 5.5 percent.

2.1.2 Digestion

The existing sludge stabilization process is single-stage mesophilic anaerobic digestion. Alternatives considered in the SWET model included both mesophilic and thermophilic anaerobic digestion. Thermophilic digestion provides benefits over mesophilic digestion including greater volatile solids reductions at lower hydraulic retention times, greater digester gas production and less digested sludge volume. Thermophilic digestion also potentially generates a Class A product. On the other hand, thermophilic digestion has a higher heat demand and is mechanically more complex than mesophilic digestion.

The digestion process recommended in the PMP is simply "anaerobic digestion". Alternatives 1, 1b, 1c, and 1e all assume mesophilic anaerobic digestion; Alternatives 2, 2b, and 2c assume a combination of digestion temperatures referred to as temperature-phased digestion or TPAD. Additional details on the feasibility of TPAD were developed this year as part of Service Order No. 4. Results were summarized in the Conceptual Design Report. The recommendation to design improvements using TPAD was accepted at a management review meeting held on June 4, 2014. The option to preserve flexibility for addition of Class A batch tanks was retained.

2.1.3 Dewatering

Dewatering technologies considered in the PMP include the following:

- belt filter press (BFP)
- centrifuge
- screw press
- rotary press
- plate and frame press

These technologies were screened based on proven performance, a reasonable number of units in service, and the ability to produce a product that is compatible with the disposition options. Applying these criteria resulted in a decision to use centrifuges as the basis for all biosolids treatment alternatives.

2.1.4 Drying

Drying technologies considered in the PMP include the following:

- air/solar drying – open systems
- air/solar drying – within structures
- heat drying – graded pellet product
- drying using waste heat
- combined centrifuge/drying

These technologies were screened based on footprint, reduction in open-air drying bed size, net energy requirements, and proven performance. The screening step eliminated only open air drying as a drying option. The other technologies, which essentially are categorized as either solar drying or thermal drying, remain of interest.

2.1.5 Combined Heat and Power

Energy and heat flows associated with biosolids processing are often interconnected with combined heat and power (CHP) facilities that use biogas from anaerobic digestion to produce mechanical or electric power and heat. Heat is primarily used to maintain elevated temperatures that are required for the anaerobic digestion process.

Currently, SJSCRWF uses a variety of CHP units spread about the plant campus including stationary engines driving aeration blowers, stationary engines driving electric generators, and a fuel cell. In addition to biogas from digestion, these devices have utilized significant quantities of landfill gas from Newby Island Landfill and natural gas purchased from Pacific Gas & Electric (PG&E). SJSCRWF plans to replace all currently functioning stationary engines with a new facility that employs stationary engines driving electric generators. The current assumption is that the new CHP facility will be sized to provide enough electric power generation capacity to meet all electric power demand at the facility. This philosophy involves purchase of supplemental natural gas from PG&E, with biogas providing a portion of the total fuel. This will avoid purchase of electricity from PG&E. All of the alternatives in this analysis utilize this assumption with regard to the participation of CHP in the energy and heat flows for biosolids processing.

For alternatives that include thermal drying, recoverable heat from CHP engines is used to offset natural gas. A separate evaluation is being conducted to determine how much recoverable heat is available for this purpose. Preliminary results indicate that approximately 25 percent of heat recoverable from CHP will be “high grade” (high temperature) and suitable for this purpose. However, the amount of heat available can only dry about 20 percent of the biosolids that will be generated.

2.2 Biosolids Treatment Alternatives

PMP biosolids treatment alternatives were developed based on the criteria discussed above; key assumptions were screened and narrowed to the following alternatives:

- *Base Condition* – Improve existing processes including co-thickening with DAFTs, mesophilic anaerobic digestion, rehabilitation of existing lagoons, and rehabilitation of existing air drying beds.
- *Mesophilic Digestion Alternatives* – Co-thickening PS and WAS with DAFTs, mesophilic anaerobic digestion, covered storage lagoons, mechanical dewatering, and drying.
- *Thermophilic Digestion Alternatives* – Co-thickening PS and WAS with DAFTs, TPAD, covered lagoons, mechanical dewatering, and drying,

PMP alternatives have been modified for the current evaluation to remove covered lagoons due to space constraints and issues raised in the Master Plan EIR.

2.2.1 Diversity of Biosolids Disposition Options

As stated previously, final disposition of biosolids is currently at the Newby Island Landfill. This is the only disposition route for biosolids produced by the City. The PMP recommended expanding the program to enhance the flexibility by creating multiple and diversified disposition options. Specifically, the recommendation was to develop three 50 percent disposition options to divert up to 30 percent of the biosolids within 30 days to another disposition route. Implementing this recommendation would provide the plant with three options for handling dewatered biosolids and each option could handle a minimum of 50 percent of the plant's biosolids.

For this evaluation, we assumed that dried (thermal or solar) biosolids would continue to go to Newby Island until 2025 and benefit from the lowest unit cost for disposition ($23/ton). Giving dried product the benefit of the doubt, it was assumed that after that time new markets would be developed and dried material would still be managed at this lower cost. Dewatered cake was assigned a higher disposition cost at $35 (for land application or landfill disposal) based on local area price surveys. Contract composting was assigned a unit cost of $51 per ton of biosolids.

Section 3: Solids Water Energy Tool (SWET) Analysis

The SWET model is a BC-developed Microsoft® Excel-based tool that tracks total solids, volatile solids, water, thermal and electricity demands and fuel, heat and electricity production through a solids process train. The tool is intended for use in comparing comprehensive solids processes and handling alternatives. The building blocks for each process train developed for this analysis fall into the following five categories:

- Feedstocks: WAS, PS, and FOG
- Thickening: DAFT
- Dewatering: centrifuge
- Stabilization/destruction: mesophilic or thermophilic digestion and solar and/or thermal drying
- Energy recovery: boiler, fuel cell and/or combined heat and power

Alternatives were compared to the PMP baseline (Alternative 1) to further evaluate methods of solids processing and handling in light of EIR restrictions (i.e. no covered lagoons without extensive permitting effort) for the project. The outputs of the model were linked to provide the capital and annual operational costs for each alternative. Outputs will be described further in Section 4 of this report.

3.1 Process Alternatives Assumptions

The foundation of any model is comprised of the assumptions and data used as a basis for the calculations. Alternative 1 (mesophilic digestion, co-thickening, dewatering, 20 percent heat drying, and 10 percent solar greenhouse drying) is the base case from the PMP. The 70 percent of dewatered biosolids that are not dried are landfilled, composted, or land applied in equal amounts with defined unit costs for disposition.

In this alternative, the plant would continue to utilize mesophilic anaerobic digestion for co-thickened WAS and PS. Co-thickening will be achieved for both of these sludge streams using the existing DAFTs, which have adequate capacity for the projected 2040 capacity requirements. The analysis assumes the DAFTs will produce thickened sludge at a solids concentration of 5.5 percent. The digester solids loading and corresponding digested biosolids yield was assumed at the mid-point load from the current year through 2030.

Dewatering of digested biosolids in this alternative, as well as all other alternatives under consideration, is based on the use of centrifuges. Centrifuge dewatering will be the basis for sizing facilities, layouts, cost estimating, and development of energy balances. Analyses assume the centrifuges produce dewatered cake

with a solids concentration of 25 percent. Several variations of Alternative 1 were considered as described below.

3.1.1 Alternative 1b – Mesophilic Digestion, Co-thickening, Dewatering, and 100 Percent Heat Drying

Alternative 1b utilizes mesophilic anaerobic digestion for co-thickened WAS and PS. The existing DAFTs would be used for co-thickening and centrifuges would be used for dewatering. In these respects, Alternative 1b is similar to Alternative 1.

The primary difference between Alternative 1b and the base alternative is the addition of thermal drying for 100 percent of the dewatered biosolids. The concept is of interest because it allows production of 100 percent Class A product and could be phased into the program in response to future regulatory changes. Thermal drying is a proven technology with numerous facilities operating in North America. It has a reputation for being costly due to the energy required to evaporate water from biosolids. On the other hand, it reduces volume and depending on the equipment used, can produce a marketable product.

The PMP recommended using recovered heat from cogeneration systems to minimize required energy and operating cost. The feasibility of doing this has not been examined. Nonetheless, SWET assumptions for this alternative include recovered heat offsetting natural gas. The economics of this alternative would be sensitive to potential increases in the cost of natural gas and the feasibility of waste heat recovery.

3.1.2 Alternative 1c – Mesophilic Digestion, Co-thickening, and Dewatering

Alternative 1c is the same as Alternative 1 except that it does not include solar drying or the thermal drying step; all Class B dewatered biosolids would be disposed of at an offsite location (landfill, compost facility, or land-application site). This alternative was intended to demonstrate potential cost savings by avoiding biosolids drying.

Alternative 1c represents a 100 percent Class B program that is similar to other existing programs in the Bay Area. However, it does not meet the implied PMP goal of providing a mix of Class A and B technologies and may have more limited flexibility in the event of future regulatory changes. The alternative could be modified if needed in the future to include some percentage of biosolids product to offsite composting or similar post processing to provide a Class A component.

3.1.3 Alternative 1e – Mesophilic Digestion with 100 Percent Offsite Composting

Alternative 1 e was intended to show the cost of 100 percent composting to produce a Class A product as an alternative to the base case. Like thermal drying, offsite composting could be developed at a later time if regulatory changes mandated this. Offsite composting has a higher unit cost for hauling and disposition because of the effort and expense to make the product.

3.1.4 Alternative 2 – TPAD, Co-thickening, Dewatering, 20 Percent Heat Drying, and 10 Percent Greenhouse Drying

This alternative is similar to Alternative 1 with the exception that TPAD would be used rather than mesophilic anaerobic digestion. The existing DAFTs would be used for co-thickening and centrifuges would be used for dewatering. The analysis assumes that the DAFTs will produce thickened sludge at a solids concentration of 5.5 percent and the centrifuges will produce dewatered cake with a solids concentration of 25 percent.

In this alternative, 20 percent of the dewatered biosolids would be sent to heat drying and 10 percent would be sent to a solar (greenhouse) dryer. The remainder of the dewatered biosolids are landfilled, composted, or land-applied. This alternative differs from the base case in that advantages of advanced digestion (greater volatile solids reductions at lower hydraulic retention times, greater digester gas production, and less

digested sludge volume) are captured. Disadvantages (higher heat demand and mechanical complexity) are also recognized in the evaluation by increasing O&M costs. Maintenance is approximately $100,000/yr higher, and dewatering polymer is approximately $200,000 higher. These costs are offset by the reduction in biosolids quantity for hauling and disposition.

This alternative has the potential to produce 100 percent Class A product if the design includes batch tanks (Alt. 2c).

3.1.5 Alternative 2b – TPAD, Co-thickening, and Dewatering

Alternative 2b is the same as Alternative 2 except that it does not have a drying step. Class B dewatered biosolids from the centrifuges would be utilized or disposed of at an offsite location (landfill, compost facility, or land-application site). Because TPAD has the potential to produce a Class A product, a sensitivity test that analyzes changes in hauling and disposition costs is warranted. The model assumes that unit costs for disposition (land application, landfill, off-site compost) will be the same as a Class B program. In reality, unit costs for disposition could be less in the event of future regulatory changes. By assuming that unit costs are the same as for Class B products, the evaluation is conservative.

3.1.6 Alternative 2c – TPAD with Batch Tanks, Co-thickening, Dewatering

In this alternative, batch tanks are added between the thermophilic and mesophilic phases to produce a Class A biosolids product. Disposition of the Class A product would be either via land application or as ADC. Development of a topsoil manufacturing operation like the City of Tacoma would also be possible with this process configuration. The alternative assumes that further processing as compost would not be appropriate because the product is already Class A, again, similar to Tacoma.

The addition of batch tanks to produce Class A biosolids is the key differentiator between Alternative 2b and this alternative. The objective in evaluating this alternative is to determine whether the additional cost of batch tanks can be offset by savings on hauling and disposition in the event future market conditions favor Class A. Unit costs for disposition are conservatively held at $35/ton, the same as Class B. Sensitivity testing for this assumption is discussed in Section 5.

3.2 Disposition of Biosolids

As noted previously, three disposition options will be developed to provide three separate routes for handling processed biosolids. Each option will have the capacity to accommodate at least 50 percent of the plant's biosolids production. The three disposition options identified by the PMP are as follows:

- offsite composting
- land application
- landfill

Information on disposition costs has been developed using survey information from other municipal agencies. This information is presented in TM 1, *Biosolids Hauling and Disposition Cost Projections*. Based on information in TM 1, unit costs used to calculate NPV are as follows:

- Contract hauling to land application - $35/wet ton
- Contract hauling to landfill - $36/wet ton
- Contract hauling to Class A composting (offsite) - $51/wet ton
- Contract hauling to ADC - $35/wet ton
- ADC at Newby Island (minimum 50 percent solids content, before 2025) - $23/wet ton

Disposition assumptions used to calculate the amount of biosolids going to each disposition route for each treatment alternative are presented in Table 1. For alternatives with PMP-based thermal (20 percent) and solar (10 percent) drying, the balance of dewatered biosolids goes to the other 3 outlets (land application, composting, landfill) in equal portions. Thermal and solar dried product was assumed to go to the landfill taking advantage of the currently low unit cost for that method of disposition.

Table 1. Assumed Disposition of Biosolids for Each Treatment Alternative

Alternative no.	Description of treatment process	Percentage of total biosolids production for each disposition method		
		Offsite composting[a]	Land application	Landfill[b]
1	Mesophilic + co-thickening + dewatering + 20% heat drying + 10% greenhouse	23	23	53
1b	Mesophilic +co-thickening + dewatering + 100% heat drying	0	0	100
1c	Mesophilic + co-thickening + Dewatering	33	33	33
1e	Mesophilic + co-thickening + dewatering + 100% compost	100	0	0
2	Alt 2 - TPAD + co-thickening + dewatering + 20% heat drying + 10% greenhouse	23	23	53
2b	Alt 2b - TPAD + co-thickening + dewatering	33	33	33
2c	Alt 2c – TPAD with batch tanks + Co-thickening + Dewatering	0	50	50

[a]*There is no composting for Alt. 2c because the biosolids are Class A and could be made into a blended topsoil product instead.*

[b]*For simplicity it has been assumed that solar or thermal dried product will be used as Landfill ADC similar to the current operation. A thermally-dried product is suitable for a wide variety of other uses including fertilizer and soil amendment but marketing for those uses may be more costly.*

Hauling and disposition of biosolids products influences annual operating costs. These costs are captured in SWET based on the relative quantities for materials in each alternative multiplied by the unit cost for each disposition method.

Section 4: Results of SWET Analysis and Discussion

The output from the SWET model for each alternative is discussed below.

4.1 Solids Quantities and Disposition Summary

A major difference between each alternative resides in the product quantity and disposition of the processed biosolids. For example, alternatives with thermal drying have a reduction in total (wet) tons per day because at least a portion of the biosolids are dried. Additional costs for drying are captured elsewhere in the model (i.e., auxiliary fuel). Dry quantities for solids within each alternative are similar with the exception that TPAD alternatives result in additional volatile solids reduction in the digestion process and corresponding reductions in biosolids product. Solids quantities in SWET are based on a constant production rate at the midpoint of the planning period (2024). The solids concentration, solids quantities, and annual hauling and disposition costs for each of the alternatives are summarized in Table 2.

Table 2. Biosolids Characteristics, Quantities and Disposition Cost Summary				
Alternative	Average product solids concentration, %	Wet tons per day	Dry tons per day	Annual disposition cost, $millions[a]
Current operation (2010)	80	113	90	0.9
Alt 1 - Mesophilic + co-thickening + dewatering + 20% heat drying + 10% greenhouse	31	281	89	3.6
Alt 1b - Mesophilic + co-thickening + dewatering + 100% heat drying	90	99	89	0.8
Alt 1c - Mesophilic + co-thickening + dewatering	25	358	89	5.3
Alt 1e- Mesophilic + co-thickening + dewatering + 100% compost	25	358	89	6.7
Alt 2 - TPAD + co-thickening + dewatering + 20% heat drying + 10% greenhouse	31	262	83	3.3
Alt 2b - TPAD + co-thickening + dewatering	25	333	83	4.9
Alt 2c – TPAD with batch tanks + Co-thickening + dewatering	25	333	83	4.2

[a]*Lower costs for alternatives that emphasize drying may be offset by other expenses such as auxiliary fuel.*

The total annual costs for hauling and disposal range from $0.9 million for current operation to $6.7 million. At the extremes are Alternatives 1b and 1e:

- Alternative 1b has the lowest annual hauling and disposition cost (outside of the current operation) because a thermally-dried product has less volume than a dewatered product, thereby requiring fewer trucks for transport. In addition, reuse of a thermal product has lower disposition costs ($23/ton) than other alternatives.
- Alternative 1e has the highest disposition cost because of the quantity of product (dewatered cake) and because the cost of contract composting has the highest per ton unit cost ($51) of all the disposition options.

Alternatives 1 and 2 are nearly equal in biosolids disposition cost. Disposition costs are an important variable in the economic evaluation described in Section 4.2 below which considers additional capital and operating costs.

4.2 Results of Economic Evaluation

An economic model was developed that considered a 30-year planning horizon to compare the biosolids treatment alternatives that are under consideration. In this case, the analysis used capital costs, annual operating costs, and revenues to project total cost over the lifetime of the project.

Following is a list of the economic assumptions used to develop annual operating costs that were common to all the alternatives:

- discount rate of 5 percent
- escalation rate of 3 percent
- electricity cost of $0.11 per kilowatt hour
- natural gas rate of $5.00 per million British thermal units (MMBtu);$7.00 per MMBtu is used in a sensitivity analysis
- polymer cost is $1.70 per pound of polymer; pounds of polymer varies with the alternative
- labor cost for one full time employee of $100,000 per year

The cost assumptions listed above have been applied to the results of the SWET model to generate estimates of the initial capital, annual operating, and NPV for each alternative. These costs are presented in Table 3.

Table 3. NPV Costs for Alternatives

Alternative no.	Description	Capital cost, $millions	Annual cost, $millions	30-year NPV, $millions
	Current operation	158	2.3	211
1	Mesophilic + co-thickening + dewatering + 20% heat drying + 10% greenhouse	404	10.6	641
1b	Mesophilic + co-thickening + dewatering + 100% heat drying	487	10.1	713
1c	Mesophilic + co-thickening + dewatering	363	11.1	612
1e	Mesophilic + co-thickening + dewatering + 100% compost	363	12.4	641
2	TPAD + co-thickening + dewatering + 20% heat drying + 10% greenhouse	412	10.6	650
2b	TPAD + co-thickening + dewatering	370	10.6	608
2c	TPAD with batch tanks + co-thickening + dewatering	383	10.3	614

On the basis of NPV, Alternatives 1c, 2b, and 2c are very similar. Capital cost for Alternative 2c is higher due to the batch tanks and the annual operating cost for this alternative is slightly lower as a result of lower disposition costs related to ADC, land application, and whether composting is included. Without a significant difference in NPV between these alternatives, the cost to produce a Class A product with TPAD can be considered comparable to the cost to produce Class B biosolids. Selection of Alternative 2c would mean the layout of the new biosolids treatment facilities would accommodate batch tanks, although installation of the tanks could occur at a future date when disposition opportunities for a Class A product have been developed. Conversely, selection of Alternative 2b would mean that biosolids treatment facilities would be designed without preserving space for the batch tanks.

Base Alternatives 1 and 2 are less competitive in terms of NPV. This suggests that further discussion of the plan recommended in the PMP is appropriate. Although manufacturing thermally-dried and solar-dried products onsite adds the diversity element that the PMP recommended, costs and space limitations should be discussed further. Alternatives 1c, 2b, and 2c offer an approach that preserves program diversity by using offsite disposition rather than on-site thermal or solar drying.

Section 5: Sensitivity Analysis

Sensitivity analyses were conducted to understand the range of likely outcomes with varied assumptions for the cost of natural gas and biosolids disposition. Results are presented in the subsections below

5.1 Cost of Natural Gas

The purchase of additional natural gas is required to run the cogeneration engines. As the price of natural gas can vary, the sensitivity of each alternative to a variation of $0.20 in the cost of natural gas was investigated. A comparison of the 30 year NPV at each gas price is outlined in Table 4.

Table 4. Sensitivity of Natural Gas Cost Changes: Analysis of 30-year NPV				
Alternative no	Description	Base case NPV w/ NG @ $0.50 per therm, $millions	Sensitivity test NPV w/NG @ $0.70 per therm, $millions	Difference, $millions
1	Mesophilic + co-thickening + dewatering + 20% heat drying + 10% greenhouse	641	671	30
1b	Mesophilic + co-thickening + dewatering + 100% heat drying	713	749	36
1c	Mesophilic + co-thickening + dewatering	612	642	30
1e	Mesophilic + co-thickening + dewatering + 100% compost	641	671	30
2	TPAD + co-thickening + dewatering + 20% heat drying + 10% greenhouse	650	679	29
2b	TPAD + co-thickening + dewatering	608	634	26
2c	TPAD with batch tanks + co-thickening + dewatering	614	640	26

Increasing the cost of natural gas resulted in modest increases of the overall NPV for each alternative. Alternative 1b saw the greatest change due to requirements for gas to run thermal drying. The difference in NPV for most of the alternatives is in the range of $26 to $36 million over the project life. When comparing these values to the total project NPVs, which are generally on the order of $650 million, the effect of natural gas cost increases results to a modest but significant level. The results show that thermal drying (1b) is the most sensitive process for this variable.

5.2 Cost of Class A Hauling and Disposition

Class A biosolids products have a higher product quality than Class B products and therefore can be used with fewer restrictions, potentially resulting in lower cost of disposition. There may also be reduced hauling distances required for Class A biosolids products, which would also reduce hauling and disposition costs.

Base case evaluations utilize the same hauling and disposition cost regardless of the Class of biosolids that are produced. The sensitivity of those alternatives that include hauling and disposition of Class A biosolids was evaluated by changing the unit disposition cost.

Hauling and disposition costs for Class A biosolids were reduced by $2.00 per wet ton, $5.00 per wet ton, and $10.00 per wet ton and NPVs were calculated in each instance to assess sensitivity. These assumptions originally affected several alternatives including those with thermal and solar drying. However, those products were already discounted to the unit cost of $23/ton based on review comments as model was developed. So the sensitivity test now only affects Alternative 2c. The results of this analysis are provided in Table 5.

Table 5. Sensitivity of Class A Hauling and Disposition Cost Changes: Analysis of 30-year NPV					
Alternative no.	Description	Base case evaluation, $millions	$2 per WT reduction, $millions	$5 per WT reduction, $millions	$10 per WT reduction, $millions
1	Mesophilic + co-thickening + dewatering + 20% heat drying + 10% greenhouse	641	641	641	641
1b	Mesophilic + co-thickening + dewatering + 100% heat drying	713	713	713	713
1c	Mesophilic + co-thickening + dewatering	612	612	612	612
1e	Mesophilic + co-thickening + dewatering + 100% compost	641	641	641	641
2	TPAD + co-thickening + dewatering + 20% heat drying + 10% greenhouse	650	650	650	650
2b	TPAD + co-thickening + dewatering	608	608	608	608
2c	TPAD with batch tanks + co-thickening + dewatering	614	608	600	586

As presented, the key conclusion that can be drawn from this analysis is the difference in NPV between Alternatives 2b and 2c. In the base case evaluation, these two alternatives have essentially the same 30-year NPV. However, as the disposition cost for Class A biosolids is reduced from the disposition cost of Class B biosolids, the NPV between Alternatives 2b and 2c becomes more pronounced with Alternative 2c as the more strongly favored alternative. These results indicate that TPAD with batch tanks provides a buffer against possible regulatory changes favoring Class A biosolids products. Alternatives 1c, 1e, and 2b do not change with this variable because these alternatives produce a 100 percent Class B biosolids product. Alternatives 1 and 2 were assigned a uniformly low unit cost ($23/WT) for the portion of dried solids produced which was held constant. It is possible that dried product can be marketed successfully in the future to produce a lower net unit cost, but there is currently no precedent for this in the Bay Area. When results were reviewed at Workshop 2 in June 2014, the decision was made to conduct further evaluations of selected alternatives using a business case evaluation (BCE) format to incorporate phasing and implementation considerations.

Section 6: Summary and Conclusions

The SWET model allowed evaluation of several variables for the biosolids transition that were not considered in depth previously. The model results provided information that can be developed further in the BCE effort for selected alternatives and future preliminary design. Conclusions from the SWET evaluation included the following:

- There is a significant increase in operations costs as the transition is implemented due to the volume of dewatered biosolids that will be hauled offsite.
- Operating costs for the future biosolids program will be closely linked with the different markets considered (land application, contract composting, landfill, and dried product).
- Several of the alternatives considered in SWET are very close in projected life-cycle cost suggesting that non-cost considerations should be a factor in the decision-making process.
- Diversity of biosolids markets as recommended by the PMP can be achieved by including multiple contracts for offsite utilization/disposal as well as by providing a mix of process technologies (partial solar drying, partial thermal drying, and Class A batch tanks).

- Alternative 2c (TPAD with batch tanks) is in the group of alternatives with the lowest life-cycle cost. The decision to construct batch tanks can be postponed to save on the initial capital investment (Approximately $12 million). This alternative is preferred based on workshops conducted under Service Order 4 (Digester Improvements Conceptual Design) due to operations considerations and preserving the potential for future Class A digestion.
- Further evaluation of issues affecting biosolids transition implementation will be addressed in a BCE format that can consider phasing and procurement of facility elements (dewatering, truck load out, nutrient removal, thermal drying, and solar drying). Some elements may be more attractive from a cost standpoint if constructed a later stage of the planning period.
- Thermal drying cost effectiveness is closely linked with the ability to utilize waste heat from the planned CHP facility. A siting evaluation (in progress) will help establish the feasibility of waste heat recovery.
- The siting evaluation will also identify space limitations for solar drying. The January 2013 Environmental Impact Report (EIR) that reviewed the PMP revealed changed assumptions that could affect project elements with large footprints.

Attachment A: SWET Model Output

Alternative	*NP Cost*	*Capital Cost Deviation from Alt. 1*	*NP Cost Deviation from Alt. 1*	*Annual Cost*
Current Operation	$211 M	-$246 M	-$431 M	$2 M
Alt 1 - Mesophilic + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	$641 M	$ M	$ M	$11 M
Alt 1b - Mesophilic + Co-Thickening + Dewatering + 100% Heat Drying	$726 M	$83 M	$85 M	$11 M
Alt 1c - Mesophilic + Co-Thickening + Dewatering	$612 M	-$41 M	-$29 M	$11 M
Alt 1e - Meso + Co-Thickening + Dewatering + 100% compost	$641 M	-$41 M	-$1 M	$12 M
Alt 2 - TPAD + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	$649 M	$8 M	$8 M	$11 M
Alt 2b - TPAD + Co-Thickening + Dewatering	$608 M	-$34 M	-$33 M	$11 M
Alt 2c - TPAD w/batch tanks + Co-Thickening + Dewatering	$615 M	-$20 M	-$26 M	$10 M

Alternative	*Average Product Solids Concentration*	*WTPD*	*DTPD*	*Annual Hauling & Disposal Cost*
Current Operation	80%	113	90	$.9 M
Alt 1 - Mesophilic + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	32%	281	89	$3.6 M
Alt 1b - Mesophilic + Co-Thickening + Dewatering + 100% Heat Drying	92%	97	89	$.8 M
Alt 1c - Mesophilic + Co-Thickening + Dewatering	25%	358	89	$5.3 M
Alt 1e - Meso + Co-Thickening + Dewatering + 100% compost	25%	358	89	$6.7 M
Alt 2 - TPAD + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	32%	261	83	$3.3 M
Alt 2b - TPAD + Co-Thickening + Dewatering	25%	333	83	$4.9 M
Alt 2c - TPAD w/batch tanks + Co-Thickening + Dewatering	25%	333	83	$4.2 M

Alternative	*%Solids Thermal Dryer*	*%Solids Solar Dryer*	*%Solids Cake*	*WTPD Thermal Dryer*	*WTPD Solar Dryer*	*WTPD Cake*
Current Operation	n/a	n/a	80%	0	0	113
Alt 1 - Mesophilic + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	90%	80%	25%	19	11	281
Alt 1b - Mesophilic + Co-Thickening + Dewatering + 100% Heat Drying	90%	n/a	n/a	97	0	97
Alt 1c - Mesophilic + Co-Thickening + Dewatering	n/a	n/a	25%	0	0	358
Alt 1e - Meso + Co-Thickening + Dewatering + 100% compost	n/a	n/a	25%	0	0	358
Alt 2 - TPAD + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	90%	80%	25%	18	10	261
Alt 2b - TPAD + Co-Thickening + Dewatering	n/a	n/a	25%	0	0	333
Alt 2c - TPAD w/batch tanks + Co-Thickening + Dewatering	n/a	n/a	25%	0	0	342

Present Worth Comparison of Current and Potential Options

Cost Element	notes	Current Operation	Alt 1 - Mesophilic + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	Alt 1b - Mesophilic + Co-Thickening + Dewatering + 100% Heat Drying	Alt 1c - Mesophilic + Co-Thickening + Dewatering	Alt 1e - Meso + Co-Thickening + Dewatering + 100% compost	Alt 2 - TPAD + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	Alt 2b - TPAD + Co-Thickening + Dewatering	Alt 2c - TPAD w/batch tanks + Co-Thickening + Dewatering	Alt 2d - TPAD + Co-Thickening + Dewatering + Mixed Product	
Construction Costs											
Near Term Construction Elements											
Base Construction Cost		$158,297,500	$403,972,000	$486,910,000	$362,514,500	$362,514,500	$411,897,947	$370,440,447	$383,878,863	$462,020,697	
Total Present Worth of Capital:		**$158,297,500**	**$403,972,000**	**$486,910,000**	**$362,514,500**	**$362,514,500**	**$411,897,947**	**$370,440,447**	**$383,878,863**	**$462,020,697**	
O&M Costs											
Daily Solids Production and Disposition Cost Assumptions											
Solids to Thickening/DAFT (DTPD)		65	170	170	170	170	170	170	170	170	
Final Biosolids Production (WTPD)		113	281	97	358	358	261	333	333	167	
Final Biosolids Production (DTPD)		90	89	89	89	89	83	83	83	83	
% to Newby Island		100%	0%	0%	0%	0%	0%	0%	0%	100%	
% Class B Cake to Land App		0%	23%	0%	33%	0%	23%	33%	0%	0%	
% Class B Cake to Landfill		0%	23%	0%	33%	0%	23%	33%	0%	0%	
% Class B Cake to Compost		0%	23%	0%	33%	100%	23%	33%	0%	0%	
% Class A Cake as Land App		0%	0%	0%	0%	0%	0%	0%	50%	0%	
% Class A Cake to ADC		0%	0%	0%	0%	0%	0%	0%	50%	0%	
% Solar Dried Class A to ADC		0%	10%	0%	0%	0%	10%	0%	0%	0%	
% Thermal Dried Class A to ADC		0%	20%	100%	0%	0%	20%	0%	0%	0%	
Mass to Newby Island		113	0	0	0	0	0	0	0	83	
Mass Class B Cake to Land App		0	65	0	118	0	60	110	0	0	
Mass Class B Cake to Landfill		0	65	0	118	0	60	110	0	0	
Mass Class B Cake to Compost		0	65	0	118	358	60	110	0	0	
Mass Class A Cake as Topsoil		0	0	0	0	0	0	0	166	0	
Mass Class A Cake to Land App		0	0	0	0	0	0	0	166	0	
Mass Solar Dried to ADC		0	28	0	0	0	26	0	0	0	
Mass Thermal Dried		0	56	97	0	0	52	0	0	0	Unit Cost / WT
Cost to Newby Island		$2,591	$0	$0	$0	$0	$0	$0	$0	$1,909	$ 23
Cost Class B Cake to Land App		$0	$2,291	$0	$4,130	$0	$2,111	$3,842	$0	$0	$ 35
Cost Class B Cake to Landfill		$0	$2,357	$0	$4,248	$0	$2,171	$3,952	$0	$0	$ 36
Cost Class B Cake to Compost		$0	$3,339	$0	$6,018	$18,236	$3,076	$5,598	$0	$0	$ 51
Cost Class A Cake to Land App		$0	$0	$0	$0	$0	$0	$0	$5,821	$0	$ 35
Cost Class A Cake to ADC		$0	$0	$0	$0	$0	$0	$0	$5,821	$0	$ 35
Cost Solar Dried Class A as ADC		$0	$645	$0	$0	$0	$601	$0	$0	$0	$ 23
Cost Thermal Dried Class A as ADC		$0	$1,291	$2,235	$0	$0	$1,201	$0	$0	$0	$ 23
Annual Biosolids Disposition Costs:		$945,577	$3,621,720	$815,694	$5,254,375	$6,656,063	$3,343,653	$4,887,996	$4,249,375	$696,817	
Electricity kWh											
Engine Uptime, hr/yr	*l*	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	
Solids Handling Power, kW		1,368	2,929	3,739	2,217	2,081	3,027	2,190	2,321	3,649	
CHP Renewable Power Generation, kW	*h*	(4,940)	(13,597)	(13,597)	(13,597)	(13,597)	(13,602)	(13,596)	(13,596)	(13,602)	
Fuel Cell Renewable Power Generation, kW	*j*	(1,366)	(1,403)	(1,403)	(1,403)	(1,403)	(1,398)	(1,398)	(1,398)	(1,398)	
Fuel Cell Uptime, hr/yr	*j*	7,446	7,446	7,446	7,446	7,446	7,446	7,446	7,446	7,446	0.85
Net Power, kW		(4,938)	(12,071)	(11,261)	(12,783)	(12,919)	(11,973)	(12,805)	(12,674)	(11,351)	
Cost of Solids Handling Power at Average Rate	*b*	$1,294,706	$2,771,087	$3,537,191	$2,097,408	$1,968,800	$2,864,057	$2,072,020	$2,195,884	$3,452,204	
Cost CHP Revenue		($4,673,574)	($12,863,427)	($12,863,427)	($12,863,410)	($12,863,410)	($12,868,148)	($12,863,373)	($12,863,373)	($12,868,148)	
Cost to purchase Fuel Cell Power	*i*	$1,232,115	$1,265,503	$1,265,503	$1,265,503	$1,265,503	$1,261,003	$1,261,003	$1,261,003	$1,261,003	0.1211
Total Annual Power Cost:	*b*	($2,146,752)	($8,826,837)	($8,060,733)	($9,500,498)	($9,629,106)	($8,743,087)	($9,530,349)	($9,406,486)	($8,154,941)	
Natural Gas											
Required Natural Gas, MMBtu/hr		0.0	68.8	95.4	68.8	68.8	67.0	60.2	60.2	70.4	
Required Natural Gas	*c,k*	$0	$3,339,675	$4,631,284	$3,339,668	$3,339,668	$3,251,139	$2,919,977	$2,919,977	$3,415,232	1.108
Thickening Polymer	*d*	$0	$2,638,027	$2,638,027	$2,638,027	$2,638,027	$2,638,027	$2,638,027	$2,638,027	$2,638,027	$ 12.75
Dewatering Polymer	*d*	$0	$970,676	$970,676	$970,676	$970,676	$1,173,890	$1,173,890	$1,173,890	$1,171,713	$ 29.75
Operations and Maintenance											
Total Maintenance Cost	*f*	$1,582,975	$4,039,720	$4,869,100	$3,625,145	$3,625,145	$4,118,979	$3,704,404	$3,838,789	$4,620,207	$3,608,703
Labor	*m*	$500,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,100,000	$1,100,000	from 2010 BCE
Fuel Cell, O&M	*g*	$119,698	$122,942	$122,942	$122,942	$122,942	$122,505	$122,505	$122,505	$122,505	0.01
Maintenance Digester Gas Treatment and CHP	*e*	$1,341,489	$3,692,280	$3,692,280	$3,692,275	$3,692,275	$3,693,635	$3,692,264	$3,692,264	$3,693,635	

Total Annual Cost:		**$2,342,987**	**$10,598,203**	**$10,679,269**	**$11,142,609**	**$12,415,690**	**$10,598,741**	**$10,608,714**	**$10,328,341**	**$9,303,195**	
Predicted Annual Increase from Base:		**N/A**	**$8,255,216**	**$8,336,283**	**$8,799,622**	**$10,072,703**	**$8,255,754**	**$8,265,727**	**$7,985,355**	**$6,960,209**	
Present Worth of Annual Costs:	*a*	**$52,474,597**	**$237,362,185**	**$239,177,778**	**$249,554,946**	**$278,067,439**	**$237,374,230**	**$237,597,588**	**$231,318,235**	**$208,358,599**	
Predicted 30-year Present Worth Increase from Base:	*a*	**$0**	**$184,887,588**	**$186,703,181**	**$197,080,349**	**$225,592,842**	**$184,899,633**	**$185,122,991**	**$178,843,639**	**$155,884,002**	
Present Worth Summary											
Total Present Cost:	*a*	**$210,772,097**	**$641,334,185**	**$726,087,778**	**$612,069,446**	**$640,581,939**	**$649,272,177**	**$608,038,035**	**$615,197,098**	**$670,379,296**	

Note Legend:

a Present worth uses a 5.0% nominal discount rate and a 3.0% escalation rate over a 30-year life; Future CIP is assumed to spent 20 years out — 0.05

b Average Cost of Power in 2013 was 10.8¢/kWh

c Price of natural gas is assumed to be $5.00/MMBtu — $5.00

d Current polymer cost is $1.70 per lb;$ per dry tons of digested sludge depends on alternative. — $42.50

e Assumed CHP and gas treatment maintenance of $0.031/kWh — $0.031

f Maintenance cost is 1 percent per year of capital cost

g $0.01 per kWh O&M cost

h Additional 0.6 MW produced by fuel cell (hot water) at no additional cost to City. Use to offset solids handling power.

i City buys back fuel cell power at 12.11 cents / kWh (2013)

Capital Outlays	Current Operation	Alt 1 - Mesophilic + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	Alt 1b- Mesophilic + Co-Thickening + Dewatering + 100% Heat Drying	Alt 1c, 1e - Mesophilic + Co-Thickening + Dewatering	Alt 2 - TPAD + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse	Alt 2b- TPAD + Co-Thickening + Dewatering	Alt 2c- TPAD w/ Batch Tanks + Co-Thickening + Dewatering
PS-01 Digesters 5-8 & Thickener Upgrades	$ 75,420,000	$ 75,420,000	$ 75,420,000	$ 75,420,000	$ 75,420,000	$ 75,420,000	$ 75,420,000
PS-02 Additional Digester Upgrades	$ 50,230,000	$ 50,230,000	$ 50,230,000	$ 50,230,000	$ 50,230,000	$ 50,230,000	$ 50,230,000
PS-03 Digested Sludge Dewatering	$ -	$ 64,320,000	$ 64,320,000	$ 64,320,000	$ 64,320,000	$ 64,320,000	$ 64,320,000
PS-05 Thermal Drying Facility		$ 27,000,000	$ 108,170,000		$ 27,000,000		
PS-06 Greenhouse Drying	$ -	$ 9,050,000			$ 9,050,000		
PS-07 Lagoons & Drying Bed Retirement	$ -	$ 26,860,000	$ 26,860,000	$ 26,860,000	$ 26,860,000	$ 26,860,000	$ 26,860,000
TPAD					$6,892,128	$6,892,128	$ 6,892,128
Batch Tanks							$ 11,685,579
Site Power	$ -	$ 15,000,000	$ 15,000,000	$ 15,000,000	$ 15,000,000	$ 15,000,000	$ 15,000,000
Civil/Site Improvements	$ -	$ 15,000,000	$ 15,000,000	$ 15,000,000	$ 15,000,000	$ 15,000,000	$ 15,000,000
Miscellaneous Improvements (15%)	$ 20,647,500	$ 52,692,000	$ 63,510,000	$ 47,284,500	$ 53,725,819	$ 48,318,319	$ 50,071,156
CHP Upgrades	$ 12,000,000	$ 68,400,000	$ 68,400,000	$ 68,400,000	$ 68,400,000	$ 68,400,000	$ 68,400,000
Total capital outlays	$ 158,297,500	$ 403,972,000	$ 486,910,000	$ 362,514,500	$ 411,897,947	$ 370,440,447	$ 383,878,863

Current Operation

	WAS		DAFT		Primary Sludge		Digester (Meso)		Fuel Cell		CHP Engine		Boiler		Lagoon		Drying Beds		Dirt	
Mass Flow	8,710	TPD			2,655	TPD													18	WTPD
TS	0.7484%				4.0%														80.0%	
VS	74%				83%														20%	
Calorific Value	10,000	Btu/lb			10,000	Btu/lb													0	Btu/lb
			88%	Capture													80.0%	TS		
			4%	TS																
							VSR	52.6%							VSR	30.0%				
									Therm Eff.	25%	Therm Eff.	33%	Therm Eff.	80%						
	Feedstock Type				Feedstock Type				Nat gas usage, cfh		Nat gas usage, cfh		Nat gas usage, cfh						Feedstock Type	
	Sludge				Sludge				0		0		0						Sludge	
									Fuel Use	19%	Fuel Use	81%	Fuel Use	0%						
Fuel Cell Power Generation	1,366	kW																		
CHP Power Generation	4,940	kW																		
Final TS, Wet	113	WT/D																		
Electricity Req.	1,368	kW							Engine Electrical Eff.		Engine Electrical Eff.									
Aux. Fuel Input	0.0	MMBtu/hr					Sludge Inlet Temp		46%		38%				Sludge Inlet Temp		Inlet Temperature			
Power Generation	6,306	kW					68.0	F	Heat Recovery		Heat Recovery		Heat Recovery		95	F	68	F		
Net Power	4,938	kW					Operation Temp		2.00	MMBtu/hr	14.64	MMBtu/hr	0.00	MMBtu/hr	Operation Temp		Discharge Temperature			
							98	F							95	F	68	F		
							600	Btu/cf							0	Btu/cf				
							16	cf/lb VS							16	cf/lb VS	0	Btu/lb		
							10.22	MMBtu/hr							0.00	MMBtu/hr				
	Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption	
	0	hp	590	hp	0	hp	1,100	hp	40	hp	30	hp	1	hp	0	hp	0	hp	0	hp
	90%	Efficiency	90%	Efficiency	90%	Efficiency	100%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency	100%	Efficiency	90%	Efficiency	90%	Efficiency
							Shell Heat Loss													
							15%													

	WAS		DAFT		Primary Sludge		Digester (Meso)		Fuel Cell		CHP Engine		Boiler		Lagoon		Drying Beds		Dirt	
Mass Flow	725,833	lb/hr	119,507	lb/hr	340,757	lb/hr	335,081	lb/hr	335,081	lb/hr	335,081	lb/hr	335,081	lb/hr	333,546	lb/hr	7,886	lb/hr	9,386	lb/hr
TS	5,432	lb/hr	4,780	lb/hr	13,520	lb/hr	7,844	lb/hr	7,844	lb/hr	7,844	lb/hr	7,844	lb/hr	6,309	lb/hr	6,309	lb/hr	7,509	lb/hr
	65.2	DTPD	57	DTPD	162	DTPD	94	DTPD	94	DTPD	94	DTPD	94	DTPD	76	DTPD	76	DTPD	90	DTPD
VS	4,020	lb/hr	3,537	lb/hr	10,791	lb/hr	5,115	lb/hr	5,115	lb/hr	5,115	lb/hr	5,115	lb/hr	3,580	lb/hr	3,580	lb/hr	3,820	lb/hr
Water	720,401	lb/hr	114,727	lb/hr	327,237	lb/hr	327,237	lb/hr	327,237	lb/hr	327,237	lb/hr	327,237	lb/hr	327,237	lb/hr	1,577	lb/hr	1,877	lb/hr
TS	1%		4%		4.0%		2.3%		2.3%		2.3%		2%		2%		80.0%		80.0%	
VS	74%		74%		79.8%		65%		65.2%		65.2%		65%		57%		56.8%		50.9%	
Water	1,443.1	gpm	229.8	gpm	655.5	gpm	655.5	gpm	655.5	gpm	655.5	gpm	655.5	gpm	655.5	gpm	3.2	gpm	3.8	gpm
Calorific Value	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS
Electrical Demand	0	kW	489.0	kW	0.0	kW	820.6	kW	33.2	kW	24.9	kW	0.8	kW	0.0	kW	0.0	kW	0.0	kW
Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-11.76	MMBtu/hr	2.00	MMBtu/hr	14.64	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-11.76	MMBtu/hr	-9.76	MMBtu/hr	4.88	MMBtu/hr	4.88	MMBtu/hr	4.88	MMBtu/hr	4.88	MMBtu/hr	4.88	MMBtu/hr
Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	54.49	MMBtu/hr	-10.14	MMBtu/hr	-44.36	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	54.49	MMBtu/hr	44.36	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Generated Steam	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr
Power Generation	0	MW	0.00	MW	0.00	MW	0.00	MW	1.37	MW	4.94	MW	0.00	MW	0.00	MW	0.00	MW	0.00	MW

Alt 1 - Mesophilic + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse

	WAS	Primary Sludge	DAFT	Digester (Meso)	Fuel Cell	CHP Engine	Boiler	Centrifuge	20% Thermal	10% Solar	70% Landfill, Land App, and Compost	Thermal Drying	Solar Dryer
Mass Flow	8,710 TPD	2,655 TPD							72 TPD	36 TPD			
TS	1%	4.0%							90.0%	65.0%			
VS	74%	83%							64%	64%			
Calorific Value	10,000 Btu/lb	10,000 Btu/lb							10,000 Btu/lb	10,000 Btu/lb			
			95% Capture					97% Capture					
			5.5% TS					25% TS				92.0% TS	80.0% TS
				VSR 54.0%							VSR 0.0%		VSR 5.0%
					Therm Eff. 25%	Therm Eff. 33%	Therm Eff. 80%						
	Feedstock Type Sludge	Feedstock Type Sludge							Feedstock Type Sludge	Feedstock Type Sludge			
					Nat gas usage, cfh 0	Nat gas usage, cfh 74,800	Nat gas usage, cfh 0						
					Fuel Use 20%	Fuel Use 80%	Fuel Use 0%						
						Total Fuel Demand 110.5 Mmbtu/hr							
						Nat gas fuel demand 68.8 Mmbtu/hr							
Fuel Cell Power Generation	1403 kW												
CHP Power Generation	13597 kW												
Final TS, Wet	281 WT/D												
Electricity Req.	2,929 kW												
Aux. Fuel Input	68.8 MMBtu/hr				Engine Electrical Eff. 46%	Engine Electrical Eff. 42%							
Power Generation	15,000 kW												
Net Power	12,071 kW												
Final TS, Dry	89 WT/D												
Final TS %	32% WT/D												
				Sludge Inlet Temp 68.0 F							Sludge Inlet Temp 98 F	Inlet / Out Temp. 80 F	Inlet Temperature 80 F
				Operation Temp 98 F	Heat Recovery 2.00 MMBtu/hr	Heat Recovery 36.45 MMBtu/hr	Heat Recovery 0.00 MMBtu/hr				Operation Temp 98 F		Discharge Temperature 220 F
				600 Btu/cf							0 Btu/cf	220 F	
				16 cf/lb VS							0 cf/lb VS		1,120 Btu/lb
				7.34 MMBtu/hr							0.00 MMBtu/hr	1,600 Btu/lb 6.94 MMBtu/hr	
	Energy Consumption 0 hp 90% Efficiency	Energy Consumption 0 hp 90% Efficiency	Energy Consumption 1,055 hp 90% Efficiency	Energy Consumption 1,100 hp 100% Efficiency	Energy Consumption 40 hp 90% Efficiency	Energy Consumption 200 hp 90% Efficiency	Energy Consumption 1 hp 90% Efficiency	Energy Consumption 225 hp 90% Efficiency	Energy Consumption 0 hp 90% Efficiency	Energy Consumption 0 hp 90% Efficiency	Energy Consumption 0 hp 100% Efficiency	Energy Consumption 500 hp 90% Efficiency	Energy Consumption 510 hp 90% Efficiency
				Shell Heat Loss 15%								Heat Loss 5%	

	WAS	Primary Sludge	DAFT	Digester (Meso)	Fuel Cell	CHP Engine	Boiler	Centrifuge	20% Thermal	10% Solar	70% Landfill, Land App, and Compost	Thermal Drying	Solar Dryer
Mass Flow	725,833 lb/hr	947,083 lb/hr	244,781 lb/hr	238,997 lb/hr	238,997 lb/hr	238,997 lb/hr	238,997 lb/hr	29,797 lb/hr	23,838 lb/hr	20,858 lb/hr	20,858 lb/hr	IN 5,959 / 1,619 lb/hr	IN 2,980 / 903 lb/hr
TS	5,432 lb/hr	14,172 lb/hr	13,463 lb/hr	7,680 lb/hr	7,680 lb/hr	7,680 lb/hr	7,680 lb/hr	7,449 lb/hr	5,959 lb/hr	5,214 lb/hr	5,214 lb/hr	1,490 / 1,490 lb/hr	745 / 722 lb/hr
	65 DTPD	170 DTPD	162 DTPD	92 DTPD	92 DTPD	92 DTPD	92 DTPD	89 DTPD	72 DTPD	63 DTPD	63 DTPD	18 / 18 DTPD	9 / 9 DTPD
VS	4,020 lb/hr	11,273 lb/hr	10,710 lb/hr	4,927 lb/hr	4,927 lb/hr	4,927 lb/hr	4,927 lb/hr	4,779 lb/hr	3,823 lb/hr	3,345 lb/hr	3,345 lb/hr	956 / 956 lb/hr	454 / 431 lb/hr
Water	720,401 lb/hr	932,912 lb/hr	231,318 lb/hr	231,318 lb/hr	231,318 lb/hr	231,318 lb/hr	231,318 lb/hr	22,348 lb/hr	17,878 lb/hr	15,643 lb/hr	15,643 lb/hr	4,470 / 130 lb/hr	2,235 / 181 lb/hr
TS	1%	1%	6%	3%	3%	3%	3%	25%	25%	25%	25%	25%	25%
VS	74%	80%	80%	64%	64%	64%	64%	64%	62%	62%	64%	64%	61%
Water	1,443.1 gpm	1,868.8 gpm	463.4 gpm	463.4 gpm	463.4 gpm	463.4 gpm	463.4 gpm	44.8 gpm	35.8 gpm	31.3 gpm	31.3 gpm	9.0 gpm	4.5 gpm
Calorific Value	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS	10,000 Btu/lb VS
Electrical Demand	0 kW	0.0 kW	874.1 kW	820.6 kW	33.2 kW	165.8 kW	0.8 kW	186.5 kW	0.0 kW	0.0 kW	0.0 kW	414.4 kW	422.7 kW
Heat	0 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	-8.44 MMBtu/hr	2.00 MMBtu/hr	36.45 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	-7.29 MMBtu/hr	0.00 MMBtu/hr
Total Heat	0 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	-8.44 MMBtu/hr	-6.44 MMBtu/hr	9.84 MMBtu/hr	9.84 MMBtu/hr	9.84 MMBtu/hr	9.84 MMBtu/hr	9.84 MMBtu/hr	9.84 MMBtu/hr	2.55 MMBtu/hr	2.55 MMBtu/hr
Aux. Fuel Added	0 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	68.82 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr
Total Aux. Fuel Added	0 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	68.82 MMBtu/hr	68.82 MMBtu/hr	68.82 MMBtu/hr	68.82 MMBtu/hr	68.82 MMBtu/hr	68.82 MMBtu/hr	68.82 MMBtu/hr	68.82 MMBtu/hr
Produced Fuel	0 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	52.05 MMBtu/hr	-10.41 MMBtu/hr	-41.64 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr
Total Produced Fuel	0 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	52.05 MMBtu/hr	41.64 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr	0.00 MMBtu/hr
Generated Steam	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr	0 lb/hr
Power Generation	0 MW	0.00 MW	0.00 MW	0.00 MW	1.40 MW	13.60 MW	0.00 MW	0.00 MW	0.00 MW	0.00 MW	0.00 MW	0.00 MW	0.00 MW

Alt 1b - Mesophilic + Co-Thickening + Dewatering + 100% Heat Drying

	WAS		Primary Sludge		DAFT		Digester (Meso)		Fuel Cell		CHP Engine		Boiler		Centrifuge		Thermal Drying	
Mass Flow	8,710	TPD	2,655	TPD														
TS	1%		4.0%															
VS	74%		83%															
Calorific Value	10,000	Btu/lb	10,000	Btu/lb														
					95%	Capture									97%	Capture		
					5.5%	TS									25%	TS	92.0%	TS
							VSR	54.0%										
									Therm Eff.	25%	Therm Eff.	33%	Therm Eff.	85%				
	Feedstock Type		Feedstock Type						Nat gas usage, cfh		Nat gas usage, cfh		Nat gas usage, cfh					
	Sludge		Sludge						0		74,800		0					
									Fuel Use	20%	Fuel Use	80%	Fuel Use	0%				
											Total Fuel Demand							
el Cell Power Generation	1403	kW									110.5	MMbtu/hr						
CHP Power Generation	13597	kW									Nat gas demand							
Final TS, Wet	97	WT/D									68.8	MMbtu/hr						
Electricity Req.	3,739	kW							Engine Electrical Eff.		Engine Electrical Eff.							
Aux. Fuel Input	95.4	MMBtu/hr					Sludge Inlet Temp		46%		42%						Inlet / Out Temp.	
Power Generation	15,000	kW					68.0	F	Heat Recovery		Heat Recovery		Heat Recovery				80	F
Net Power	11,261	kW					Operation Temp		2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr				
							98	F									220	F
							600	Btu/cf										
							16	cf/lb VS									1,600	Btu/lb
							7.34	MMBtu/hr									34.72	MMBtu/hr
	Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption	
	0	hp	0	hp	1,055	hp	1,100	hp	40	hp	200	hp	1	hp	225	hp	2,000	hp
	90%	Efficiency	90%	Efficiency	90%	Efficiency	100%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency
							Shell Heat Loss										Heat Loss	
							15%										5%	
Mass Flow	725,833	lb/hr	947,083	lb/hr	244,781	lb/hr	238,997	lb/hr	238,997	lb/hr	238,997	lb/hr	238,997	lb/hr	29,797	lb/hr	8,097	lb/hr
TS	5,432	lb/hr	14,172	lb/hr	13,463	lb/hr	7,680	lb/hr	7,680	lb/hr	7,680	lb/hr	7,680	lb/hr	7,449	lb/hr	7,449	lb/hr
	65.2	DTPD	170	DTPD	162	DTPD	92	DTPD	92	DTPD	92	DTPD	92	DTPD	89	DTPD	89	DTPD
VS	4,020	lb/hr	11,273	lb/hr	10,710	lb/hr	4,927	lb/hr	4,927	lb/hr	4,927	lb/hr	4,927	lb/hr	4,779	lb/hr	4,779	lb/hr
Water	720,401	lb/hr	932,912	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	22,348	lb/hr	648	lb/hr
TS	1%		1%		6%		3%		3%		3%		3%		25%		92%	
VS	74%		80%		80%		64%		64%		64%		64%		64%		64%	
Water	1,443.1	gpm	1,868.8	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	44.8	gpm	1.3	gpm
Calorific Value	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS
Electrical Demand	0	kW	0.0	kW	874.1	kW	820.6	kW	33.2	kW	165.8	kW	0.8	kW	186.5	kW	1657.8	kW
Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-8.44	MMBtu/hr	2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-36.46	MMBtu/hr
Total Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-8.44	MMBtu/hr	-6.44	MMBtu/hr	9.84	MMBtu/hr	9.84	MMBtu/hr	9.84	MMBtu/hr	-26.61	MMBtu/hr
Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	68.82	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	26.61	MMBtu/hr
Total Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	68.82	MMBtu/hr	68.82	MMBtu/hr	68.82	MMBtu/hr	95.43	MMBtu/hr
Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	52.05	MMBtu/hr	-10.41	MMBtu/hr	-41.64	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	52.05	MMBtu/hr	41.64	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Generated Steam	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr
Power Generation	0	MW	0.00	MW	0.00	MW	0.00	MW	1.40	MW	13.60	MW	0.00	MW	0.00	MW	0.00	MW

Alt 1c - Mesophilic + Co-Thickening + Dewatering

	WAS		Primary Sludge		DAFT		Digester (Meso)		Fuel Cell		CHP Engine		Boiler		Centrifuge	
Mass Flow	8,710	TPD	2,655	TPD												
TS	1%		4.0%													
VS	74%		83%													
Calorific Value	10,000	Btu/lb	10,000	Btu/lb												
					95%	Capture									97%	Capture
					5.5%	TS									25%	TS
							VSR	54.0%								
									Therm Eff.	25%	Therm Eff.	33%	Therm Eff.	80%		
	Feedstock Type		Feedstock Type						Nat gas usage, cfh		Nat gas usage, cfh		Nat gas usage, cfh			
	Sludge		Sludge						0		74,800		0			
									Fuel Use	20%	Fuel Use	80%	Fuel Use	0%		
Fuel Cell Power Generation	1403	kW														
CHP Power Generation	13597	kW														
Final TS, Wet	358	WT/D														
Electricity Req.	2,217	kW							Engine Electrical Eff.		Engine Electrical Eff.					
Aux. Fuel Input	68.8	MMBtu/hr					Sludge Inlet Temp		46%		42%					
Power Generation	15,000	kW					68.0	F	Heat Recovery		Heat Recovery		Heat Recovery			
Net Power	12,783	kW					Operation Temp		2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr		
							98	F								
							600	Btu/cf								
							16	cf/lb VS								
							7.34	MMBtu/hr								
	Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption	
	0	hp	0	hp	1,055	hp	1,100	hp	200	hp	200	hp	5	hp	225	hp
	90%	Efficiency	90%	Efficiency	90%	Efficiency	100%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency
							Shell Heat Loss									
							15%									
Mass Flow	725,833	lb/hr	947,083	lb/hr	244,781	lb/hr	238,997	lb/hr	238,997	lb/hr	238,997	lb/hr	238,997	lb/hr	29,797	lb/hr
TS	5,432	lb/hr	14,172	lb/hr	13,463	lb/hr	7,680	lb/hr	7,680	lb/hr	7,680	lb/hr	7,680	lb/hr	7,449	lb/hr
	65.2	DTPD	170	DTPD	162	DTPD	92	DTPD	92	DTPD	92	DTPD	92	DTPD	89	DTPD
VS	4,020	lb/hr	11,273	lb/hr	10,710	lb/hr	4,927	lb/hr	4,927	lb/hr	4,927	lb/hr	4,927	lb/hr	4,779	lb/hr
Water	720,401	lb/hr	932,912	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	22,348	lb/hr
TS	1%		1%		6%		3%		3%		3%		3%		25%	
VS	74%		80%		80%		64%		64%		64%		64%		64%	
Water	1,443.1	gpm	1,868.8	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	44.8	gpm
Calorific Value	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS
Electrical Demand	0	kW	0.0	kW	874.1	kW	820.6	kW	165.8	kW	165.8	kW	4.1	kW	186.5	kW
Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-8.44	MMBtu/hr	2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-8.44	MMBtu/hr	-6.44	MMBtu/hr	30.01	MMBtu/hr	30.01	MMBtu/hr	30.01	MMBtu/hr
Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	68.82	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	68.82	MMBtu/hr	68.82	MMBtu/hr	68.82	MMBtu/hr
Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	52.05	MMBtu/hr	-10.41	MMBtu/hr	-41.64	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	52.05	MMBtu/hr	41.64	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Generated Steam	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr
Power Generation	0	MW	0.00	MW	0.00	MW	0.00	MW	1.40	MW	13.60	MW	0.00	MW	0.00	MW

Alt 1e - Meso + Co-Thickening + Dewatering + 100% compost

	WAS		Primary Sludge		DAFT		Digester (Meso)		Fuel Cell		CHP Engine		Boiler		Centrifuge	
Mass Flow	8,710	TPD	2,655	TPD												
TS	1%		4.0%													
VS	74%		83%													
Calorific Value	10,000	Btu/lb	10,000	Btu/lb												
					95%	Capture									97%	Capture
					5.5%	TS									25%	TS
							VSR	54.0%								
									Therm Eff.	25%	Therm Eff.	33%	Therm Eff.	80%		
	Feedstock Type		Feedstock Type						Nat gas usage, cfh		Nat gas usage, cfh		Nat gas usage, cfh			
	Sludge		Sludge						0		74,800		0			
									Fuel Use	20%	Fuel Use	80%	Fuel Use	0%		
el Cell Power Generation	1403	kW														
CHP Power Generation	13597	kW														
Final TS, Wet	358	WT/D														
Electricity Req.	2,081	kW							Engine Electrical Eff.		Engine Electrical Eff.					
Aux. Fuel Input	69	MMBtu/hr					Sludge Inlet Temp		46%		42%					
Power Generation	15,000	kW					68.0	F	Heat Recovery		Heat Recovery		Heat Recovery			
Net Power	12,919	kW					Operation Temp		2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr		
							98	F								
							600	Btu/cf								
							16	cf/lb VS								
							7.34	MMBtu/hr								
	Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption	
	0	hp	0	hp	1,055	hp	1,100	hp	40	hp	200	hp	1	hp	225	hp
	90%	Efficiency	90%	Efficiency	90%	Efficiency	100%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency
							Shell Heat Loss									
							15%									
Mass Flow	725,833	lb/hr	947,083	lb/hr	244,781	lb/hr	238,997	lb/hr	238,997	lb/hr	238,997	lb/hr	238,997	lb/hr	29,797	lb/hr
TS	5,432	lb/hr	14,172	lb/hr	13,463	lb/hr	7,680	lb/hr	7,680	lb/hr	7,680	lb/hr	7,680	lb/hr	7,449	lb/hr
	65.2	DTPD	170	DTPD	162	DTPD	92	DTPD	92	DTPD	92	DTPD	92	DTPD	89	DTPD
VS	4,020	lb/hr	11,273	lb/hr	10,710	lb/hr	4,927	lb/hr	4,927	lb/hr	4,927	lb/hr	4,927	lb/hr	4,779	lb/hr
Water	720,401	lb/hr	932,912	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	22,348	lb/hr
TS	1%		1%		6%		3%		3%		3%		3%		25%	
VS	74%		80%		80%		64%		64%		64%		64%		64%	
Water	1,443.1	gpm	1,868.8	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	44.8	gpm
Calorific Value	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS
Electrical Demand	0	kW	0.0	kW	874.1	kW	820.6	kW	33.2	kW	165.8	kW	0.8	kW	186.5	kW
Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-8.44	MMBtu/hr	2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-8.44	MMBtu/hr	-6.44	MMBtu/hr	30.01	MMBtu/hr	30.01	MMBtu/hr	30.01	MMBtu/hr
Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	68.82	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	68.82	MMBtu/hr	68.82	MMBtu/hr	68.82	MMBtu/hr
Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	52.05	MMBtu/hr	-10.41	MMBtu/hr	-41.64	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	52.05	MMBtu/hr	41.64	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Generated Steam	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr
Power Generation	0	MW	0.00	MW	0.00	MW	0.00	MW	1.40	MW	13.60	MW	0.00	MW	0.00	MW

Alt 2 - TPAD + Co-Thickening + Dewatering + 20% Heat Drying + 10% Greenhouse

	WAS	Primary Sludge	DAFT	Digester (Thermo)	Fuel Cell	CHP Engine	Boiler	Centrifuge	20% Thermal	10% Solar	70% Landfill, Land App, and Compost	20% Thermal Thermal Drying	10% Solar Solar Dryer
Mass Flow	8,710 TPD	2,655 TPD							67 TPD	33 TPD			
TS	1%	4.0%							90.0%	65.0%			
VS	74%	83%							64%	64%			
Calorific Value	10,000 Btu/lb	10,000 Btu/lb							10,000 Btu/lb	10,000 Btu/lb			
			95% Capture					97% Capture					
			5.5% TS					25% TS				92.0% TS	80.0% TS
				VSR 59%							VSR 0.0%		VSR 5.0%
					Therm Eff. 25%	Therm Eff. 33%	Therm Eff. 80%						
	Feedstock Type Sludge	Feedstock Type Sludge			Nat gas usage, cfh 0	Nat gas usage, cfh 65,445	Nat gas usage, cfh 0		Feedstock Type Sludge	Feedstock Type Sludge			
					Fuel Use 17%	Fuel Use 83%	Fuel Use 0%						
						Total Fuel Demand 110.5 Mmbtu/hr							
						Nat gas fuel demand 60.2 Mmbtu/hr							
					Engine Electrical Eff. 46%	Engine Electrical Eff. 42%							
				Sludge Inlet Temp 68.0 F							Sludge Inlet Temp 98 F	Inlet / Out Temp. 80 F	Inlet Temperature 80 F
				Operation Temp 131 F	Heat Recovery 2.00 MMBtu/hr	Heat Recovery 36.46 MMBtu/hr	Heat Recovery 0.00 MMBtu/hr				Operation Temp 98 F	220 F	Discharge Temperature 220 F
				600 cf gas/VS							0 Btu/cf		
				16 cf/lb VS							0 cf/lb VS	1,600 Btu/lb	1,120 Btu/lb
				15.42 MMBtu/hr							0.00 MMBtu/hr	6.46 MMBtu/hr	
	Energy Consumption 0 hp	Energy Consumption 0 hp	Energy Consumption 1,055 hp	Energy Consumption 1,246 hp	Energy Consumption 40 hp	Energy Consumption 200 hp	Energy Consumption 1 hp	Energy Consumption 225 hp	Energy Consumption 0 hp	Energy Consumption 0 hp	Energy Consumption 0 hp	Energy Consumption 500 hp	Energy Consumption 510 hp
	90% Efficiency	90% Efficiency	90% Efficiency	100% Efficiency	90% Efficiency	90% Efficiency	90% Efficiency	90% Efficiency	90% Efficiency	90% Efficiency	100% Efficiency	90% Efficiency	90% Efficiency
				Shell Heat Loss 15%								Heat Loss 5%	

Power Generation		
Fuel Cell Power Generation	1398	kW
CHP Power Generation	13602	kW
Final TS, Wet	261	WT/D
Electricity Req.	3,027	kW
Aux. Fuel Input	67	MMBtu/hr
Power Generation	15,000	kW
Net Power	11,973	kW

	WAS		Primary Sludge		DAFT		Digester (Thermo)		Fuel Cell		CHP Engine		Boiler		Centrifuge		20% Thermal		10% Solar		70% Landfill, Land App, and Compost		20% Thermal Thermal Drying IN			10% Solar Solar Dryer IN		
Mass Flow	725,833	lb/hr	947,083	lb/hr	244,781	lb/hr	238,462	lb/hr	238,462	lb/hr	238,462	lb/hr	238,462	lb/hr	27,719	lb/hr	22,175	lb/hr	19,404	lb/hr	19,404	lb/hr	5,544	1,506	lb/hr	2,772	850	lb/hr
TS	5,432	lb/hr	14,172	lb/hr	13,463	lb/hr	7,144	lb/hr	7,144	lb/hr	7,144	lb/hr	7,144	lb/hr	6,930	lb/hr	5,544	lb/hr	4,851	lb/hr	4,851	lb/hr	1,386	1,386	lb/hr	693	680	lb/hr
	65.2	DTPD	170	DTPD	162	DTPD	86	DTPD	86	DTPD	86	DTPD	86	DTPD	83	DTPD	67	DTPD	58	DTPD	58	DTPD	17	17	DTPD	8	8	DTPD
VS	4,020	lb/hr	11,273	lb/hr	10,710	lb/hr	4,391	lb/hr	4,391	lb/hr	4,391	lb/hr	4,391	lb/hr	4,259	lb/hr	3,407	lb/hr	2,981	lb/hr	2,981	lb/hr	852	541	lb/hr	257	244	lb/hr
Water	720,401	lb/hr	932,912	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	20,790	lb/hr	16,632	lb/hr	14,553	lb/hr	14,553	lb/hr	4,158	121	lb/hr	2,079	170	lb/hr
TS	1%		1%		6%		3%		3%		3%		3%		25%		25%		25%		25%			25%			25%	
VS	74%		80%		80%		61%		61%		61%		61%		61%		62%		62%		61%			61%			35%	
Water	1,443.1	gpm	1,868.8	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	41.6	gpm	33.3	gpm	29.2	gpm	29.2	gpm		8.3	gpm		4.2	gpm
Calorific Value	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS		10,000	Btu/lb VS		10,000	Btu/lb VS
Electrical Demand	0	kW	0.0	kW	874.1	kW	929.7	kW	33.2	kW	165.8	kW	0.8	kW	186.5	kW	0.0	kW	0.0	kW	0.0	kW		414.4	kW		422.7	kW
Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-17.73	MMBtu/hr	2.00	MMBtu/hr	36.46	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr		-6.78	MMBtu/hr		0.00	MMBtu/hr
Total Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-17.73	MMBtu/hr	-15.73	MMBtu/hr	9.85	MMBtu/hr	9.85	MMBtu/hr	9.85	MMBtu/hr	9.85	MMBtu/hr	9.85	MMBtu/hr	9.85	MMBtu/hr		3.06	MMBtu/hr		3.06	MMBtu/hr
Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.21	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr		6.78	MMBtu/hr		0.00	MMBtu/hr
Total Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.21	MMBtu/hr	60.21	MMBtu/hr	60.21	MMBtu/hr	60.21	MMBtu/hr	60.21	MMBtu/hr	60.21	MMBtu/hr		66.99	MMBtu/hr		66.99	MMBtu/hr
Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.66	MMBtu/hr	-10.37	MMBtu/hr	-50.29	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr		0.00	MMBtu/hr		0.00	MMBtu/hr
Total Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.66	MMBtu/hr	50.29	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr		0.00	MMBtu/hr		0.00	MMBtu/hr
Generated Steam	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr		0	lb/hr		0	lb/hr
Power Generation	0	MW	0.00	MW	0.00	MW	0.00	MW	1.40	MW	13.60	MW	0.00	MW	0.00	MW	0.00	MW	0.00	MW	0.00	MW		0.00	MW		0.00	MW

Alt 2b - TPAD + Co-Thickening + Dewatering

	WAS		Primary Sludge		DAFT		Digester (Thermo)		Fuel Cell		CHP Engine		Boiler		Centrifuge	
Mass Flow	8,710	TPD	2,655	TPD												
TS	1%		4.0%													
VS	74%		83%													
Calorific Value	10,000	Btu/lb	10,000	Btu/lb												
					95%	Capture									97%	Capture
					5.5%	TS									25%	TS
							VSR	59%								
									Therm Eff.	25%	Therm Eff.	33%	Therm Eff.	80%		
	Feedstock Type		Feedstock Type													
	Sludge		Sludge						Nat gas usage, cfh		Nat gas usage, cfh		Nat gas usage, cfh			
									0		65,400		0			
									Fuel Use	17%	Fuel Use	83%	Fuel Use	0%		
el Cell Power Generation	1398	kW														
CHP Power Generation	13596	kW														
Final TS, Wet	333	WT/D														
Electricity Req.	2,190	kW							Engine Electrical Eff.		Engine Electrical Eff.					
Aux. Fuel Input	60.2	MMBtu/hr					Sludge Inlet Temp		46%		42%					
Power Generation	14,995	kW					68.0	F	Heat Recovery		Heat Recovery		Heat Recovery			
Net Power	12,805	kW					Operation Temp		2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr		
							131	F								
							600	cf gas/VS								
							16	cf/lb VS								
							15.42	MMBtu/hr								
	Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption	
	0	hp	0	hp	1,055	hp	1,246	hp	40	hp	200	hp	1	hp	225	hp
	90%	Efficiency	90%	Efficiency	90%	Efficiency	100%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency
							Shell Heat Loss									
							15%									
Mass Flow	725,833	lb/hr	947,083	lb/hr	244,781	lb/hr	238,462	lb/hr	238,462	lb/hr	238,462	lb/hr	238,462	lb/hr	27,719	lb/hr
TS	5,432	lb/hr	14,172	lb/hr	13,463	lb/hr	7,144	lb/hr	7,144	lb/hr	7,144	lb/hr	7,144	lb/hr	6,930	lb/hr
	65.2	DTPD	170	DTPD	162	DTPD	86	DTPD	86	DTPD	86	DTPD	86	DTPD	83	DTPD
VS	4,020	lb/hr	11,273	lb/hr	10,710	lb/hr	4,391	lb/hr	4,391	lb/hr	4,391	lb/hr	4,391	lb/hr	4,259	lb/hr
Water	720,401	lb/hr	932,912	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	20,790	lb/hr
TS	1%		1%		6%		3%		3%		3%		3%		25%	
VS	74%		80%		80%		61%		61%		61%		61%		61%	
Water	1,443.1	gpm	1,868.8	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	41.6	gpm
Calorific Value	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS
Electrical Demand	0	kW	0.0	kW	874.1	kW	929.7	kW	33.2	kW	165.8	kW	0.8	kW	186.5	kW
Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-17.73	MMBtu/hr	2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-17.73	MMBtu/hr	-15.73	MMBtu/hr	20.72	MMBtu/hr	20.72	MMBtu/hr	20.72	MMBtu/hr
Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.17	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.17	MMBtu/hr	60.17	MMBtu/hr	60.17	MMBtu/hr
Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.66	MMBtu/hr	-10.37	MMBtu/hr	-50.29	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.66	MMBtu/hr	50.29	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Generated Steam	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr
Power Generation	0	MW	0.00	MW	0.00	MW	0.00	MW	1.40	MW	13.60	MW	0.00	MW	0.00	MW

Alt 2c - TPAD w/batch tanks + Co-Thickening + Dewatering

	WAS		Primary Sludge		DAFT		Digester (Thermo)		Fuel Cell		CHP Engine		Boiler		Centrifuge	
Mass Flow	8,710	TPD	2,655	TPD												
TS	1%		4.0%													
VS	74%		83%													
Calorific Value	10,000	Btu/lb	10,000	Btu/lb												
					95%	Capture									97%	Capture
					5.5%	TS									25%	TS
							VSR	59%								
									Therm Eff.	25%	Therm Eff.	33%	Therm Eff.	80%		
	Feedstock Type		Feedstock Type						Nat gas usage, cfh		Nat gas usage, cfh		Nat gas usage, cfh			
	Sludge		Sludge						0		65,400		0			
									Fuel Use	17%	Fuel Use	83%	Fuel Use	0%		
el Cell Power Generation	1398	kW														
CHP Power Generation	13596	kW														
Final TS, Wet	333	WT/D														
Electricity Req.	2,321	kW							Engine Electrical Eff.		Engine Electrical Eff.					
Aux. Fuel Input	60.2	MMBtu/hr					Sludge Inlet Temp		46%		42%					
Power Generation	14,995	kW					68.0	F	Heat Recovery		Heat Recovery		Heat Recovery			
Net Power	12,674	kW					Operation Temp		2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr		
							131	F								
							600	cf gas/VS								
							16	cf/lb VS								
							15.42	MMBtu/hr								
	Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption		Energy Consumption	
	0	hp	0	hp	1,055	hp	1,422	hp	40	hp	200	hp	1	hp	225	hp
	90%	Efficiency	90%	Efficiency	90%	Efficiency	100%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency	90%	Efficiency
							Shell Heat Loss									
							15%									
Mass Flow	725,833	lb/hr	947,083	lb/hr	244,781	lb/hr	238,462	lb/hr	238,462	lb/hr	238,462	lb/hr	238,462	lb/hr	27,719	lb/hr
TS	5,432	lb/hr	14,172	lb/hr	13,463	lb/hr	7,144	lb/hr	7,144	lb/hr	7,144	lb/hr	7,144	lb/hr	6,930	lb/hr
	65.2	DTPD	170	DTPD	162	DTPD	86	DTPD	86	DTPD	86	DTPD	86	DTPD	83	DTPD
VS	4,020	lb/hr	11,273	lb/hr	10,710	lb/hr	4,391	lb/hr	4,391	lb/hr	4,391	lb/hr	4,391	lb/hr	4,259	lb/hr
Water	720,401	lb/hr	932,912	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	231,318	lb/hr	20,790	lb/hr
TS	1%		1%		6%		3%		3%		3%		3%		25%	
VS	74%		80%		80%		61%		61%		61%		61%		61%	
Water	1,443.1	gpm	1,868.8	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	463.4	gpm	41.6	gpm
Calorific Value	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS	10,000	Btu/lb VS
Electrical Demand	0	kW	0.0	kW	874.1	kW	1060.6	kW	33.2	kW	165.8	kW	0.8	kW	186.5	kW
Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-17.73	MMBtu/hr	2.00	MMBtu/hr	36.45	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Heat	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	-17.73	MMBtu/hr	-15.73	MMBtu/hr	20.72	MMBtu/hr	20.72	MMBtu/hr	20.72	MMBtu/hr
Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.17	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Aux. Fuel Added	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.17	MMBtu/hr	60.17	MMBtu/hr	60.17	MMBtu/hr
Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.66	MMBtu/hr	-10.37	MMBtu/hr	-50.29	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Total Produced Fuel	0	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	60.66	MMBtu/hr	50.29	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr	0.00	MMBtu/hr
Generated Steam	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr	0	lb/hr
Power Generation	0	MW	0.00	MW	0.00	MW	0.00	MW	1.40	MW	13.60	MW	0.00	MW	0.00	MW

FROM BC BCE:

Thickening		
GBT	25	hp
Centrifuge	varies - see tab	hp
DAFT co-thickening	1054.6	hp
Rotary Drum	30	hp
Gravity Thickening	15	hp
DAFT WAS only	590	hp
Dewatering		
BFP	35	hp
Centrifuge	225	hp
Electro	250	hp
Fournier	40	hp
Screw Press	35	hp
Solid Destruction		
Dryer	90	hp
Solar Thermal	30	hp
Cambi & Meso Digester	427	hp
Meso Digester	1100	hp
FBR	200	hp
Gasifier	135	hp
Lagoons	10	hp
Thermo Digester	1246	hp
Thermal		
Gas Turbine	60	hp
Steam Turbine	100	hp
CHP Engine	100	hp
Micro Turbine	60	hp
Fuel Cell	60	hp
CHP Engine	30	hp
Boiler	40	hp

DAFT Electrical Use, HP (from Kenny)					total hp
Pressurization Pumps	900				
Top Drives	1.2				1055
Bottom drives	1.2				
Bottom screw	1.2				
Bottom pumps	16				
Blend tank recirc	20				
DAFT Feed pumps	35				
Thickened sludge pumps	60				
FA Blowers (A)	15				
FA Blowers (B)	5				
Mesophilic Digesters Electric Use, HP	hp, each	quantity	total hp		
Mixing (8 digesters in service, 30hp each mixer)	30	8	240		
Digester Hot Water Pumps (8 digesters in service, 1 pump per digester, 7.5 hp each)	7.5	8	60		
DS Recirculation Pumps (8 digesters in service, 1 pun	22.5	8	180		
Digester Sludge Transfer Pumps (8 digesters in service, 2 pumps per digester, 25hp each)	30	16	480		1100
Control Valves	20	1	20		
Primary loop pump (assume 1 running)	30	1	30		
Digester Drain pump (normally off)	0	1	0		
Feed pumps (8 dig in service, 15 hp each)	11	8	90		
			0		
Lagoons Electric Use, HP					
Lagoon Transfer Pumps	10				
Dewatering, Lagoons (mesophilic)					
Centrifuge	171				
Polymer Use 17.5#/DT	2000				
Thermophilic Digesters Electric Use, HP					total hp
Mixing (8 digesters in service, 30hp each mixer)	30	8	240		1246
Digester Hot Water Pumps (8 digesters in service, 1	7.5	16	120		
DS Recirculation Pumps (8 digesters in service, 1 pun	22.5	8	180		
Digester Sludge Transfer Pumps (8 digesters in	22.5	24	540		
Control Valves	20	1	20		
Primary loop pump (assume 1 running)	30	1	30		
Digester Drain pump (normally off)	0	1	0		
Feed pumps (8 dig in service, 15 hp each)	11	8	90		
Effluent pump at 3W station	19	1	18.75		
Cooling loop pump	7.5	1	7.5		
Batch Tanks, HP					total hp
Batch tank circ pump	11	6	67.5		1422
Batch tank grinder	4	4	15		
Batch tank hot water pump	1	4	3		
Batch tank transfer pump	45	2	90		
Lagoons Electric Use, HP					
Lagoon Transfer Pumps	9				
Dewatering, Lagoons (Thermophilic)					
Centrifuge	152				
Polymer Use 17.5#/DT	1800				
Pre-dewatering (WAS)					
Transfer Pumps	7				
Centrifuges	157				
Polymer Use 8#/DT	1467				
DAFT (WAS) Electrical Use, HP					
Pressurization Pumps	370				
Collector Mechanism	45				
THS Pumps	72				
Miscellneous, 10 percent	103				590
Polymer Use 7.5#/DT	0				

Radiation Losses (Meso), MMBTU/hr	0.944
Radiation Losses (Thermo), MMBTU/hr	1.61
Meso Digesters	8
CAMBI (Meso) WAS only	6
CAMBI (Meso) PS and WAS	4
Thermo Digesters	8

Radition Losses

Meso Digesters, MMBTU/hr	7.552
CAMBI (Meso) WAS only, MMBTU/hr	5.664
CAMBI (Meso) PS and WAS, MMBTU/hr	3.776
Thermo Digesters, MMBTU/hr	12.88

Sludge Heating

Meso Digesters, MMBTU/hr	14.8
CAMBI (Meso) WAS only, MMBTU/hr	0
CAMBI (Meso) PS and WAS, MMBTU/hr	0
Thermo Digesters, MMBTU/hr	29.5

CAMBI Heating

Meso Digesters, MMBTU/hr	0
CAMBI (Meso) WAS only, MMBTU/hr	21.4
CAMBI (Meso) PS and WAS, MMBTU/hr	24.5
Thermo Digesters, MMBTU/hr	0

Total MMBTU

Meso Digesters, MMBTU/hr	22.352
CAMBI (Meso) WAS only, MMBTU/hr	27.064
CAMBI (Meso) PS and WAS, MMBTU/hr	28.276
Thermo Digesters, MMBTU/hr	42.38

Attachment B: TM 1. Biosolids Hauling and Disposition Cost Projections

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Technical Memorandum

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 1, Service Order #5

Subject: Biosolids Hauling and Disposition Cost Projections

Date: August 7, 2014

To: Linda Stewart, Senior Engineer, City of San José

From: Steve Wilson, Chief Scientist, Brown and Caldwell

Copy to: File

Prepared by: _____
Steve Wilson, Chief Scientist

Reviewed by: _____
Grace Chow P.E., Vice President

Limitations:

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Section 1: Purpose and Background

The purpose of this Technical Memorandum No. 1 (TM 1) is to recommend values for cost of biosolids disposition to be used in business case analyses of alternatives for reconfiguration of biosolids management at the San José-Santa Clara Regional Wastewater Facility (SJSCRWF). The current configuration for biosolids management includes mesophilic anaerobic digestion, followed by multi-year stabilization in sludge lagoons. Lagoons are dredged and the dredged biosolids are air-dried before trucking to the Newby Island landfill for use as alternative daily cover (ADC). The City of San José (City) has been directed to stop feeding the lagoons by 2018 and must ultimately decommission the lagoons and drying bed operations. This directive has created the need to determine a new configuration for biosolids management at SJSCRWF that does not rely on lagooning and/or open air drying of biosolids. The new configuration also requires review of disposition alternatives other than the Newby Island landfill because there is currently a minimum 50 percent solids by weight criterion for acceptance there and that facility is nearing the end of its life for accepting materials. As a minimum, the new configuration will very likely involve mechanical dewatering of anaerobically digested sludge.

Understanding the future costs for disposition of biosolids products aids decision-making for upstream processes such as anaerobic digestion. Additional biosolids processing including Class A technologies (thermal drying, composting) and solar drying were recommended in the Plant Master Plan (PMP). Application of these technologies influences both processing costs and product disposition cost. Rational economic analysis of alternatives for reconfiguration requires assumptions regarding the cost of removal and appropriate disposition of biosolids from the SJSCRWF site. These costs are impacted by the quality of the biosolids leaving the site and the ultimate disposition fate for the biosolids. This TM was prepared to review the experience of neighboring California peer facilities in terms of the various disposition outlets and associated costs. This information was then converted into an assumed set of costs that can be applied to economic analysis of alternatives for reconfiguration of the SJSCRWF biosolids management program.

Section 2: Biosolids Quantities for SJSCRWF

Projected quantities of mesophilic anaerobically digested biosolids are shown in Table 2–1.

Table 2-1. Projected Digested Solids Loads

Load Condition	Day 1 TS, dry ton/day	2030 TS, dry ton/day
Annual Average	82	102
Max Month	109	135
Peak 2 week	117	146
Peak week	122	151
Peak Day	126	157

Loads are expressed on a dry solids basis however costs for transport and disposition are based upon the actual wet tonnage of the biosolids. Wet tonnage is derived by dividing the dry tonnage by the decimal equivalent of the percent solids of the biosolids product (e.g. 82 dry tons per day at 25 percent solids is 82/0.25 = 328 wet tons per day). With current operations, after air drying and handling, the biosolids transported to Newby Landfill are approximately 80 percent dry solids by weight. When discharge to the lagoons is ceased, mechanical dewatering will be required and the biosolids cake product will be in the range of 20 to 25 percent dry solids (75 percent water). This increases the volume of product requiring hauling and disposition by a factor of three. Newby Island landfill may not accept the wetter product under the current contract. Alternatives for biosolids management reconfiguration may include transport and disposition of dewatered cake or additional contained-type drying processes (thermal or solar greenhouse) that can reduce the water content and, consequently, the wet tonnage of biosolids for transport and disposition.

Loading projections are in the process of being updated and actual loads may prove to be less than shown above. Loadings described in this report are intended for comparative purposes and preliminary estimates of disposition cost only.

Section 3: Disposition Opportunities

Peer agencies in the Northern California area predominantly seek competitive contractual arrangements for the transport and legally permitted disposition of their biosolids products. Contracts are variable with regard to prescriptive requirements for the final disposition of the biosolids. Table 3-1 presents generic description of the most used disposition methods.

Table 3-1. Generic Description of Disposition Opportunities

Disposition Method	Description
Land Application	Application to agricultural land for beneficial use. Application constrained by weather and jurisdictional limitations. Class B biosolids limited to non-food crops. Class A biosolids have more flexible options for land application use.
Alternative Daily Cover at Landfills	Beneficial use that displaces use of topsoil in the management of active landfill disposal cells. Not typically limited by weather conditions. Class B biosolids usually the threshold quality level.
Composting	Additional aerobic stabilization of biosolids to produce a Class A product suitable for flexible beneficial use. Usually conducted at a site remote from the wastewater treatment facilities. Market in Bay Area incentivized by Solano County requirement that requires diversion of some portion of Class B biosolids to Class A composting as a condition for County's acceptance of Class B biosolids for land application.
Landfill	Non-beneficial disposal of biosolids in active cells of municipal solid waste landfills or dedicated sludge mono-fills. Typically subject to same tipping fees as other forms of refuse received at the landfill.

Class B and Class A designations for biosolids relate to the level of stabilization of the biosolids and the expected content of pathogenic organisms that create risks associated with human contact of the biosolids. Class B biosolids are considered stabilized sufficiently to reduce odors and attraction of 'vectors' (flies, birds, and rodents) that could transmit pathogens and diseases resulting from contact with the sludge. Management practices such as limiting crop type and preventing immediate public access to Class B

application sites are considered protective. Class A biosolids are considered well stabilized and treated to eliminate active pathogenic organisms in the biosolids. Risks associated with contacting or handling Class A biosolids are considered minimal so there are fewer restrictions for product use.

Section 4: Information on Disposition Costs for Other Agencies

Previous studies have identified regional opportunities and costs for biosolids management. This was evaluated initially in Biosolids Treatment Alternatives TM 5.2 (Carollo Eng., Brown and Caldwell, et al, 2011. Task Order 5, TM 2, "Biosolids Treatment Alternatives"). Appendix A of TM 5.2 evaluated biosolids reuse and disposition options. Unit costs were identified and summarized in Table A.4 of the report (Figure 4-1). The annual costs for this table were based on an assumed 2010 annual average biosolids production rate of 67 dry tons per day.

Table A-4 2010 Biosolids Disposition Costs
San José/Santa Clara Water Pollution Control Plant Master Plan
City of San José

		2010 Disposition Cost		
Product	**Location**	**($/dry ton)**	**($/wet ton)**	**($/yr)[3]**
Current Operation	Newby Landfill	58[(1)]	23	1,420,000
Land App (Local)	Silva Ranch, Herald	50[(2)]	40	1,220,000
Landfill (Local)	Vasco, Livermore	55[(2)]	44	1,350,000
Landfill (Remote)	Salinas	74[(2)]	59	
Landfill (Local)	Manteca	82[(2)]	66	2,010,000
Land App (Local)	Silva Ranch, Herald	160	40	3,910,000
Landfill (Local)	Vasco, Livermore	176	44	4,300,000
Composting (Off-Site)	Synagro, Merced	180	45	4,400,000
Landfill (Remote)	Salinas	235	59	
Landfill (Local)	Manteca	263	66	6,430,000
Composting (On-Site)	SJ/SC WPCP	288	72	7,040,000
Composting (Off-Site)	Synagro, Kern	340	85	8,310,000
Land App (Remote)	Gerlach, NV	340	85	8,310,000

(1) Value calculated based on 80 percent solids dryness and 50 percent of the solids are soil due to current method of removing biosolids from the drying beds.
(2) Value calculated based on 80 percent solids, all other values calculated based on 25 percent solids.
(3) Cost based on all biosolids to this disposition option.

Figure 4-1. Image of Table A-4 from Plant Master Plan TM

Figure 4-2 below illustrates the range of unit costs for all of California as they have varied over the last few decades. This data was presented in Workshop 1 of the Biosolids Feasibility Study project.

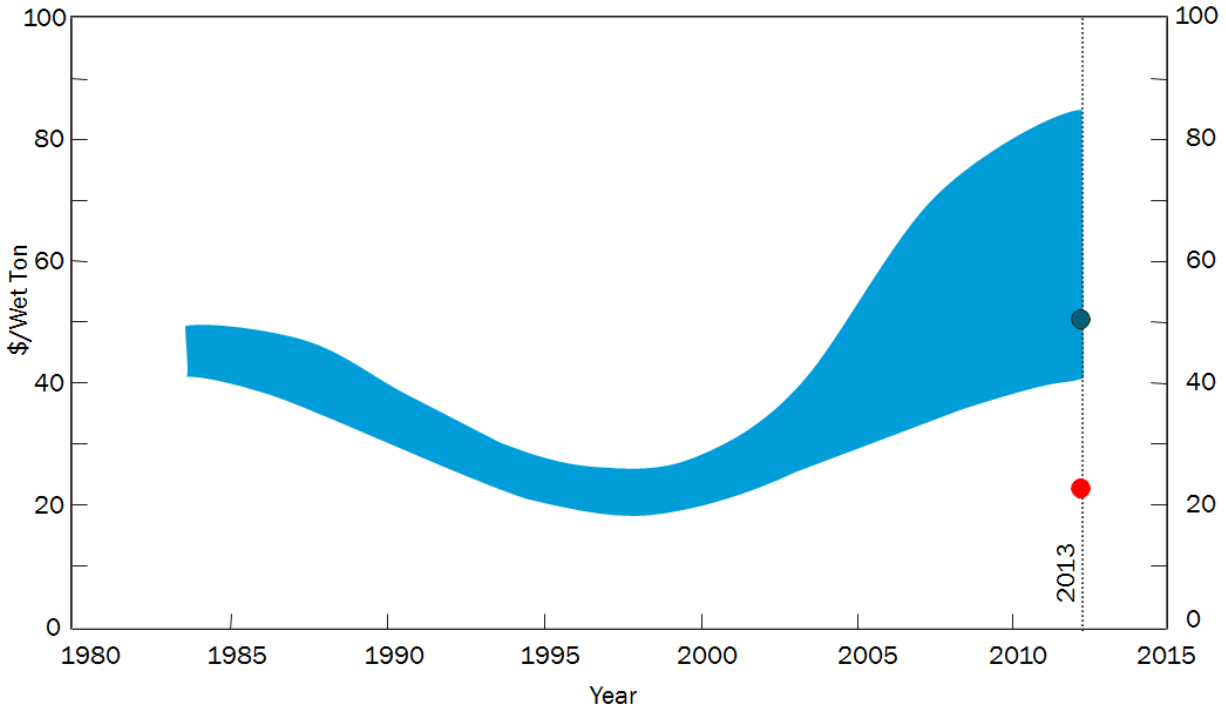

Figure 4-2. California Price Range for Class A/B Cake Trucking and Use/Disposal

The red dot on the slide represented the current cost for Newby Landfill while the green dot represented the midrange of future costs. In the workshop, Brown and Caldwell explained that unit costs may vary for different biosolids products. Class A cake, for example, may have a lower unit cost than Class B cake because of reduced hauling distances and restrictions on use. Most agencies in the Bay Area produce Class B cake so there is a better database for known Class B costs.

The data in Figure 4-2 look at California as a whole however there appears to be a cost differential between southern California agencies and northern California agencies, with northern California seeing lower costs. A survey of other biosolids programs in California was produced for the SFPUC in 2013 (SFPUC Program Management Consultants, 2013. TM 4 “Review of Other Biosolids Programs”). That survey included and differentiated northern and southern CA agencies, one of which produces a significant amount of Class A cake. Data from the survey are summarized in Figure 4-3.

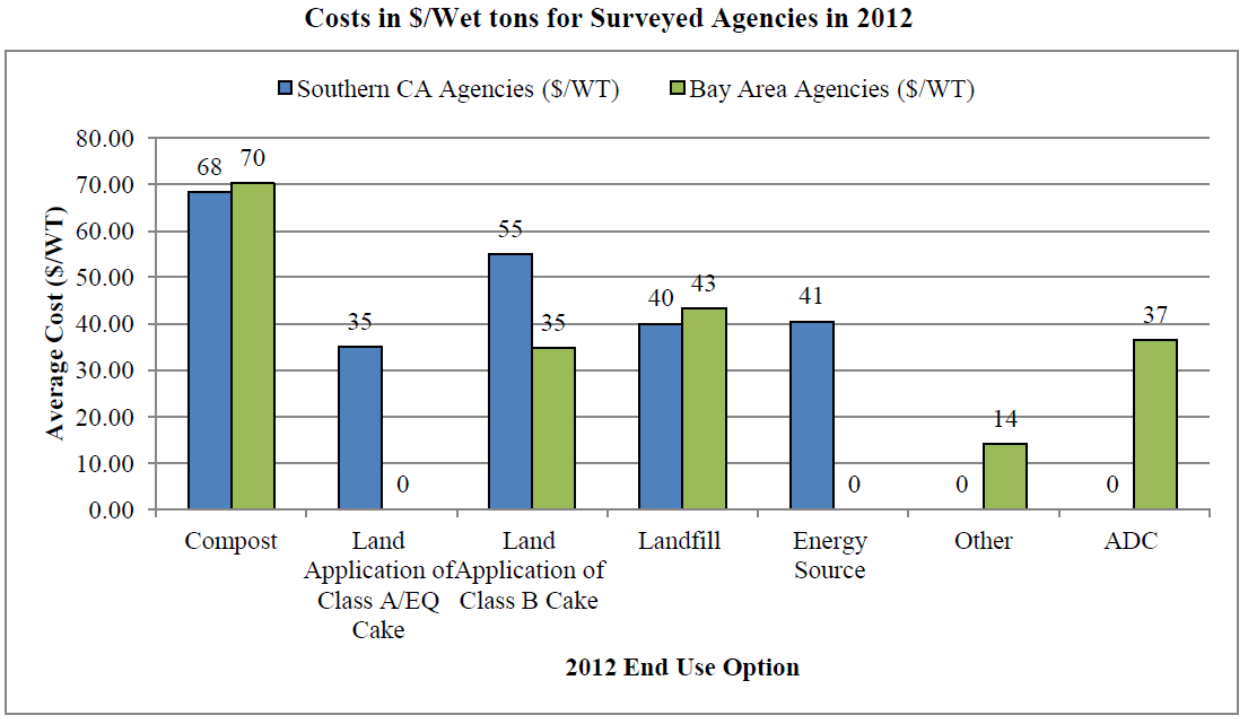

Figure 4-3. 2012 California Survey by SFPUC (Cost Per Wet Ton)

The results support the concept of projecting a lower unit cost for Class A cake. In addition, the figure illustrates that contract composting has a higher unit cost than land application because of additional processing requirements. An assumption that Class A biosolids produced at the wastewater treatment plant site result in a lower disposition cost in northern California is not directly supported from the data because northern California has few facilities producing a recognized Class A biosolids product at the plant site.

Currently, most Bay Area agencies have Class B programs. Calls were made to area biosolids generators to confirm current costs for hauling and disposal or beneficial use of biosolids. Agencies contacted and current prices are summarized in Table 4-1.

Table 4-1. Current Unit Costs for Biosolids Hauling and Disposition in the Bay Area

Agency	Disposition Method / Cost, $/wet ton				Quantity, tons/year
	Compost	Land Application	Landfill	ADC	
Central Marin Sanitation Agency		36		44	
Delta Diablo Sanitation District	46	30	30		
East Bay Municipal Utility District		30		35	70,000
Fairfield-Suisun Sewer District				33	
Millbrae		52			1,500
San Mateo		34			19,000
Santa Rosa[a]	155	34		34	
Union Sanitary District	47	28			20,000
SFPUC	72	35-38	32-41	36	84,000
San Leandro (Class A Biosolids)		29			1,200
Merced proposal to Palo Alto	60				
Sunnyvale WPCP		42	42	42	
San José (Newby Island) (Class A, 80% solids)				23	30,000

[a]*Santa Rosa uses an in-vessel compost system onsite which is expensive to operate and not representative of off-site options; not included in average.*

Section 5: Recommended Assumptions for Disposition Costs in Alternatives Analysis

Brown and Caldwell is evaluating process alternatives and costs by applying a proprietary Solids/Water/Energy Tool (SWET model). Results of this evaluation will be presented in a separate TM. A fundamental input to SWET is the unit cost for biosolids hauling and disposition.

Based on the information in this TM, unit costs in the SWET model were assumed as follows:

- Contract hauling to land application - $35/ton.
- Contract hauling to landfill - $36/ton.
- Contract hauling to Class A composting (off-site) - $51.
- Contract hauling to ADC - $35.
- ADC at Newby Island (minimum 50 percent solids content, before 2025) - $23.

Unit costs for biosolids hauling and disposition may be subject to change in the future due to regulatory changes or other variables. It may be deemed prudent to assume lower disposition costs for biosolids of higher quality to incentivize production of higher quality biosolids as a hedge against changing regulatory and market conditions. Sensitivity tests for the SWET model and/or business case evaluations are under consideration to ensure that the preferred biosolids transition alternatives are viewed from this perspective. Ultimately, costs for biosolids disposition at San José will be determined by the market in response to specific solicitations. When that time comes, contractor qualifications and experience should be considered in addition to price to ensure a reliable program. The City may choose to be prescriptive with regard to disposition methods associated with a contract as a means of achieving various non-economic objectives.

Some agencies have invested in programs to produce biosolids products suitable for local distribution. Examples include the Tacoma TAGRO program and Pierce County's SoundGRO program. Producing a Class A biosolids is essential for consideration of such programs. It would be imprudent to assume that there is an alternative that could immediately direct significant quantities of biosolids in this manner in a short time period. However, maintaining the option to pilot and develop such programs may be a significant non-economic attribute associated with production of higher quality biosolids products from the plant site.

Brown AND Caldwell

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Technical Memorandum
FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.1

Subject: Regional San Facility Tour Summary

Date: July 3, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steve A. Wilson
Steve Wilson, Chief Scientist

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Limitations:

This document was prepared solely for City of San José in accordance with professional standards at the time the services were performed and in accordance with the contract between City of San José and Brown and Caldwell dated October 8, 2013. This document is governed by the specific scope of work authorized by City of San José; 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 City of San José and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Location

Sacramento Regional Wastewater Treatment Plant
8521 Laguna Station Road
Elk Grove, California 95758

Date of Tour

February 19, 2014

Visit Duration

10:00 a.m. to 1:30 p.m.

Areas of Interest

Biosolids Recycling Facility and fats, oils, and grease Receiving Station

Attendees

Mariana Chavez-Vazquez, City of San José
Chris Nations, City of San José
Robert Cuellar, City of San José
Hugh Logan, City of San José
Michele Young, City of San José
Steve Wilson, Brown and Caldwell
Alison Nojima, Brown and Caldwell
Issayas Lemma, City of San José
Carlos Musquez, City of San José
Woody Hassman, City of San José
Linda Stewart, City of San José
John Cannon, City of San José
Lloyd Slezak, Brown and Caldwell
Pat Tangora, Brown and Caldwell (via teleconference)

Tour Leaders

Mike Donahue, Regional San
Mick Berklich, Regional San
Jan Guy, Synagro
Josh Nurmi, Regional San
Swargit Bhatia (Vino), Synagro

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Purpose of Visit

The purpose of this site visit was to learn about the Sacramento Regional County Sanitation District (Regional San) Biosolids Recycling Facility (BRF) and Class A pelletizing system and fats, oil and grease (FOG) receiving station with the goal of obtaining information that will assist the City of San José in developing and designing a new biosolids treatment process. Subjects of interest included planning, engineering, and project delivery components of capital projects, Operation and Maintenance (O&M) experiences and lessons learned, and methods of biosolids recycling.

Site Overview

This section contains a summary of the toured facilities.

Biosolids Facilities

Influent flow to Regional San is 150 million gallons per day (mgd), with a peak capacity of 330 mgd. Regional San produces 28,500 dry tons per year (DT/yr) of anaerobically digested biosolids. Biosolids are sent to two process trains:

- The Biosolids Recycling Facility (BRF) processes 7,300 DT/yr (30 percent of biosolids) of digested biosolids through an Andritz drum drying system (DDS) thermal dryer that has been in operation since 2004. The BRF has a design capacity of 30 dry tons per day (DT/day) and produces Class A pellets that are 95 percent solids.
- The remainder of Class B digested biosolids (21,200 DT/yr, or 70 percent of total) is sent to solids stabilization basins (SSBs) and lined dedicated land disposal (DLD) units.

Biosolids Recycling Facility

The BRF dewatering and drying facility was procured through a design-build-operate (DBO) contract. Synagro handles about 25 percent of the Sacramento Regional Wastewater Treatment Plant (SRWTP) digested sludge production and operates Monday to Friday. A 10 day on/2 day off schedule is favored so there is less start up and stopping of the facility. The BRF is staffed with 11 people at all times during operation.

Thermal drying is accomplished with a single Andritz DDS, shown in Figure 1. Prior to drying, solids are screened and pumped through a strainpress to remove all foreign material. Solids are then mechanically dewatered through two Andritz DL centrifuges. The input digested biosolids feed concentration to the BRF is on average 1.5 percent solids and typically ranges between 0.9 percent and 2.5 percent. The ideal feed concentration to the BRF is greater than 1.7 percent solids.

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Figure 1. Andritz Drum Dryer

The BRF centrifuges produce a cake of 20 percent solids on average, typically ranging from 18 percent and 25 percent. Percent solids are continuously monitored to optimize dewatering and dryer performance. Dryer process air is 90 percent recycled and the remaining 10 percent is sent to an air treatment system and exhausted to a stack.

Finished pellets are stored in a 40-ton capacity silo, shown in Figure 2, and the dust is collected separately. Nitrogen is added in the storage silo to reduce flammability and an oil coat is added to the pellets to minimize product dust.

Figure 2. Regional San BRF Pellet Storage Silo

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The pelletized end product is hauled approximately 20 miles away from the BRF and sold to local farms. Recently, Regional San has begun blending some of the BRF product with commercial fertilizer to market a bagged product.

While the Sacramento Municipal Utility District (SMUD) cogeneration facility next door to the SRWTP has steam and waste heat available, using this energy to power the thermal dryer was never considered by Regional San. Instead, natural gas is used and costs approximately $69/DT. Regional San also pays for extra polymer requirements outside of the contract when feed solids concentrations falls below 1.7 percent.

Dewatering and drying operating costs for the BRF are $595/DT. The amortized capital cost for construction of the facility is $234/DT, resulting in a total BRF cost of $829/DT. Economic information related to product distribution and revenue is proprietary to Synagro. The remaining (approximately 75 percent) of the anaerobically digested biosolids at the SRWTP that are not treated through the BRF are processed in the SSBs and deposited in the DLDs at a cost of $150/DT (including the $21M liner upgrade completed in fiscal year 2003 to 2003). However, this cost may go up in the future as stricter regulations requires more site upgrades (e.g. the lining of solids storage lagoons).

FOG Facility

Regional San also has a FOG facility at the SRWTP that receives 3 trucks per day of FOG (roughly 10,000 gallons per day). The FOG receiving station is shown in Figure 3. A FOG vendor was selected in 2001 and the facility has been in operation since 2004.

Figure 3. Regional San FOG Receiving Station

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BRF Project Delivery Method Discussion

One of the drivers for the BRF was to produce a Class A biosolids end product due to uncertainty about Class B land application local ordinances. In addition, Regional San wanted to have a diversified biosolids program. Rapid procurement and implementation was driven by a "cease and desist" order for the original unlined DLDs. A request for qualifications was sent out and potential firms were short-listed. Contract terms were subsequently negotiated with Synagro. Centrifuge dewatering as an alternative for the SSBs and DLDs was originally considered in 1997 and detailed design was completed. However, the dewatering facility was never built because of Class B concerns.

The Regional San biosolids system works because the plant has redundant capacity for processing biosolids when the BRF is down for maintenance. Regional San wanted maximum risk transfer for this system, and therefore chose DBO and was willing to pay a premium price to achieve this objective. The BRF is running well but is considered costly compared to other sludge-biosolids options at the SRWTP. The BRF capital cost was $21 million and the contract duration is 20 years. Because of the high operating cost, Regional San may not renew the contract after its expiration in 2024.

Plant Feedback and Other Observations

Regional San staff provided the following feedback on issues with the biosolids facility.

Operations

Table 1. Regional San Operations Feedback

Feedback	To be Considered by San José
The digester solids concentration is highly variable (0.9-2.0 percent); Regional San's contract with Synagro specifies 1.7 percent.	
The screening and strainpress units had to be added to the biosolids processing to remove foreign material and protect product quality.	
400 to 600 gallons per minute of secondary effluent is required for operation of the BRF.	
Siloxane disturbs the regenerative thermal oxidizer (RTO), which destroys hazardous air pollutants, volatile organic compounds and other odorous emissions from the BRF; the source of siloxane is unclear since primarily natural gas is used.	
150-180 DT/yr of solids per acre is sent to the DLDs; solids are injected as a slurry into the soil where biological decomposition takes place.	
The dryer takes some time to start and stop; therefore, continuous operation is favored.	
Current BRF production (7,300 DT/yr) may increase to 10,565 DT/yr in 2014 by increasing the number of days of operation.	
Nocardia have upset the anaerobic digesters and resulted in inconsistent digested sludge quality for dewatering and drying.	
Struvite in the centrifuge discharge is problematic.	
3,000 pounds per day of ammonia in the centrate is returned to the head of the SRWTP when the BRF is operating at 7,300 DT/yr.	

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Maintenance

Table 2. Regional San Maintenance Feedback	
Feedback	To be Considered by San José
RTO maintenance is required every 10 years and is included in the contract.	
The BRF was down for six weeks for maintenance in 2013.	

Project Delivery/Project Management

Table 3. Regional San Project Delivery/Project Management Feedback	
Feedback	To be Considered by San José
Regional San is looking at sidestream treatment for both the BRF and SSBs.	
BRF was DBO contracted with Synagro. Contract duration is 20 years. Facility was built in 2005 to handle 25 DTPD and costed $21.2M. DB contract was with Black and Veatch and O&M contract is with Synagro. Synagro teamed with Andritz-Ruthner Inc. for vital technologies for the dryer and centrifuges.	
Synagro is also marketing the product and contracts private fertilizer blenders for the distribution of the finished fertilizer pellet to farmers that use it for growing rye and sudan grass and occasionally on field corn crops.	
New FOG receiving station was $3.2M and is owned and operated by Regional San. A pilot study was performed prior to implementation. • FOG is added directly to the mixed sludge loop that feeds the digesters as opposed to pre-blending with digester content in the FOG homogenization tanks and then feeding slowly to the digesters that was proposed by FOG Energy Corporation for SJSCRWF. • The system is simple and only requires a rock and plastic trap, coarse screening, chopper pumps, and FOG homogenization tanks.	

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Technical Memorandum
FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.2

Subject: San Diego Metro Biosolids Center Tour Summary

Date: July 3, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steve Wilson
Steve Wilson, Chief Scientist

REGISTERED PROFESSIONAL ENGINEER
LLOYD A. SLEZAK
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Location

San Diego Metro Biosolids Center
5240 Convoy Street
San Diego, California 92111

Date of Tour

March 26, 2014

Visit Duration

11:00 p.m. to 2:30 p.m.

Areas of Interest

Biosolids centrifuge dewatering, cake pumps, storage silos, and truck loadout facilities.

Attendees

Mariana Chavez-Vazquez, City of San José
Robert Cuellar, City of San José
Satya Nand, City of San José
John Cannon, City of San José
Alison Nojima, Brown and Caldwell
Issayas Lemma, City of San José
Salvador Campos, City of San José
Linda Stewart, City of San José
Steve Wilson, Brown and Caldwell
Jan Davel, Carollo

Tour Leaders

Dwight Correia, City of San Diego
John Medina, City of San Diego

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Purpose of Visit

The purpose of this site visit was to learn about the City of San Diego (City) Metro Biosolids Center's (MBC) biosolids processing facilities with the goal of obtaining information that will assist the City of San José in developing and designing a new biosolids treatment process. Subjects of interest included facility planning, engineering, and project delivery methods for capital projects, and Operations and Maintenance (O&M) requirements and lessons learned. In particular, the tour focused on the following areas of the MBC biosolids processing facilities:

- thickening centrifuges
- dewatering centrifuges
- cake storage and truck loadout

Site Overview

The MBC has been in operation since 1998 and is entirely devoted to solids processing. The system consists of sludge storage, degritting, thickening, anaerobic digestion, dewatering, truck loadout, and a 6.4-megawatt (MW) capacity cogeneration system, which also includes landfill gas. Design information for the MBC facility is presented in Table 1.

Table 1. MBC Biosolids Processing Design Summary

Parameter	Value
Influent Flow, mgd	180
Biosolids Quantity Processed, WTPD[a]	300
Year Started Service	1998
Sludge Thickening	Alfa Laval centrifuges
Digested Sludge Dewatering	Alfa Laval centrifuges
Percent Solids to Digesters	5%
Percent Solids Dewatered Cake	28%

a. *Wet tons per day*

Components of the MBC solids processing system are as follows:

- Raw (undigested primary and secondary) solids are pumped five miles from the North City Water Reclamation Plant (NCWRP) at an average flow of 1.1 million gallons per day (mgd) to the MBC.
- The raw solids from NCWRP are held in receiving tanks, degritted using three teacup degritters, and thickened to 5 percent solids using Alfa Laval centrifuges prior to digestion. The thickening process consists of five centrifuges; at the time of the site visit, one of the five thickening centrifuges was in operation. The NCWRP thickened solids are digested at the MBC with three mesophilic anaerobic digesters, each of which has a 2.9 million gallon (MG) capacity, and sent to two biosolids storage tanks, each of which has a 1.3 MG capacity.
- In addition, the Point Loma Wastewater Treatment Plant (PLWWTP) sends an average of 1.5 mgd of digested solids through a 17-mile pipeline to the MBC. The solids from PLWWTP and NCWRP are combined in the two biosolids storage tanks prior to dewatering.

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- Three fixed cover, single-stage, high rate mesophilic anaerobic digesters operate at 20 days detention time to digester raw solids. Currently one out of three digesters is in service. Mixing is accomplished with centrifugal and vertical and axial pumps.
- MBC has eight Alfa Laval DS-706 dewatering centrifuges that produce a cake of 28 percent solids. These centrifuges are shown in Figure 1. During average flow, four of the eight centrifuges are in operation five days a week for 24 hours. The additional centrifuges provide redundancy and time for routine equipment maintenance and inspections at regular intervals. Centrate from the dewatering process is returned to the sewer system for treatment.
- Dewatered sludge is pumped into eight storage silos using Schwing cake pumps (shown in Figure 2). Each silo (shown in Figure 3) has a 3-day capacity and is equipped with pug mill cake choppers and gear-driven leveling screws. The storage silos provide flexibility for trucks to pick up the biosolids at night to reduce traffic around the plant during the day.
- Loadout to trucks is accomplished in two minutes and operates between 6:30 a.m. and 3:30 p.m Monday through Friday. without much restriction. The loadout facility loads 20 trucks per day on average, except on Mondays and Tuesdays when the loadout can reach 30 trucks per day after a long weekend storage.

Figure 1. MBC Dewatering Alfa Laval DS-706 Centrifuges

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Figure 2. MBC Schwing Cake Pumps and Piping

Figure 3. Cake Storage Silos

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The main driver for constructing the dewatering facility at the MBC was the closing of the Fiesta Island Biosolids Drying Facility, where biosolids were previously being solar dried. The closing of the Fiesta Island facility resulted in a rushed dewatering facility design and construction at the MBC. Procurement for the dewatering project was design-bid-build with a total construction cost of $185 million (which included a new sludge force main).

The centrifuges have been running for approximately 14 years and are operated by City staff. In recent years, the frequency of major repairs on these centrifuges has increased and the City believes that they are now reaching the end of their useful life. A capital improvement project is underway to replace six of the eight existing centrifuges with larger capacity units.

The quantities and hauling/disposal costs for the Class B cake produced at the MBC are shown in Table 2. Hauling and disposal for landfill and alternative daily cover is covered by a single contract. An average of 90 dry tons of biosolids per day is hauled from the MBC.

Table 2. MBC Hauling and Disposal Summary

Disposition Location	% Sent to Location	Cost ($/WT)
Landfill	22%	37
Alternative Daily Cover	78%	46

Plant Feedback

City staff provided the following feedback on design and O&M requirements and issues associated with the MBC biosolids facility.

Operations

Table 3. MBC Operations Feedback

Feedback	To be Considered by San José
Ferric addition upstream of the centrifuges corroded the metal and tour leaders acknowledge that this was a mistake.	
Smooth transition from land based processing to mechanical dewatering requires planning ahead for operator training and integrating into new biosolids facility.	
Parkson Strainpresses were installed but not well designed and the wet well level was getting to the LO-LO too often, which caused the pumps to constantly stop.	
Blending tanks were installed but later bypassed.	
Much more redundancy than actually needed – base design on realistic flow and load projections that takes into account the decreasing wastewater flows.	
False level readings in the silo has caused overfill and overflow.	

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Maintenance

Table 4. MBC Maintenance Feedback	
Feedback	To be Considered by San José
Recommend having a CMMS to keep track of parts and maintenance.	
Monthly jetting by maintenance staff is needed to remove vivianite scale that has built up in the MBC process units.	
The City recommends finding a source outside of the vendor to supply parts, if possible.	
Silos have screws that cannot be taken down, making it difficult to access this equipment.	
Maintenance is based on run times, not calendar years. This change was in attempt to minimize costs. The computer system tracks run times for equipment.	
The MBC maintenance staff includes one full-time mechanical engineer, one mechanical supervisor, three centrifuge mechanics, and two intermediate-level mechanics.	

Project Delivery/Project Management

Table 5. MBC Project Delivery/Project Management Feedback	
Feedback	To be Considered by San José
When the City first started centrifuge operations at the MBC, a warranty with Alfa Laval was contracted for 10 years. The City found that the work from Alfa Laval was inconsistent, unreliable, and very costly. This resulted in the City shifting to owner maintenance, which took approximately four years for the plant mechanics to learn. Now all O&M is done in house with three operators and three full-time maintenance employees. Recommend avoiding long maintenance contracts and train in-house staff instead. Realistic time is four years of training.	
The City recommends a Stand-alone Computerized Maintenance Management System (CMMS) for work orders and preventative maintenance is also recommended.	
The City provided some design advice in which they emphasized the following: (1) the importance of good control systems, (2) operational simplicity, (3) centrifuge elevation, (4) avoiding extra conveyance systems, and (5) designing facilities to have a minimum of 3 feet clearance from equipment for O&M staff access.	
The City believes that the MBC biosolids quantity is currently declining.	
City will stay Class B for as long as possible due to cost. If they go to Class A, they will utilize a drum dryer of gasification technology.	
There was not enough time for the planning phase. The facility was designed for a different location that had to be changed. When the facility was relocated to the current site, the design was not modified, and some elements that were a constraint in the original location did not exist in the new one.	

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Brown AND Caldwell

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Technical Memorandum

FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.3

Subject: Hyperion Treatment Plant (City of Los Angeles) Tour Summary

Date: July 3, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steve A. Wilson
Steve Wilson, Chief Scientist

REGISTERED PROFESSIONAL ENGINEER
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Location

Hyperion Treatment Plant
12000 Vista Del Mar
Playa Del Ray, California

Date of Tour

March 27, 2014

Visit Duration

8:00 a.m. to 11:30 a.m.

Areas of Interest

Biosolids processing and truck loadout facilities

Visit Attendees

John Cannon, City of San José
Mariana Chavez-Vazquez, City of San José
Sal Campos, City of San José
Robert Cuellar, City of San José
Alison Nojima, Brown and Caldwell
Linda Stewart, City of San José
Issayas Lemma, City of San José
Satya Nand, City of San José
Jan Davel, Carollo
Steve Wilson, Brown and Caldwell

Tour Leaders

Ronald Palacios, City of Los Angeles
Francisco Ramirez, City of Los Angeles
Efrain Gonzalez, City of Los Angeles
Mark Starr, City of Los Angeles
Michael Noguchi, City of Los Angeles
Ron Bell, City of Los Angeles
Emmanuel Alloh, City of Los Angeles

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Purpose of Visit

The purpose of this site visit was to learn about City of Los Angeles (City of LA) Hyperion Treatment Plant (HTP) biosolids processing facilities with the goal of obtaining information that will assist the City of San José in developing and designing a new biosolids treatment process. Subjects of interest included capital improvement project (CIP) planning, engineering, and project delivery; Operations and Maintenance (O&M) requirements and lessons learned; and biosolids hauling and disposal diversification for the HTP. In particular, the tour focused on the following biosolids processing areas:

- class a thermophilic digestion
- centrifuge dewatering facilities
- cake storage and truck loadout

Site Overview

The HTP is a large wastewater treatment plant located in Manhattan Beach, CA serving the City of Los Angeles. The average daily flow to the HTP is 230 million gallons per day (mgd); total biosolids production averages 630 wet tons per day (wtpd), equivalent to 230 dry tons per day (dtpd). The end product of the solids processing train is Class A biosolids. The City of LA opted to produce Class A biosolids primarily because of regulatory disposition issues in Kern County, which bans Class B land application.

A summary of Hyperion's biosolids processing design criteria is shown in Table 1.

Table 1. HTP Solids Processing Summary

Parameter	Value
Average Wastewater Flow Rate, mgd	230
Biosolids Production, wtpd	630
Thermophilic Digesters Startup Year	2001
Average Digester Temperature	128°F
Average Digester Volatile Solids Reduction (VSR)	63-65%
Digested Sludge Dewatering Method	Alfa Laval centrifuges
Dewatered Cake Solids Content	28-30%

The treatment process consists of preliminary screening and enhanced primary treatment, a pure oxygen secondary activated sludge process, egg-shaped thermophilic anaerobic digesters, solid bowl centrifuges for sludge thickening and dewatering, and biosolids handling and storage.

Biosolids at HTP are stabilized using egg-shaped primary thermophilic anaerobic digestion (16 primary digesters total) followed by batch reactor tanks (four batch tanks total). The detention times in the thermophilic digesters and batch tanks are 12 days and 16 hours, respectively. Stage one digesters are for volatile solids reduction and stage 2 is for pathogen destruction. The batch tanks are operated at a time-temperature combination less than defined in 40 CFR Part 503, primarily to prevent an increase in the generation of methyl mercaptans that caused a number of complaints from the public.

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The digesters are heated with steam and are mixed with draft tube mixers. Three batteries of egg-shaped digesters were constructed in the mid 1990's that operated in the mesophilic temperature range; these digesters were converted to thermophilic digesters with batch tanks in 2001. Two of the HTP thermophilic egg-shaped digesters are shown in Figure 1.

Figure 1. HTP Egg-Shaped Thermophilic Digesters

Digested solids are conditioned with Mannich polymer then dewatered using high-speed (2,100 revolutions per minute) Alfa Laval centrifuges. The Class A biosolids cake produced in the dewatering process is generally between 28 and 30 percent solids. The capture efficiency of these centrifuges is reported to be 90 percent. There are eight Alfa Laval 706 centrifuges in the dewatering building with six of them running continuously during average conditions. Polymer requirements for dewatering are between 12 to 15 pounds per dry ton. This polymer consumption rate has decreased since the thermophilic digesters were brought online in 2001.

Dewatered biosolids are pumped using Schwing Bioset cake pumps (shown in Figure 2) to a loadout facility with 8 biosolids storage silos. Each silo has a capacity of 100 tons. Trucks are loaded from the storage silos from 10 p.m. to 10 a.m. daily.

The City of LA has three disposition options for HTP biosolids:

- land application at green acres farm
- composting
- deep well injection (2 contracts)

The portion of biosolids product currently being sent to each disposition location is represented in Figure 3.

Biogas from the digesters is piped to an adjacent power plant, which returns steam and electrical power to the HTP. The power plant plans to cease operation in 2016; because of the planned shutdown, the City of LA is constructing a 22-megawatt (MW) onsite turbine cogeneration system for the HTP. The new turbine cogeneration system was design-build-operate procured with a recent request for proposals.

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Figure 2. HTP Schwing Bioset Cake Pumps

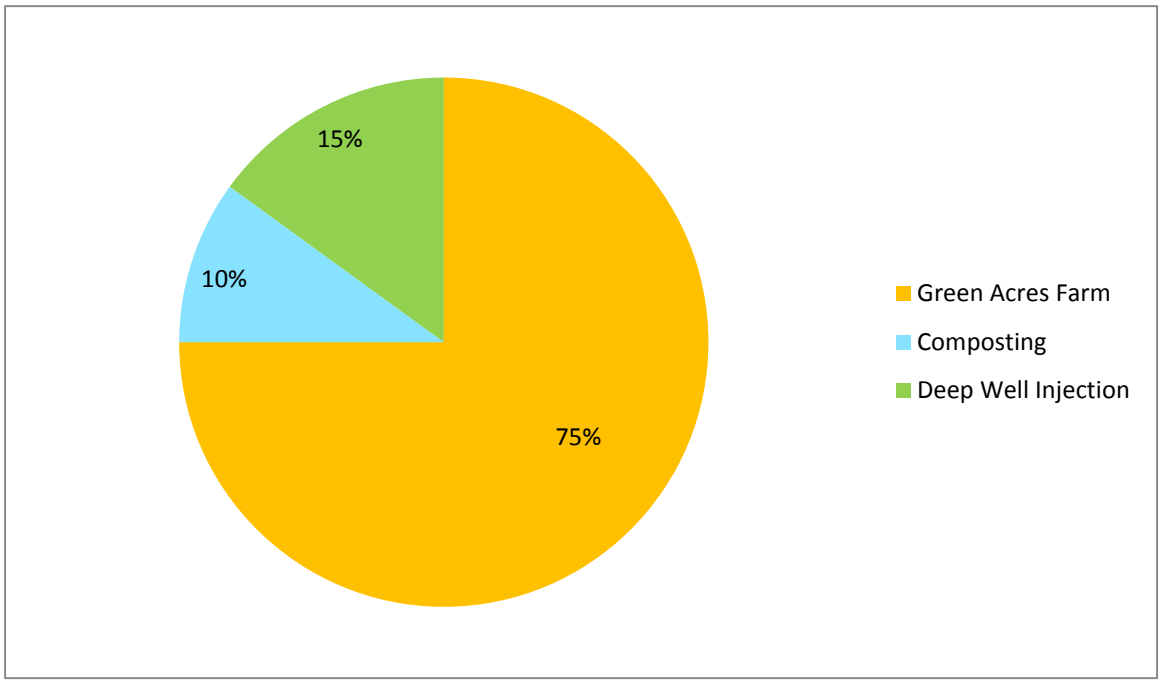

Figure 3. City of LA HTP Biosolids Disposition Locations

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Plant Feedback and Other Observations

City of LA staff provided the following feedback the HTP biosolids facility.

Operations

Table 2. HTP Operations Feedback	
Feedback	To be Considered by San José
New Alfa Laval centrifuges are being installed which are less noisy, easier to maintain, and have lower power consumption than the current centrifuges.	
No regrowth has been detected in thermophilic digestion system or any upstream or downstream facilities. Pipes are heat traced to keep the product Class A until it is loaded in the truck. Temperature must be carefully managed since not temperature phased anaerobic digestion.	
Tour leaders emphasized the importance trucking the biosolids product immediately to the farm for application and soil incorporation.	
City of LA staff believes that land application of Class A biosolids at Green Acres Farm is a very cost-effective operation.	
Compact and efficient solids processing facility: • Currently, HTP takes up 3 times less land area per million gallon (MG) wastewater treated than SJSCRWF. • The thickening/dewatering and biosolids loadout buildings are located in close proximity at the plant site. • Centrifuges are used for waste activated sludge (WAS) thickening with provision to co-thicken primary and WAS.	
Spray system utilized to mask odors on trucks before leaving facility.	
Trucks are loaded mostly 10 pm to noon to avoid afternoon rush hour and each truck takes 10 to 15 minutes to load. There are 4 loading bays.	
Thermophilic digestion has improved VSR and dewaterability, and reduced polymer consumption, but has increased the ammonia load in the centrate stream, odor issues, and the colloidal content of the final effluent. Incremental cost of producing Class A biosolids is $9.15 per wet ton, which translates to $2M per year at current biosolids production.	

Maintenance

Table 3. HTP Maintenance Feedback	
Feedback	To be Considered by San José
Most of maintenance is handled by HTP staff. Maintenance staff is capable of doing balancing on centrifuges.	

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Project Delivery/Project Management

Table 4. HTP Project Delivery/Project Management Feedback	
Feedback	**To be Considered by San José**
The City of LA transitioned the HTP to a Class A biosolids production to continue use of their Green Acres Farm in Kern County. Kern County has recently implemented a ban on Class B solids.	
The City of LA is currently conducting a Fats, oils, and grease receiving and treatment system pilot at the HTP.	
Los Angeles County is also purchasing land for compost and land application of biosolids.	
Establishing a strong biosolids management program that is guided by policy will help to define the biosolids program goals. HTP has been a member of the National Biosolids Partnership since 2003 and is the recipient of its highest EMS Platinum Award in 2006 and 2013.	
Currently HTP uses 3 times less land area per MG wastewater treated than SJSCRWF. Thickening, dewatering and loadout are located in close proximity to the plant site.	
Pilot study determined that centrifuges operated better with thermophilic digestion.	

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Technical Memorandum

FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.4

Subject: Orange County Sanitation District Plant 2 Tour Summary

Date: July 3, 2014

Revised August 5, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steve A. Wilson
Steve Wilson, Chief Scientist

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Location

Orange County Sanitation District Plant 2
22212 Brookhurst Street
Huntington Beach, California

Date of Tour

March 27, 2014

Visit Duration

1:30 p.m. to 4:30 p.m.

Areas of Interest

Biosolids processing and truck loadout facilities

Attendees

Mariana Chavez-Vazquez, City of San José
Robert Cuellar, City of San José
Satya Nand, City of San José
John Cannon, City of San José
Alison Nojima, Brown and Caldwell
Deirdre Bingman, OCSD
Issayas Lemma, City of San José
Salvador Campos, City of San José
Linda Stewart, City of San José
Steve Wilson, Brown and Caldwell
Jan Davel, Carollo

Tour Leaders

Michelle Hetherington, OCSD
Roy Reynolds, OCSD

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Purpose of Visit

The purpose of the Orange County Sanitation District (OCSD) Plant 2 tour was to gain an understanding of the solids processing operations, discuss solids operations and maintenance (O&M) lessons learned, and learn the capital improvement projects currently in design or construction. The goal of this site visit was to obtain information that will assist the City of San José in developing and designing a new biosolids treatment process. In particular, the tour focused on the following process areas:

- cake storage
- current dewatering capital improvement project

Wastewater Treatment System Overview

OCSD owns and operates two wastewater treatment plants: Plant 1 in Huntington Beach, CA and Plant 2 in Fountain Valley, CA. The facility tour focused only on Plant 2. Plant 1 treats an average of 97 million gallons per day (mgd) and Plant 2 treats an average of 103 mgd for a total of 200 mgd. In 2013, 770 wet tons per day (WTPD) of biosolids (280,000 wet tons per year [WT/yr]) were processed at both facilities combined. At both plants, sludge is digested using mesophilic anaerobic digestion, yielding a Class B biosolids product. Digester gas is blended with natural gas at both plants to produce a total of 5.4 megawatts (MW) of power.

The Class B product is hauled to four different locations, including two composting operations, a landfill, and a farm, where biosolids are used as fertilizer. The breakdown of biosolids disposition is shown in Figure 1.

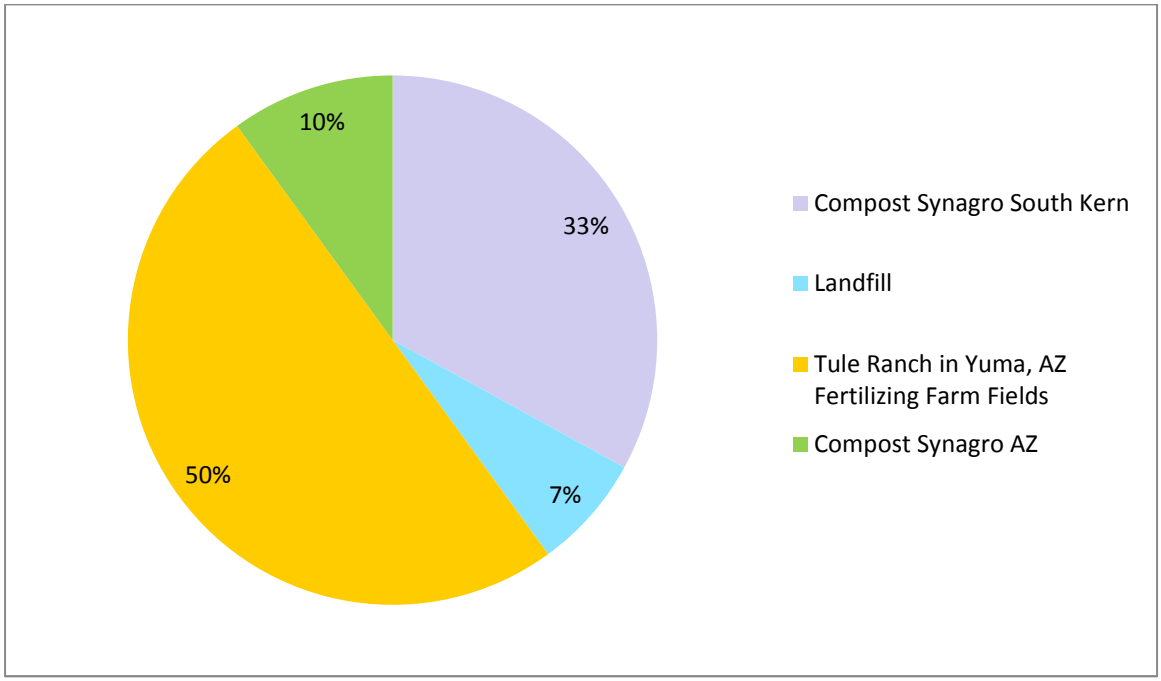

Figure 1. OCSD Plants 1 and 2 Biosolids Disposition Locations

Hauling and disposal costs of the Class B biosolids product (including material from both plants) for the four disposition locations are presented in Table 1.

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Table1. Cost Summary for OCSD Biosolids Disposition	
Location	$/WT
South Kern Composting (Synagro)	68
Arizona Composting (Synagro)	63
Tule Ranch (Yuma, AZ) Land Application	55
Landfill	53

Plant 2 Site Overview

Following is a summary of the elements of the Plant 2 solids processing train:

- Primary sludge (from chemically enhanced primary treatment) and primary scum are pumped directly to the digesters.
- Waste activated sludge is thickened in dissolved air flotation thickeners (DAFTs) and then pumped to the digesters.
- Sludge is treated in single-stage mesophilic anaerobic digesters. There are 10 recently rehabilitated digesters at Plant 1 and 15 at Plant 2. Plant 1 achieves 53 percent volatile solids reduction (VSR) at 18 days solids residence time (SRT) while Plant 2 achieves 55 percent VSR at 21 days SRT.
- Digested sludge is currently dewatered with 15 belt filter presses, which increase the solids content to approximately 25 percent.
- Dewatered sludge is transported from the dewatering building to the cake transfer station using belt conveyors. The conveyors transport the sludge to two 450-cubic yard storage bins.
- Biosolids are dropped into trucks on a daily basis in the Truck Loading Facility (shown in Figure 2) and then hauled offsite. Compact, 2-bay biosolids loadout facility is a good example of a simple, efficient design, however, needs improvements around discharge ports into the trucks and is messy.

Figure 2. Truck Loading Facility Bay

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A capital improvement project is currently nearing design completion that will replace the belt filter presses and install both thickening and dewatering centrifuges. Four of the existing DAFTs will be upgraded to thicken WAS, while primary sludge will be pumped directly to the digesters. Alfa Laval, Westfalia, Flottweg and Andritz are being considered for the centrifuges. Also part of the design, dewatered sludge will be pumped using Schwing-Bioset or Putzmeister piston pumps at a rate of 40 gallons per minute (gpm) and 25 percent solids. The entire project construction cost is estimated at $57 million and is expected to be completed in 2019. It is anticipated that improving the dewatering technology will increase the solids concentration of the biosolids from 18 to 20 percent in the BFP to 26 to 28 percent in the centrifuges, thus reducing the quantity of biosolids to be transported offsite by roughly 33 percent. This estimated savings in hauling and disposal cost will be $7M per year.

Plant Feedback and Other Information

OCSD staff provided the following feedback on issues associated with their solids processing facilities.

Operations

Table 2. OCSD Operations Feedback

Feedback	To be Considered by San José
OCSD recommends using more and smaller centrifuges to add solids treatment redundancy. They also noted that the future thickening centrifuges will be used for co-thickening, which is projected to extend digester capacity.	
Solids processing facility is compact and efficient. Solids processing building is centralized and houses thickening, dewatering with cake storage and loadout in close proximity to the plant.	
At this time, OCSD has no particular interest in onsite Class A biosolids processing; OCSD believes that the current biosolids disposition outlets are viable for the immediate future.	
12 hauling and disposal trucks come in through the facility per day. Trucks pass through the facility, but do not cause problems. They seldom arrive at the same time.	

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Project Delivery/Project Management

Table 4. OCSD Project Delivery/Project Management Feedback

Feedback	To be Considered by San José
OCSD has a strong and very extensive biosolids management program and is engaged in outreach programs and a part of the National Biosolids Partnership Environmental Management System that helps them document regulatory compliance requirements and the best management practices for biosolids. This helps gain public confidence and acceptance in the biosolids beneficial use programs. OCSD has been a member since 2003 and has multiple biosolids EMS awards.	
Centralized thickening and dewatering facility highly desirable. Siting of dewatering and truck loadout facilities in close proximity would be beneficial.	
There is staff dedicated completely to the biosolids program, including securing contracts and negotiating contracts.	
Moved from doing open RFI to more formal RFP so they can ensure contractors comply with things are important to the facility.	
$18M annual biosolids budget for disposal of 287,400 wet tons of cake per year from Plant 1 and Plant 2. Relatively diversified with the disposal options and nearly equally divided between in-state composting and out-of-state land application.	
Experience with design-build (DB) is limited to the $15.5M Magnolia Trunk sewer project. Since requirements for electrical, instrumentation and other onsite concerns are tighter and many details have to be known ahead of time, DB was not used for big capital projects at OCSD.	
The Plant 2 solids processing system currently includes two additional non-Plant 2 solids streams: a portion of the solids produced at Plant 1 and solids from the Irvine Ranch Water District (IRWD) wastewater treatment plant. In the future, IRWD plans to install its own solids processing facilities, after which that solids stream will be removed from Plant 2. The planned facility at IRWD is egg-shaped digesters and thermal drying. Thermal drying costs were estimated at $135/ton.	
The failed Enertech biosolids-to-energy facility was taking some biosolids from the OCSD plants at $70/ton. OCSD was told that condensate treatment was problematic in the Enertech facility. OCSD understands that the facility was purchased by Anergia and its future remains unclear.	
OCSD put out a recent request-for-proposal (RFP) for a new land application facility for its biosolids; OCSD is willing to share the RFP with the tour group. OCSD tour leaders noted that there would be an emphasis on qualifications, not price.	
A seismic study for the OCSD digesters is a future project; this study may include consideration of various digester technology upgrades.	
Commissioning of centrifuges took one year.	
OCSD implemented a Long-Range Biosolids Management Plan guideline for biosolids disposal and contracting. In 2013, a new guideline was adopted for biosolids disposal and contracting diversity: • ≥ 3 product manufacturing options • ≤ 50% in any one market • ≤ 50% to any one contractor • < 1/3rd per merchant facility • (Source: Bingman et al (2009) WEFTEC publication)	
OCSD is conducting bench-scale testing of a Supercritical Water Oxidation (SCWO) process called AquiCritox® at Plant 1.	
Successful collaborative efforts between OCSD and OCWD placed Orange County district at the forefront in recycle water use. Currently the District converts 35% of its total combined secondary effluent to near distilled-quality water produced at OCWD's state-of the-art Groundwater Replenishment System (GWRS). Currently, Plant 1 is the provider of secondary effluent to GWRS. The recycle water production will increase to 50% of the combined secondary effluent when the 100 MGD expansion project of the GWRS will be completed by 2015. The reclaimed water is largely used to replenish the county's groundwater basin and to prevent sea water intrusion.	
Plant 1 is currently replacing 6 WAS only DAFTs with four centrifuges for primary and secondary sludge co-thickening.	
Putzmeister pump can run 24 hours a day, 7 days a week for up to a year before a rebuild is needed while the Schwing pump	

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needs to be serviced 3 to 4 times a year.	

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Technical Memorandum

FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.5

Subject: Green Acres Tour Summary

Date: July 3, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steve Wilson
Steve Wilson, Chief Scientist

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Location

Green Acres Farm
15702 Union Road
Bakersfield, California 93311

Date of Tour

March 28, 2014

Visit Duration

10:00 a.m. to 12:00 p.m.

Areas of Interest

Land application of Class A biosolids product

Attendees

Issayas Lemma, City of San José
Robert Cuellar, City of San José
Satya Nand, City of San José
Steve Wilson, Brown and Caldwell
Jan Davel, Carollo
John Cannon, City of San José
Salvador Campos, City of San José
Linda Stewart, City of San José
Alison Nojima, Brown and Caldwell

Tour Leaders

Robert Fanucchi, Green Acres Farm
Arturo Perez, Green Acres Farm
James Stockton, Green Acres Farm

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Purpose of Visit

The purpose of the touring Green Acres Farm was to learn about land application of Class A biosolids as a disposition alternative.

Site Overview

Green Acres Farm (shown in Figure 1) is a 4,688-acre farm in Kern County owned and operated by the City of Los Angeles (City of LA). The City of LA purchased the farm in 2000 from the City of Bakersfield for $10M. Since then, the farm has been utilized for land application of Class A biosolids, which help improve soil quality and crop growth. Approximately 80,000 dry tons of biosolids are applied to the farmlands annually as cited in the "City of Los Angeles Green Acres Fact Sheet".

Figure 1. Green Acres Farm Site

The main crops grown at Green Acres include wheat, corn, alfalfa, sudan, and milo. Biosolids cake is spread using a front-end loader then immediately incorporated into the soil per an agreement with Kern County. Equipment used for soil incorporation is shown in Figure 2. The land is left open for application in between rotated crops. All of the crops are sold to nearby dairies for feed and the Farm generated close to $3.8M in revenue from 2012 to 2013.

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Figure 2. CAT Challenger and Disc Implement for Incorporating Biosolids into the Soil

The City of Los Angeles pays $150,000 per year in property tax to Kern County. In spite of the success, the Farm is under threat of closure due to Kern County's 2006 ban on all biosolids land application. Because of the 2013 court injunction on Kern County's ban, Hyperion Treatment Plant is still continuing to land apply biosolids at Green Acres Farm.

Farm Feedback

Green Acres Farm staff provided the following feedback on benefits and issues related to project management.

Table 1. Green Acres Feedback

Feedback	To be Considered by San José
Recycling biosolids saves local and state government money through lower management costs and sales of biosolids-derived products, keeping biosolids out of landfills, and placing them where they can be beneficially reused.	
Public risk perception is that biosolids are not safe for crops. The agency has struggled for years with County-sponsored bans on land application. Class B land application is banned in Kern County and Class A land application was also banned previously. Legal costs continue as court decisions are appealed.	
The farm operation takes a dedicated team of people to carefully monitor soil nitrogen content, and to match that content with the appropriate crop rotation.	
A combination of a number of fortunate aspects make Green Acres Farm particularly successful: • The soil on the farm is somewhat arid; therefore it is not very desirable for other applications. • Fertilizer is already contained in the Hyperion Treatment Plant biosolids applied at the farm. • The farm has a secure effluent water source from the Bakersfield Wastewater Treatment Plant. • There is a large demand for the farm products in the adjacent dairy farms.	
The City of LA pays property taxes and biosolids permit fees to Kern County for operating the Green Acres Farm.	
Green Acres Farm crop sales were approximately $1 million in 2013. Crop sales help offset the operating costs for the farm as well as legal costs. However, the net costs are considered lower than hauling beyond Kern County to another location.	

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Technical Memorandum

FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.6

Subject: South Kern Composting Tour Summary

Date: July 3, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steve A. Wilson
Steve Wilson, Chief Scientist

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Location

South Kern Composting Facility
2653 Santiago Road
Taft, California

Date of Tour

March 28, 2014

Visit Duration

12:30 p.m. to 2:00 p.m.

Areas of Interest

Composting operations and product marketing

Attendees

Issayas Lemma, City of San José
Robert Cuellar, City of San José
Satya Nand, City of San José
Steve Wilson, Brown and Caldwell
Jan Davel, Carollo
John Cannon, City of San José
Salvador Campos, City of San José
Linda Stewart, City of San José
Alison Nojima, Brown and Caldwell

Tour Leaders

Layne Baroldi, Synagro
Jose Rodriguez, Synagro
Tony Cordova, Synagro

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Purpose of Visit

The purpose of the South Kern Composting (SKC) Facility tour was to learn about the compost product marketing, and Operations and Maintenance (O&M) requirements and issues related to the facility. Synagro owns and operates the SKC Facility.

Site Overview

The SKC Facility has been in operation since 2007. The total construction cost of the facility was approximately $25 million. Since 2007, over 2 million tons of organic materials have been processed into high-quality compost, which improves soil heath, aids agriculture, and reduces recyclable materials going into landfills. The SKC Facility is a Platinum Certified Environmental Management System facility and chooses to participate in this program voluntarily.

The composting site footprint is approximately 50 acres and uses the aerated static pile compost process, pictured in Figure 1. The tour leaders noted that smaller composting facilities in California use a less expensive windrow composting process. The SKC Facility permit capacity is 550 wet tons per day (WTPD) of biosolids and 600 WTPD of green waste. Major biosolids suppliers include the Los Angeles County Sanitation Districts wastewater treatment plants (WWTPs), the City of Los Angeles Hyperion Treatment Plant, and the Orange County Sanitation District Plants 1 and 2. There are a total of eight California wastewater agencies that provide biosolids to SKC.

Figure 1. Aerated Static Pile Composting

Biosolids must be between 18 and 30 percent solids to be accepted at the SKC Facility. The facility uses wood chips used as the bulking agent for the feedstock to achieve the desired solids content. Biosolids from the wastewater treatment plants and the bulking agent (shipped in primarily from Bakersfield) are received in a building and mixed in a 1:1 ratio (by volume). The feedstock mix of biosolids and bulking agent is

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transferred to the aerated static piles. Primary pathogen reduction occurs in the first 22 days at a temperature range of 145 to 151 degrees Fahrenheit.

Foul air inside the building is collected and treated in bulk organic media biofilters. Tour leaders noted that odor control is required by the South Coast Air Quality Management District (SCAQMD) when composting facilities exceed 100,000 tons of material per year. Ductwork for the SKC Facility odor control system is shown in Figure 2.

Figure 2. Odor Control Ductwork

Facility Feedback

SKC Facility staff provided the following feedback on the design features, product marketing, and operation issues with the composting facility.

Operations

Table 2. SKC Operations Feedback

Feedback	To be Considered by San José
Rain does not present an issue for the composting process.	
The SKC Facility meets Best Available Control Technology (BACT) requirements for the SCAQMD.	
The SKC Facility is odorous, in spite of the negative aeration of the compost piles. Because of this, the facility had to be located outside of urban areas.	

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Project Delivery/Project Management

Table 4. SKC Project Delivery/Project Management Feedback	
Feedback	**To be Considered by San José**
Sourcing amendments takes a lot of time and effort for the facility.	
There is dual ownership of the biosolids once the biosolids are on the truck and are being hauled to the SKC Facility site. The biosolids generator responsibility ends once the composting process has been completed. However, in some cases the biosolids generator may not be able to completely contract liability to another entity even after composting completion.	
Marketing requires a significant amount of effort to build relationships with haulers and farmers.	
The close proximity to the region's major biosolids generating WWTPs and to the end use market makes SKC Facility operations feasible.	
There are some limitations on the final use of the compost product due to competition with other producers who can label their product as "biosolids free."	

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Technical Memorandum
FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.7

Subject: Chambers Creek Regional Wastewater Treatment Plant (Pierce County) Tour Summary

Date: July 3, 2014

Revised August 5, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steven A. Wilson
Steve Wilson, Chief Scientist

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Location

Chambers Creek Regional Wastewater Treatment Plant (Pierce County)
10311 Chambers Creek Road, W.
University Place, Washington 98467

Date of Tour

April 4, 2014

Visit Duration

9:00 a.m. to 11:30 a.m.

Areas of Interest

Biosolids processing, fertilizer manufacturing facility, product sales and marketing, sidestream treatment

Attendees

Mariana Chavez-Vazquez, City of San José
Hugh Logan, City of San José
Woody Hassman, City of San José
John Cannon, City of San José
Steve Wilson, Brown and Caldwell
Jan Davel, Carollo
Issayas Lemma, City of San José
Steve Contreras, City of San José
Linda Stewart, City of San José
David Huerta, City of San José
Alison Nojima, Brown and Caldwell

Tour Leaders

Amanda Summers, Pierce County
Katherine Brooks, Pierce County
Melissa Newell, Pierce County
Larry Ekstrom, Pierce County

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Purpose of Visit

The purpose of this site visit was to learn about Pierce County's biosolids processing facilities with the goal of obtaining information that will assist the City of San José in developing and designing a new biosolids treatment process. In particular, the tour focused on the following topics:

- class a SoundGRO product
- sidestream nutrient removal
- alternative project delivery

Subjects discussed with Pierce County included the planning, engineering, and project delivery features of the biosolids processing facilities and Operations and Maintenance (O&M) requirements and lessons learned. SoundGRO is manufactured using the same drum drying system (DDS) thermal dryer that the group visited at the Sacramento Regional Wastewater Treatment Plant; however the Pierce County facility is owner-operated where the Sacramento Regional facility is operated by a contractor.

Solids Processing Overview

The Pierce County Chambers Creek Regional Wastewater Treatment Plant (CCRWTP) solids processing system includes sludge thickening, digestion, and drying that converts dewatered sludge into a dry pelletized commercial fertilizer called SoundGRO. The average annual flow at Pierce County is 19 million gallons per day (mgd) with an operational capacity of 24 mgd.

SoundGRO is a registered Class A "Exceptional Quality" (EQ) product. The CCRWTP produces an average of 2,400 tons per year (TPY) of SoundGRO in its Fertilizer Manufacturing Facility (FMF). The FMF has been in operation since June 2006. Bags of SoundGRO are shown in Figure 1.

Figure 1. Bagged SoundGRO Product

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One of the drivers to move Pierce County to a Class A EQ product was to cease Class B land application, which was considered by Pierce County to be higher risk. The 2001 Unified Sewer Plan and Master Site Plan also recommended that Pierce County move to a Class A biosolids final product.

At the CCRWTP, sludge is thickened using gravity belt thickeners (GBTs) and then is digested using two-stage mesophilic anaerobic digestion. Digested biosolids are then dewatered using Andritz centrifuges to achieve 19 to 21 percent dry solids. Polymer usage for dewatering is approximately 50 pounds per dry ton. Dewatered solids are then conveyed to a wet materials bin for storage. Dewatered cake from the wet materials bin and a combination of dust and pellets from the recycle bin are combined and sent to a mixer. The mixed solids have a concentration of 70 percent dry matter. Figure 2 depicts the solids process flow downstream of centrifugation.

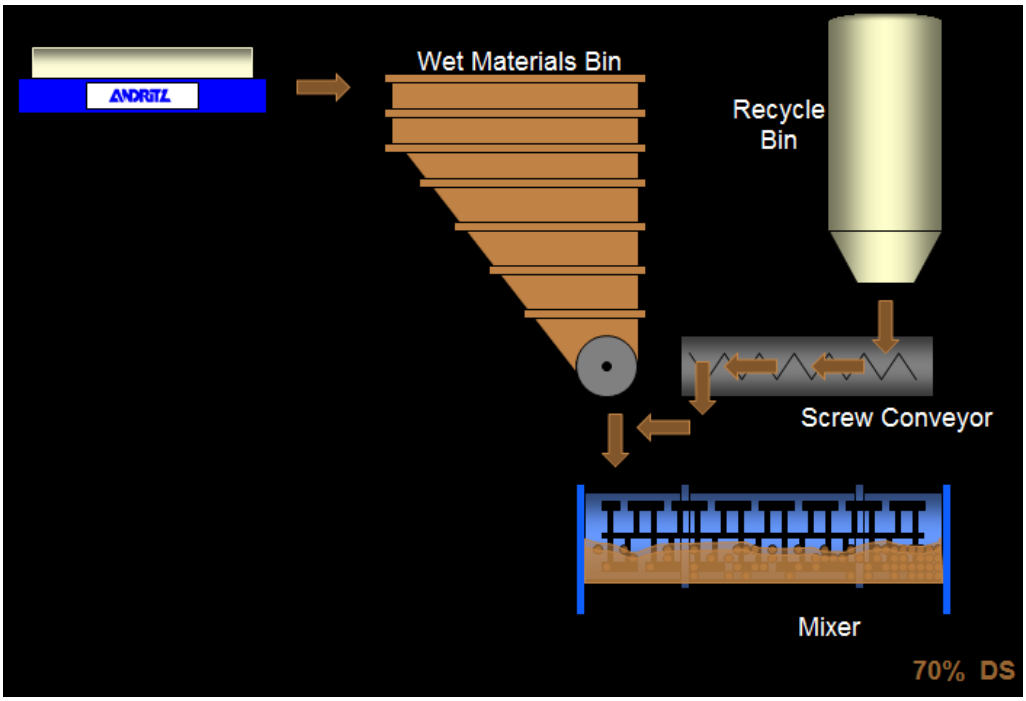

Figure 2. CCRWTP Solids Process Flow

After mixing, solids are then sent to a drum dryer. The dryer operates 24 hours a day for typically 5 days a week, during which time 4,400 pounds per hour of water are evaporated. During times when the FMF is not in operation, solids are stored in the digesters and/or a Class B product is produced. Class B biosolids can be hauled to land application as a contingency.

The thermal dryer, a portion of which shown in Figure 3, is fueled by surplus digester gas and natural gas. The facility has an annual operating cost of $1.54 million and retains $140,000 from product revenue. The net operating cost is therefore on the order of $640/dry ton (similar to the Sacramento Regional County Sanitation District dryer facility). An estimate for the average annual maintenance labor is 3,050 hours, which equates to roughly 1,700 work orders.

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Figure 3. Dry Solids Recycle and Mixing

From the drum dryer, the pellet product is sent to the pre-separator/polycyclone then to the vibrating screens. The vibrating screens sort out pellets by size, and those that are within 0.5 to 2.0 millimeters are sent to the pellet cooler. These pellets are transferred with a pneumatic conveyor to the storage silos, and then the finished product is ready for sale. Fertilizer is sold in 50 pound bags, 1-ton totes, and loose bulk. The bulk market is preferred. Design criteria and economic criteria for the FMF are summarized in Table 1.

Table 1. CCRWTP Fertilizer Production Design and Economic Summary

Parameter	Value
Annual Fertilizer Production, TPY	2,400
Fertilizer Production Cost, $/dry ton	640
FMF Capital Cost	$13 million
Annual Operating Cost (Cost – Revenue)	$1.54 million
Annual Revenue	$140,000
Final Product Percent Solids	91%
Final Product Size, mm	0.5-2.0

Some of the key benefits of the FMF identified by Pierce County staff included the following:

- Lower odors as compared to the Class B product.
- 80 percent volume reduction.
- A marketable product that can recover some costs associated with production.
- Greater public acceptability versus Class B biosolids.

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Sidestream Treatment Pilot Overview

In addition to a biosolids processing facility, the group discussed a four-month Anammox pilot that was conducted in 2011. This sidestream treatment pilot project was dedicated to dewatering centrate and was successful at removing about 80 percent of total inorganic nitrogen (TIN). During the pilot, there were issues with zoogleal slime bulking, which is attributed to a possible magnesium deficiency. To address the problem, alkalinity was added, which in turn improved TIN removal to 90 percent.

Following a successful pilot study, Pierce County moved forward to implement the Anammox process at full scale (first in USA at full scale). World Water Works is the supplier for the Anammox process and the facility should be online in 2015.

Plant Feedback and Other Information

Pierce County staff provided the following feedback on issues related to the biosolids facility and FMF.

Operations

Table 2. Pierce County Operations Feedback

Feedback	To be Considered by San José
Staff is happy with the GBT performance, but will transition to rotating drum thickeners because they believe it will be a simpler process.	
A Washington sales tax exemption was obtained for the FMF as a "manufacturing facility", but total operating cost is still greater than hauling and Class B land application.	
The FMF has strict regulatory requirements for air quality permitting and metals content.	
The regenerative thermal oxidizer (RTO) unit needs to be at optimal temperature before it becomes operational; this has been the bottleneck in the FMF process.	
The FMF is an award winning facility for recycling, excellence in biosolids management, sustainable practices, and pollution prevention.	
Some of the operational challenges with the Annamox pilot include the following: • Early washout of Annamox biomass • Nitrite toxicity • Challenges from nutrient deficiency • Requirement for tighter process control	

Maintenance

Table 3. Pierce County Maintenance Feedback

Feedback	To be Considered by San José
FMF is operated 24 hours per day, 5 days per week. Mondays and Tuesdays are off days, and maintenance is performed on these days.	
There is a tremendous lead time for proprietary dryer parts.	
The FMF equipment requires excessive maintenance and is a poor return on investment. There are 3500 hours of maintenance and 1700 work orders. There are 7 mechanics for preventative maintenance alone.	

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Project Delivery/Project Management

Table 4. Pierce County Project Delivery/Project Management Feedback	
Feedback	**To be Considered by San José**
Most of work is design-bid-build. Pierce County has done design-build in the past, however, would prefer GC/CM to put the construction manager at risk. This method is preferred for the City of Seattle and Tacoma.	
Initial registration required fertilizer content laboratory analysis for nitrogen-phosphorus-potassium (NPK), micronutrients, and metals.	
Pierce County prefers to secure contracts with large fertilizer companies who use the product to blend with theirs. The bagging operation has extensive handling requirements for storage, disposal/sale of small quantities and higher worker injuries.	
Pierce County is currently re-evaluating the decision to register their fertilizer due to complexity and administrative requirements.	
Pierce County recommends knowing the market before committing to a big capital improvement program for reusable biosolids.	
Annamox system will save money on aeration costs. The system was pre-purchased and extensive testing was performed.	
Pierce County sole-sourced the equipment purchases to Andritz, for both the centrifuges the drying equipment. Since then, the Agency has changed its policy and all capital improvements to the plant are decided on a Net Present Value basis, considering initial capital cost and O&M costs.	
Prefer to have RFPs to attract larger companies that would provide a more reliable and consistent way to move product.	
Commercializing a fertilizer product requires full time employees to deal with sales, marketing and customer service. In retrospect, Pierce County does not see the benefit of registration. Most of the major clients do not care about registration.	
Pierce County is an excellent agency to reach out to for side stream treatment for dewatering facilities.	
Pierce County produces a 21% dewatered cake using significantly more polymer than other similar facilities (50-60 lb/ dry ton)	
Prefer to have a secure contract with larger buyers or dried product and manage fewer contracts	
Invested $1 M in a commercial bagging system to pack their 50 LB pellet bags and the investment is never recovered. The amount of effort to keep the ordering, inventory and dealing with the number of injuries is not worth the effort.	
Correct sizing for pellet silos is important. Keep silos small to avoid prolonged onsite storage and reduce the need for inert gas purging to prevent combustion. If pellet silos are too large, and/or there is a long retention time in the silos, the pellets will spontaneously combust.	
Product must be kept dry to prevent spontaneous combustion. Re-wetting of product from external sources (i.e. rain) or internal (condensation) must be controlled.	

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Technical Memorandum
FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.8

Subject: Tacoma Central Wastewater Treatment Plant and TAGRO Tour Summary

Date: July 3, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steve A. Wilson
Steve Wilson, Chief Scientist

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Location

Tacoma Central Wastewater Treatment Plant
2201 Portland Avenue
Tacoma, Washington 98421

Date of Tour

April 3, 2014

Visit Duration

1:30 p.m. to 4:30 p.m.

Areas of Interest

DAFTs, digestion facilities, TAGRO facility, product sales and marketing

Attendees

Mariana Chavez-Vazquez, City of San José
Hugh Logan, City of San José
Woody Hassman, City of San José
John Cannon, City of San José
Steve Wilson, Brown and Caldwell
Jan Davel, Carollo
Issayas Lemma, City of San José
Steve Contreras, City of San José
Linda Stewart, City of San José
David Huerta, City of San José
Alison Nojima, Brown and Caldwell

Tour Leaders

Daniel Thompson, City of Tacoma
Larry King, City of Tacoma
Jeff McVicker, City of Tacoma
Jody Bratton, City of Tacoma
Mike Patrick, City of Tacoma
Russ Muncy, City of Tacoma
Ho-ping Wei, City of Tacoma

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Purpose of Visit

The purpose of this site visit was to learn about the City of Tacoma (City) biosolids processing facilities and the operation that creates their TAGRO (short for "Tacoma Grow") product. In particular, the tour focused on the following process areas:

- Autothermal thermophilic aerobic digestion (ATAD) and temperature phased anaerobic digestion (TPAD)
- Dissolved air flotation thickening
- Class A TAGRO product

Subjects of interest included the facility features planning, engineering, and project delivery aspects, Operations and Maintenance (O&M) requirements and lessons learned, and the marketing aspects of the TAGRO product.

Site Overview

The City of Tacoma Central Treatment Plant (CTP) treats an average wastewater flow of 20 million gallons per day (mgd) and produces an average of 11 dry tons per day (DTPD) of biosolids. The Tacoma CTP liquid-phase treatment processes consist of primary sedimentation, high-purity oxygen activated sludge secondary treatment, secondary clarification, disinfection, and effluent pumping into Puget Sound.

Primary and secondary sludge is co-thickened using dissolved air flotation thickeners (DAFTs) to five percent solids. The DAFTs were recently converted from secondary sludge thickening to co-thickening. A picture of a DAFT at the Tacoma CTP is shown in Figure 1.

Figure 1. Tacoma CTP DAFT

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Following treatment in the DAFTs, thickened sludge is fed directly to the digesters. Digestion at the Tacoma CTP is accomplished using a two-stage, aerobic and anaerobic process:

- The aerobic first stage in the digestion process is autothermal thermophilic aerobic digestion (ATAD). A picture of the ATAD reactor tanks is shown in Figure 2. The ATAD process achieves Class A pasteurization in small aerobic digesters that operate at a temperature of 140°F with a detention time of 1 day. The process uses eight 22,000 gallon tanks that operate in a plug flow configuration.
- The anaerobic second stage in the digestion process is temperature phased anaerobic digestion (TPAD). In this stage, volatile solids reduction and stabilization occur. The TPAD stage is divided into two parts in series: thermophilic digestion at 128°F and mesophilic digestion at 96°F.

Figure 2. Tacoma CTP ATAD Reactor Tanks

This dual digestion system (ATAD followed by TPAD) has been operating at the Tacoma CTP for 20 years. It is thought to be the only system in existence operating with this specific configuration.

Digested biosolids are dewatered using belt filter presses to achieve 22 percent solids. Polymer dosing for dewatering is on the order of 25 pounds per dry ton. Tour leaders noted that the belt filter presses are relatively old, and the City of Tacoma will be transitioning to screw presses for dewatering next year. The screw presses are projected to require less horsepower, use less water, and have lower polymer dosage requirements. The new screw presses will essentially be an unmanned facility with continuous operation.

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The main driver for the conversion to screw presses is that the Tacoma CTP is currently running at maximum electrical capacity and the screw press technology reduces power consumption. Tour leaders noted that the City needed to maintain a 20 percent solids concentration because it is preferred for their TAGRO operation rather than a higher percent solids cake. The screw press technology provides this solids content.

At the Tacoma CTP, the dewatered cake is considered an intermediate product. Rather than hauling away cake, the biosolids are blended with sand and sawdust using a front-end loader and rotary screen shown in Figure 3.

Figure 3. Biosolids Blending with Sand and Sawdust

Following blending, the mixture is shredded and mixed again to make the TAGRO product. The material is stored in a building until it is loaded into a customer's vehicle.

The TAGRO product was created for landscaping primarily for housing developments of Pierce County. A summary of economics of the TAGRO operation are shown in Table 1.

Table 1. TAGRO Production Economic Summary

Parameter	Value
Annual Biosolids Production, dry tons/year	3,500 –4,000
Facility Yearly Operating Cost	$950,000
Facility Yearly Revenue	$600,000
Net Cost per Dry Ton	$88-$100

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Plant Feedback and Other Observations

The City of Tacoma and TAGRO staff provided the following feedback on their lessons learned for operations, maintenance, and project delivery/project management.

Operations

Table 2. Tacoma Operations Feedback

Feedback	To be Considered by San José
The Tacoma DAF primary and WAS cothickening clearly demonstrated the limitation of DAF thickening in achieving 5.5% solids feed sludge concentration at SJSCRWF. With polymer addition, the DAFT can only thicken up to 4.5%. • With a 4.5% feed sludge concentration, the primary objective of recovering additional digestion capacity with the current DAFT co-thickening project at SJSCRWF may not be realized. • This project (at Tacoma) was implemented to solve a solids settling problem in the primary clarifiers, not to recover additional digester capacity. • A stress test conducted at Tacoma prior to the conversion to co-thickening indicated an increase in subnatant solids concentration.	
TAGRO Model: • The City manages the demand for their TAGRO product by disposing of excess quantities in a liquid format, which requires none of the mixing or handling that the solid product requires. • TAGRO has been very successful, partly because of biosolids reuse culture in Washington and an inspired operations staff. Public relations and marketing also made the program successful. There are 11 operators, 3 marketing staff, and a delivery driver. • Class A cake is blended with locally available sawdust, sand, and bark to produce potting soil and mulch that is sold under the brand name of TAGRO. • Places a priority in creating a market 'demand' for its products. • Market strategy seems to produce cliental that is willing to pay for TAGRO products. This model of making a product primarily for sale and not disposal alone has been successful.	
An additional polymer line was installed at the influent well of the belt press for fine tuning.	
Production of the Class A TAGRO product is cost-competitive with Class B land application if digestion costs are not considered	
Recommend plunger type mixing for digesters because it is more efficient.	
The City will be looking at fats, oil, and grease (FOG) and food waste receiving and treatment to utilize surplus digester capacity.	
New screw presses will essentially be an unmanned facility and will operate 24/7. Continuous operation will even out the ammonia slugs to the secondary treatment process, which they currently experience with the BFPs.	

Maintenance

Table 3. Tacoma Maintenance Feedback

Feedback	To be Considered by San José
Maintenance staff is very capable. City utilizes a DCS system to keep track of all components via their CMMS system.	
No equipment gets replaced unit a root cause analysis is completed.	
DAFT units are enclosed in a building which is fully ventilated. DAFTs were previously covered, but maintenance staff prefers to see mechanisms, thus all covers were removed.	

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Project Delivery/Project Management

Table 4. Tacoma Project Delivery/Project Management Feedback	
Feedback	**To be Considered by San José**
The City is now primarily using the General Contractor/Construction Manager (GC/CM) delivery method because design-build did not work well. CG/CM is preferred so that City can be more involved with the design.	
City chose all of the equipment, which was problematic because it removed the responsibility from the contractor.	
The design-build/fixed price (legislative requirement) of the ATAD/TPAD system was not smooth; there was not enough oversight and project startup was delayed for three years. The City of Tacoma wanted more input and control with project. Layouts did not take into account accessibility or ease of operation, the training component failed, and the quality of record drawings and instrumentation drawings were poor.	
Recommended to have an adequate staffing level prior to a DB contract.	
City provided their own design standards, which they wrote into the contract.	
There were problems during peak wet weather flows, but by the time this occurred, the contractor was gone.	
Important to provide adequate record drawings.	

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Technical Memorandum

FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 3.9

Subject: Brightwater Treatment Plant (King County) Tour Summary

Date: July 3, 2014

To: Linda Stewart, City of San José

From: Lloyd Slezak, Project Manager, Brown and Caldwell

Prepared by: Alison Nojima
Alison Nojima, Engineer

Reviewed by: Steve Wilson
Steve Wilson, Chief Scientist

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Limitations:

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Location

Brightwater Treatment Plant
22505 State Route 9 SE
Woodinville, Washington 98072-6010

Date of Tour

April 4, 2014

Visit Duration

9:00 a.m. to 12:30 p.m.

Areas of Interest

Biosolids processing, odor control, membrane bioreactors, and truck loadout facilities

Attendees

John Cannon, City of San José
Mariana Chavez-Vazquez, City of San José
Steve Contreras, City of San José
Woody Hassman, City of San José
Jan Davel, Carollo
Alison Nojima, Brown and Caldwell
Linda Stewart, City of San José
Issayas Lemma, City of San José
Hugh Logan, City of San José
David Huerta, City of San José
Tom Chapman, Brown and Caldwell
Steve Wilson, Brown and Caldwell

Tour Leaders

Ron Kohler, King County
Andy Strehler, King County
Gunars Sreibers, King County

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Purpose of Visit

The purpose of this site visit was to tour various components of the King County Brightwater Treatment Plant (BTP) with the goal of obtaining information that will assist the City of San José in developing and designing a new biosolids treatment process.

In particular, the tour focused on the following process areas:

- gravity belt thickening
- submerged fixed digester covers
- draft tube mechanical mixing
- odor control systems
- alternative project delivery

Items discussed with King County included the following:

- Planning, engineering, and project delivery for design and construction of the process areas toured.
- Operation and Maintenance (O&M) requirements, challenges, and lessons learned.
- Elements of biosolids hauling and disposal methods.

Site Overview

The BTP is a green field facility located in King County, Washington. The BTP has been in operation since September 2011 and treats an average flow of 36 million gallons per day (mgd). The facility produces 37 wet tons per day (wtpd) of biosolids.

The total capital cost for constructing the new wastewater facilities was $1.9 billion, half of which is associated with the collection system and 13-mile outfall. The odor control facilities' capital cost was $70 million. The BTP was constructed using the Construction Management/General Contractor (CM/GC) delivery method and the outfall project was constructed using the design-build delivery method.

A summary of the liquid-phase processes at the BTP is as follows:

- Headworks screens remove debris and inorganic material larger than two millimeters.
- Primary clarification is achieved using rectangular tanks.
- Secondary treatment is accomplished using the membrane bioreactor (MBR) technology. With a permitted capacity of 36 mgd, the BTP has one of the larger MBR facilities in the country. The MBR produces a very high quality effluent and discharges into Puget Sound.

A summary of the solid-phase processes at the BTP is as follows:

- Primary and secondary sludge is conveyed to gravity belt thickeners (GBTs) for thickening to approximately 5 percent. One of the GBTs is shown in Figure 1. The GBT technology was selected over dissolved air flotation thickening due to lower energy requirements.
- Sludge is stabilized in mesophilic anaerobic digesters to Class B status. The BTP has three 65-foot tall silo digesters with draft tube mixers; one silo digester is shown in Figure 2. One blend tank is used for digested sludge.
- Digested sludge is dewatered using centrifuges to roughly 20 percent solids. Centrifuges drop cake into screw conveyors that transfer the cake to two 90-ton hoppers (shown in Figure 3) in the loadout facility. On average, cake is loaded into 1.5 trucks per day, each hauling 31 tons per load. Cake is primarily sent to agricultural land east of the mountains and a small portion is sent to forests and offsite composting.

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- All biogas produced in the digesters is currently conveyed to a boiler. BTP tour leaders indicated that a cogeneration facility will be constructed in the future.

Figure 1. BTP Gravity Belt Thickener

Figure 2. BTP Silo Digester

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Figure 3. BTP Cake Loadout Hoppers

A summary of the biosolids processing design criteria for the BTP is presented in Table 1.

Table 1. BTP Solids Processing Design Criteria

Parameter	Value
Average Wastewater Influent Flow Rate, mgd	36
Biosolids Quantity, wtpd	37
Year Started Service	2011
Secondary Treatment Method	Membrane bioreactor
Sludge Thickening Method	Gravity belt thickeners
Digestion Method	Mesophilic
Sludge Dewatering Method	Centrifuges
Thickened Sludge Solids Content	5%
Dewatered Cake Solids Content	20%

The BTP odor control system is extensive. All odorous treatment facilities are enclosed and foul air is treated in a three-stage system: bioscrubbers followed by chemical scrubbers and then activated carbon. A picture of the activated carbon vessels and outlet stack is shown in Figure 4. The odor control system continuously treats 400,000 cubic feet per minute (cfm) of foul air and requires a stack outlet concentration of 3 parts per billion by volume (ppbv) of hydrogen sulfide (H_2S) maximum. King County also reduces dissolved sulfide

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concentrations in the collection system by dosing nitrate solution upstream, which lowers the total odor load to the BTP.

Figure 4. Activated Carbon Odor Control Units

Plant Feedback and Other Observations

BTP tour leaders provided the following feedback on their lessons learned for operations, maintenance, and project delivery/project management.

Operations

Table 2. BTP Operations Feedback

Feedback	To be Considered by San José
Rapid rise events have occurred in the digesters. It is important to think about rapid rise potential during the design phase and have adequate pipe sizing to evacuate the gas production that may occur during those events.	
Dual safety devices were implemented on the BTP gas piping.	
The MBR allows for advanced wastewater treatment with a smaller footprint. The footprint reduction associated with using the MBR technology as compared to other secondary treatment technologies allowed space for the addition of future Class A batch tanks.	
Digested sludge contains 80 percent volatile solids (VS), making dewatering a challenge.	
The BTP thickened sludge has an unusually high VS concentration, approximately 90 percent.	
Brightwater plant installs grinders upstream of all pumps and recommends either fine screens or grinders.	
Plant is completely wired and instrumented.	
The odor control goal of zero complaints has been achieved since the BTP was placed on line in 2011. Plant's odor control system achieves a 0.8 ppb hydrogen sulfide concentration at the fenceline.	
The MBR secondary treatment facility is currently only nitrifying. Operators have determined that the wastewater is alkalinity limited, so the plant cannot denitrify without process modifications. The facility design does take this into consideration and modifications can be made if denitrification is required in the future.	

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Maintenance

Table 3. BTP Maintenance Feedback	
Feedback	To be Considered by San José
Plant is behind on preventative maintenance due to inadequate staffing.	
Plant was designed for easy access for maintenance. There are sufficiently sized overhead cranes and space to move process equipment in and out for overhauls (except for the centrifuges).	

Project Delivery/Project Management

Table 4. BTP Project Delivery/Project Management Feedback	
Feedback	To be Considered by San José
Design build was the selected project delivery method and was very successful from a capital cost perspective, but it was challenging for O&M. O&M didn't have the opportunity to share their input past the 30 percent design. Too many nuances of operations are found in the deliberative process of collaboration at 60 percent design, and O&M input is critical to a successful project. The Project Manager emphasized the need for operator input from the very beginning of project, and throughout. They dedicated 3 full time employees from Operations throughout the entire project and the project manager believed it saved the project.	
In DB, you cannot make changes after the initial 30 percent design, and thus, should be able to visualize the 100 percent project scope at the 30 percent design phase.	
Plant staff gave up a lot of control related to the design and it took time to get used to this delivery method. Many details were overlooked by the designer since the type of deliverable is not comparable to what O&M traditionally sees.	
For the design to be successful, it is recommended to provide all standard details that show desired features, facility design standards, and have staff with design experience and knowledge overseeing the design effort. This will minimize the risk of relinquishing the owner's involvement through the design development. The owner should also ask consultant to provide all necessary drawings from other similar projects at the 30 percent design phase.	
There is a significant learning curve for the owner's staff and DB will be more complex and riskier than DBB, especially if there is no sufficient past experience with DB.	
Class A digestion was initially rejected due to cost, but was also a policy decision because the Class B program in the area works well.	
Staff evaluated GBTs versus DAFTs and selected GBTs because the process had a lower net present value cost.	

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Technical Memorandum 4
FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum 4

Subject: Sidestream Treatment Evaluation

Date: October 21, 2014

To: Lily Zhu, Project Manager, City of San José

From: Lloyd Slezak, P.E., Project Manager, Brown and Caldwell

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Executive Summary

This Technical Memorandum (TM) 4 contains preliminary technical information for a potential treatment system to remove total nitrogen from the return wastewater stream associated with the planned dewatering facility at the San Jose-Santa Clara Regional Wastewater Facility (RWF). This TM is part of an overall Biosolids Transition Study for the RWF being conducted by Brown and Caldwell (BC).

Although the City's program manager has indicated to BC that a sidestream treatment system will not be required when the dewatering facility first comes online; however such a system could be required by future regulatory changes or if the existing secondary treatment system does not have sufficient capacity to treat the dewatering sidestream. The results of this study will therefore be used to identify footprint requirements so that enough land is reserved to allow for such future development should it be required.

The sidestream nitrogen removal process evaluated in this TM, the DEamMONification (DEMON®) system, includes pumping, equalization, and nitrogen treatment. The DEMON® system is not the only sidestream treatment technology available. If a sidestream treatment system is determined to be required in the future, additional treatment technologies other than the DEMON system should be evaluated.

A preliminary cost estimate, conceptual layout, and vendor quote from World Water Works (WWW), which is the supplier for the DEMON® system, are included in this TM. Odor control for removal of projected high gas-phase ammonia and amines is also discussed and developed to a conceptual level sufficient to identify an approximate layout of major equipment items and preliminary cost estimate.

A summary of the major findings of this TM are as follows:

- A mass balance was produced to calculate sidestream treatment design criteria. The mass balance values matched reasonably well with historical ammonia concentrations in digested sludge and historical digested solids loading to the lagoons.
- Design criteria were developed for the sidestream treatment system, incorporating input from WWW and some data from a similar BC project. Odor control design criteria were also developed, assuming ammonia and amine reduction in an acid scrubber and treating foul air from the first two tanks in the sidestream treatment train.
- Conceptual layouts were developed for the sidestream treatment system (assuming the DEMON technology), electrical facilities, and odor control. Footprints for each of these areas were calculated using information from WWW and a similar project for the odor control layout. Based on these layouts, the footprint requirements total about 43,000 square feet.
- Planning-level preliminary costs were developed for the entire system, including both the sidestream treatment complete system and the associated odor control. The total estimated capital cost is $35.4M (which does not include allied costs such as design and construction management, or contingencies. The projected annual operations and maintenance (O&M) cost is $408,000, the majority of which is electrical costs for the sidestream treatment aeration system.

Figure 1 shows the overall process flow schematic for sidestream treatment system at the RWF.

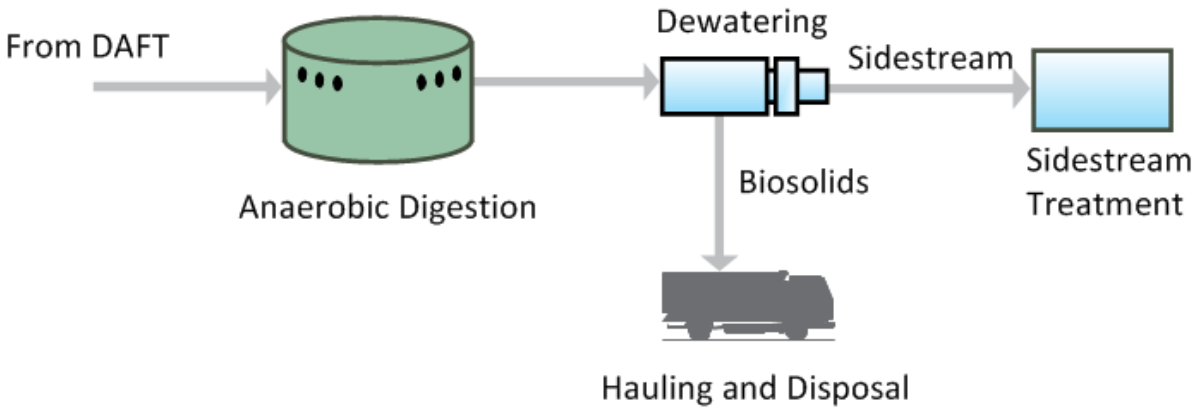

Figure 1. Overall schematic of sidestream process.

Section 1: Introduction

The RWF is currently sending its anaerobically digested sludge directly to storage lagoons and then to drying beds as its form of solids dewatering. The current operation functions well, but for several reasons discussed in detail in other documents, the City will need to cease these solids handling operations in the near future. As such, the RWF is currently planning to build a post-digestion dewatering facility as a part of its Biosolids Transition Program.

Dewatering biosolids results in a liquid sidestream that is typically no greater than 1 percent of the total plant flow. However, the sidestream accounts for 15 to 30 percent of the influent nitrogen load when the sidestream is routed to the head of the plant. This sidestream is conventionally returned to the headworks for treatment; however, it may be more efficient and cost-effective to treat the sidestream rather than returning it to the headworks untreated. A recent business case evaluation (BCE) performed for Pierce County (WA) found the net present value (NPV) of sidestream treatment to be approximately $7-8 million lower than sending centrate back to headworks, as calculated over a 15-year life cycle.

Based on the Plant Master Plan analysis, the existing secondary treatment system has sufficient capacity to treat sidestream loadings that will be generated from the dewatering facility. While a standalone sidestream treatment system at the RWF is likely not required in the near term, it is prudent to identify and reserve a location for it in the future.

Moving to a mechanical dewatering facility will increase the nitrogen load to be treated by the RWF. This is because the existing sludge lagoons lose ammonia to volatilization. Therefore, when the sludge lagoons are decommissioned and dewatering is implemented, nitrogen loadings will increase. The sidestream flow will be highly concentrated with nitrogen and represents up to 30 percent of the influent ammonia load. In the future, if the aeration basins reach capacity and cannot treat the sidestream loadings, a standalone sidestream treatment system may be a more cost effective alternative than an aeration basin expansion. In addition, nutrient removal in the Bay Area is becoming more of a concern and agencies may face more stringent regulations in the near future. A sidestream treatment system could help the RWF meet stricter nutrient removal regulations in the future at a lower operating cost.

Section 2: Total Nitrogen Removal Technologies

This section discusses the total nitrogen removal process for sidestream treatment and provides a brief overview of the systems in the industry that provide it.

2.1 Traditional Total Nitrogen Removal Process

Traditional total nitrogen removal is accomplished through nitrification and denitrification. In nitrification, ammonia is oxidized to nitrite and nitrite is then oxidized to nitrate. Nitrification requires oxygen, provided through a mechanical aeration system (e.g. blowers, diffusers). Denitrification is the biological reduction of nitrate to ultimately produce nitrogen gas. A carbon source is required as an electron donor in this process. The carbon source can either be present in the influent wastewater or added in as an external carbon source (e.g. acetic acid or methanol). A schematic of the traditional nitrogen removal process is shown in Figure 2.

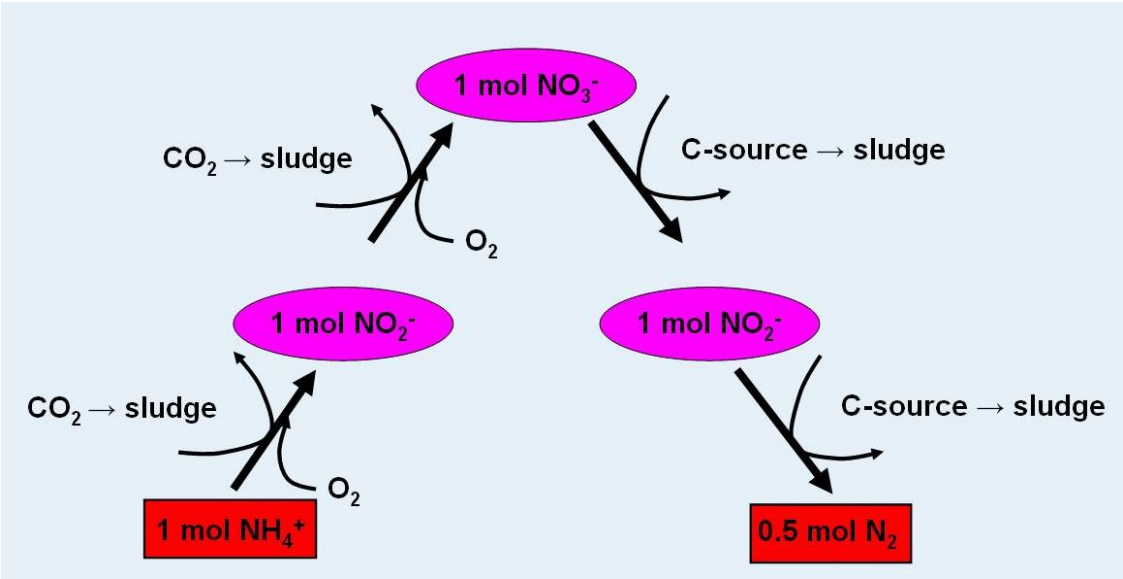

Figure 2. Traditional nitrogen removal process

Source: http://english.logisticon.com/?DEMONDEamMONnificatie.html=&mod=CMS&pId=791

2.2 Alternative Total Nitrogen Removal Systems

Several advanced technologies are available for sidestream total nitrogen removal. The deammonification process uses a special class of bacteria (ANaerobic AMMonia Oxidation, or Anammox) to convert ammonia in the dewatering streams to nitrogen gas, which is then discharged into the air. Deammonification involves the partial nitritation of ammonia by ammonia oxidizing bacteria (AOB) and subsequent anaerobic autotrophic ammonium oxidation (Anammox) to produce nitrogen gas. A schematic of the deammonification process is shown in Figure 3.

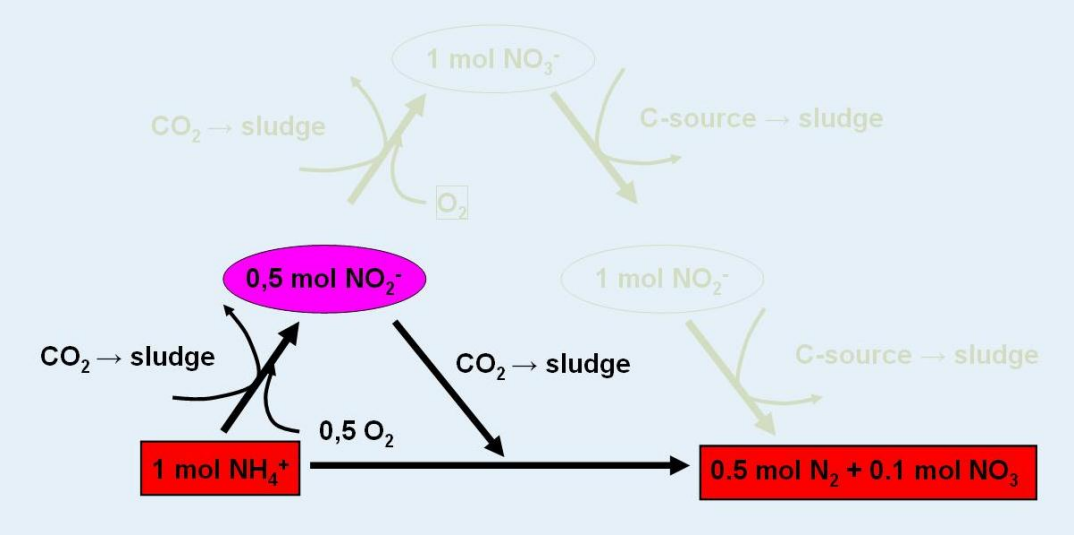

Figure 3. Deammonification nitrogen removal process

Source: http://english.logisticon.com/DEMONDEamMONnificatie.html=&mod=CMS&pld=791

One system that utilizes Annamox bacteria is the DEMON® system from World Water Works (WWW). The DEMON® process includes a suspended growth sequencing batch reactor (SBR) where total nitrogen removal is achieved. A typical SBR used in the DEMON system is shown in Figure 4. A full budgetary proposal from WWW is provided in Attachment A.

Figure 4. DEMON® SBR installation

The DEMON® system is a proven technology in Europe where there are over 25 operational installations of various sizes. In North America, the system has been successfully applied at 2 installations, with 6 more currently in various stages of design or construction. Of the Annamox-based systems currently on the market, the DEMON® system is by far the most proven technology available with roughly 10 times more worldwide installations than any comparable systems.

Experience at full scale operation has indicated that the DEMON system has the ability to achieve an average ammonia removal rate of more than 90 percent. The providers of the system (WWW) have indicated that it retains the following advantages in comparison to traditional total nitrogen removal processes:

- It has a lower aeration energy requirement (less than half) because only about half of the ammonium supplied has to be oxidized in the reactor.
- It typically has no supplemental alkalinity requirement.
- It does not require an external organic carbon source (such as methanol) because ammonium is used the electron donor in the reactor.
- It has a lower sludge output because of the low yield of the Annamox bacteria.
- It retains a smaller total footprint in comparison to what would be required in a secondary treatment expansion, assuming the sidestream were routed to the headworks.

A competitor of the DEMON system is Anita-Mox, which is marketed by Kruger. Anita-mox is a plastic media-based system that is similar to an integrated fixed-film activated sludge process. It has been successfully piloted by the Denver Metro Wastewater Reclamation District, and is in various stages of design or construction at two locations in North America: the Metropolitan Water Reclamation District of Greater Chicago (IL) and the South Durham Water Reclamation Facility (NC). BC believes that this system is reliable for total nitrogen removal, as it depends upon very similar underlying processes as DEMON. At this time, there is little difference in cost and footprint between Anita-Mox and DEMON.

Three other total nitrogen removal systems with fewer North America applications include the following:

- Paques-Anammox system
- Cleargreen
- Terra-N®

BC believes that these systems do not have a sufficient track record of successful implementation to be considered for a full-scale sidestream treatment implementation at this time, but may be considered in the future given documented success at multiple installations.

Section 3: Basis of Design Development

This section develops a basis of design for a future total nitrogen removal system at the RWF, assuming construction of a DEMON® system. Included in this section are an analysis of system loads, development of a mass balance model to calculate system parameters, sidestream treatment process flow development and unit process sizing, and odor control system sizing.

3.1 Sidestream Treatment Load Analysis

Design loading values for the DEMON® system were be based on a mass balance model using typical unit process performance parameters because the thickening and digestion processes will be upgraded as part of the construction of the future dewatering facility. Therefore, actual loading parameters do not yet exist.

Table 1 lists process design criteria for the sidestream treatment system. Design criteria values are based on an analysis of previously produced documents for the RWF specific to raw influent wastewater

characteristics, primary sludge and waste activated sludge (WAS) characteristics, volatile solids reduction (VSR) in the digesters, and dissolved air flotation thickener (DAFT) performance parameters.

Table 1. Process Parameters for Sidestream Treatment System Loading

Parameter	Annual Average	Maximum Month
Raw influent TKN concentration, mg/L[a]	47.9	47.9
Secondary effluent TKN concentration, mg/L[a]	1.6	1.6
pTKN:VSS ratio for Primary Sludge[b]	3.2%	3.2%
pTKN:VSS ratio for WAS[b]	9.0%	9.0%
Overall VSR	59.0%	56.0%
VSR for Primary Sludge	65.0%	62.0%
VSR for WAS	49%	47%
DAFT capture efficiency	98%	98%
DAFT solids concentration, % Total Solids (TS)	5.5%	5.5%
Centrifuge capture efficiency, %	97%	97%
Centrifuge cake concentration, %	25%	25%

[a]*TKN is total Kjeldahl nitrogen and VSS is volatile suspended solids*

[b]*pTKN is particulate total Kjeldahl nitrogen and VSS is volatile suspended solids*

The Table 1 design criteria are based on the following specific assumptions and sources:

- Temperature-phased anaerobic digestion (TPAD) is provided for RWF primary sludge and WAS.
- Flows and loads are as stated in the 2012 Plant Master Plan (PMP) for the design year of 2030, assuming continuous 24/7 operation.
- The raw influent TKN concentrations are taken from TM 4.6 of the 2012 PMP and the secondary effluent TKN concentrations are taken from the 2012 Annual Self Monitoring Report for the RWF.
- This analysis uses the assumption for primary sludge loading stated in TM 1 that in-tank primary sludge thickening will no longer be performed following construction of the future dewatering facility. Therefore, primary sludge will be more dilute in the future and as a result, will contain a higher amount of TKN, originating from the influent wastewater.
- The pTKN to VSS ratios are those used in a BioWin model run for the 2012 PMP.
- Primary and secondary sludge flows and loads are from TM 1, Digester and Dissolved Air Flotation Thickener Design Loadings and Criteria, from the Digester and Thickener Facilities Upgrade Project Conceptual Design.
- The overall VSR is taken from an evaluation conducted during the 2011 Digester Study for mesophilic and thermophilic digestion.
- Centrifuge capture efficiency and cake concentration values are assumed based on similar facilities.
- The nitrogen loading from fats, oils, and grease (FOG) is assumed to be insignificant and was not considered in this evaluation.

3.2 Mass Balance Model Development

BC completed a mass balance model to calculate design criteria for the future sidestream treatment system. Inputs to the model are listed in Table 1 and are based on assumptions made in Section 3.1. The model results produced the sidestream treatment design criteria shown in Table 2. Mass balance model equations are provided in Attachment B.

Table 2. Mass Balance Model Output Sidestream Treatment Design Criteria

Parameter	Annual Average	Maximum Month
Sidestream Flow, mgd[a]	0.72	0.94
Total Suspended Solids (TSS) concentration, mg/L	960	1,014
pN load, lb/d	210	301
Nitrogen concentration, mg-N/L	1,693	1,618
Nitrogen loading, lb/d	10,133	12,392

[a]*mgd is million gallons per day*

In the mass balance model, ammonia load projections are based on assumptions of particulate TKN to VSS ratios from BioWin simulations as discussed in Section 3.1 and an assumption of proportional distribution of soluble TKN between solids and liquid streams. These ammonia loadings are conservative in that they are based on influent TKN, and effectively assume that all organic nitrogen is converted to ammonia.

Note that another approach to calculating sidestream design criteria would be to develop a whole-plant BioWin model that considers both liquids and solids processes. However, for planning purposes, the simpler mass balance approach was used to estimate footprint and costs since the whole-plant BioWin model is not yet finished.

To assess whether the mass balance model yielded nitrogen and TSS loadings and concentrations within reason, the results from the model were compared with historical RWF data from 2010 to 2014 using digested sludge ammonia concentrations and digester solids (total solids) loading over that period.

The digested sludge ammonia concentration during the historical period analyzed is shown in Figure 5. During that period, the average digested sludge ammonia concentration was 703 mg/L as compared to a model prediction of 973 mg/L of ammonia. The model ammonia concentration is likely high because it treats all TKN as ammonia and does not account for dilution across the thickening step, as discussed above.

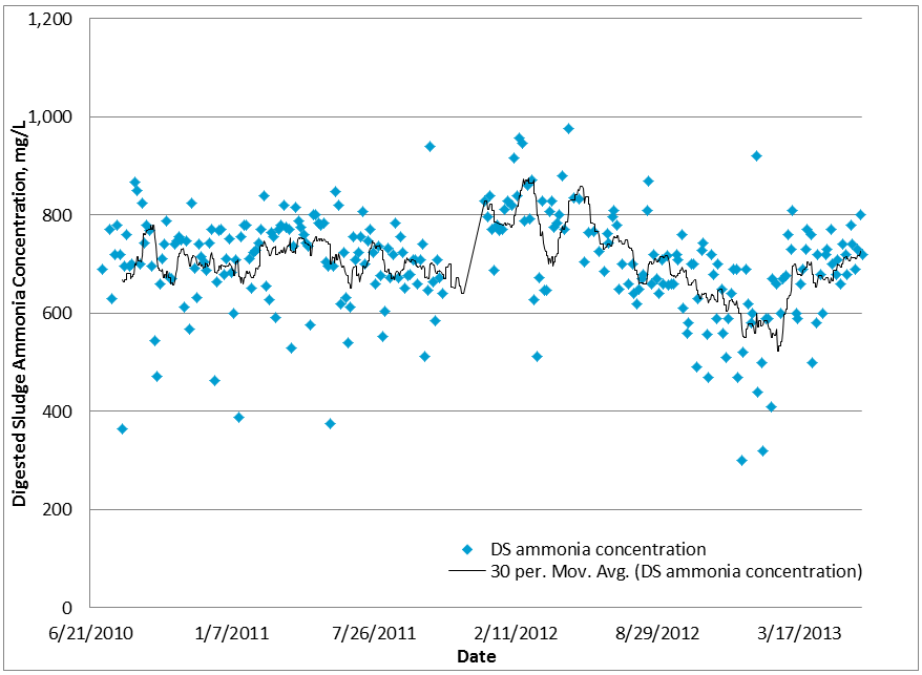

Figure 5. RWF historical ammonia concentration in digested sludge

The digested solids (DS) loading to the lagoons during the historical period analyzed is shown in Figure 6. During that period, the average DS loading (reported as TS) was 130,000 pounds per day (ppd), as compared to the model prediction of and 133,000 ppd of digested sludge. This indicates that the model is accurate in projecting the loading and is reliable for sidestream treatment design criteria development.

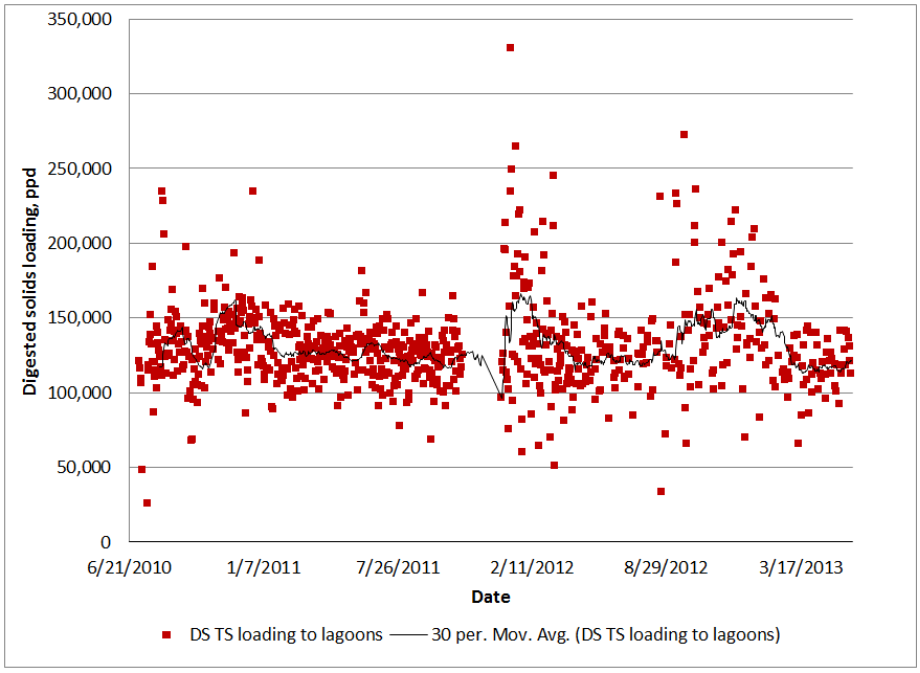

Figure 6. Historical digested solids loading to lagoons

3.3 Sidestream Treatment Unit Process Sizing

A process flow diagram for the future sidestream treatment system, assuming construction of the DEMON system, is shown in Figure 7. Major process units include a pre-sedimentation tank, a flow equalization basin, three reactors, and an effluent storage basin. Of these processes, the pre-sedimentation tank and flow equalization basin would be covered with the exhaust conveyed to a new odor control system (see Section 3.4). The process reactors and effluent basin have a low ammonia concentration, and are typically much less odorous than the pre-sedimentation tank and flow equalization basin, which contain undiluted centrate.

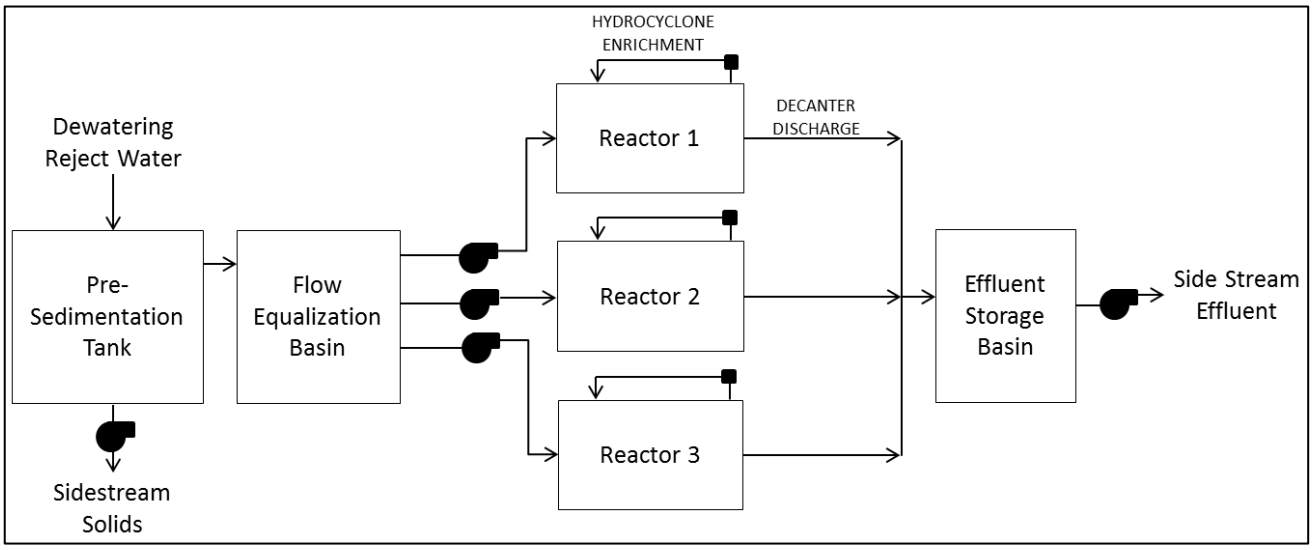

Figure 7. Process flow diagram for proposed sidestream treatment system

Table 3 summarizes the unit process sizing of major equipment and tankage for the sidestream treatment system. Note that ancillary equipment associated with the DEMON® system is included in a vendor submittal and is not shown in the table.

Table 3. Sidestream Treatment System Unit Process Sizing

Parameter	Units	Design Value
Pre-sedimentation Tank		
Design flow (peak two-week with 24x5 operation)	mgd	1.43
Type	--	Rectangular
Cover	--	FRP
Surface overflow rate	gpm/ft^2	500
Number	--	1
Dimensions (L x W x SWD), each	ft	36 x 80 x 21

Table 3. Sidestream Treatment System Unit Process Sizing

Parameter	Units	Design Value
Pre-sedimentation Scum/Sludge Collector Mechanism		
Type	--	Chain-and-flight scraper
Motor	hp	1.5
Pre-sedimentation solids pumps (1 for settled solids, 1 for floatable solids, 1 standby)		
Design load (peak two-week with 24x5 operation)	ppd	11,917
Assumed sludge concentration	mg/L	8,000
Type	--	Positive displacement
Number	--	2+1
Capacity, each (intermittent operation)	gpm	250
Power, each	hp	2
Flow equalization basin		
Design flow (peak month, averaged over 7 days)	mgd	0.94
Type	--	Rectangular
Cover	--	Yes
Number	--	1
Dimensions (L x W x SWD), each	ft	79 x 80 x 20
Reactor Feed Pumps		
Type	--	Centrifugal
Number	--	3 + 1
Capacity, each (based on 240 min/d of feed per reactor)	gpm	3,000
DEMON® Reactors		
Design ammonia-nitrate (NH_3N) load (peak two-week with 24x5 operation)	ppd	19,285
Minimum ammonia removal	%	80
Minimum total inorganic nitrogen removal	%	70
Number	--	3
Dimensions (L x W x SWD), each	ft	80 x 80 x 21
Effluent Storage Basin		
Design flow (peak two-week with 24x5 operation)	mgd	1.43
Hydraulic retention time (at peak flow)	hr	4
Type	--	Rectangular
Number	--	1
Dimensions (L x W x sidewall depth), each	ft	27 x 80 x 15
Effluent Pumps		
Type	--	Centrifugal
Number	--	1 + 1
Capacity, each	gpm	1,300

3.4 Odor Control System Sizing

The first two tanks of the sidestream treatment system are assumed to be covered with their exhaust air conveyed to a new odor control system. Emissions from these tanks are projected to be high in ammonia and amine concentrations, both of which produce an irritating and sometimes burning odor that would produce significant impacts to workers in the vicinity of the tanks if the air were not treated. Offsite impacts are also possible if concentrations were to be sufficiently high.

BC's experience has been that ammonia and other nitrogen-based odorous compounds, such as amines, are best controlled either by an organic media biofilter or an acid scrubber. Both technologies take advantage of the fact that ammonia is highly water soluble to effect removal. The chemical scrubber additionally utilizes acid (typically sulfuric acid) to optimize ammonia removal (typically greater than 99 percent removal efficiency) and will also convert amines to non-odorous species, resulting in a high removal efficiency.

For this sidestream treatment system, it is assumed that an acid scrubber is the preferable odor control technology because it will require much less footprint than an organic media biofilter treating the same air flow. Because of ammonia's high water solubility, the chemical scrubber size would be smaller than a similar scrubber designed to remove compounds such as hydrogen sulfide using alkaline chemicals in the scrubbing solution (caustic and hypochlorite, typically).

Projected design criteria for the acid scrubber odor control system are provided in Table 4. Values for cover dimensions are based on surface area of the pre-sedimentation and flow equalization tanks. The manufacturer indicated that DEMON reactor tanks would not be covered, therefore it is assumed that odor control will not be needed for those tanks. This is a logical approach as ammonia and amine levels will be highest upstream of the reactor tanks, where the ammonia is removed.

Table 4. Sidestream Treatment Odor System Sizing

Parameter	Units	Design Value
Pre-sedimentation tank cover area	ft^2	2,880
Flow equalization basin cover area	ft^2	6,300
Total cover area	ft^2	9,180
Cover area ventilation rate	cfm/ft^2	0.5
Air flow rate to odor control (rounding up)	cfm	5,000
Acid scrubber diameter	ft	4
Packing height	ft	4
Approximate odor control footprint (with fan)	ft x ft	6 x 12
Liquid flow rate through packing (recycled)	gpm	60
Projected ammonia removal efficiency	--	99%
Projected amines removal efficiency	--	95%
Sulfuric acid storage tank capacity	gal	500
Sulfuric acid concentration	--	93%
Sulfuric acid storage tank diameter	ft	5

Tight flat covers are assumed for the first two unit process tanks and an air flow rate is determined by removing air at a rate of 0.5 cubic feet per minute (cfm) per square foot (ft^2) of cover area. This process of determining air flow rate is typically used by BC when needing to apply a negative pressure on the entire

area under the cover. This analysis does not consider the potential for a higher air flow rate based upon applying a certain number of air changes per hour to the headspace beneath the covers because that method is often applied to corrosion prevention, and with projected low hydrogen sulfide concentrations in the foul air, corrosion is not projected to be an issue.

Section 4: Conceptual Layouts

Based on the sidestream flows and concentrations determined in the mass balance model, WWW provided a conceptual-level tankage estimate of the DEMON® system. The footprint for the DEMON® system is estimated at three basins at 80 feet wide by 80 feet long with a maximum side water depth (SWD) of 21 feet. The layout for the entire system is based on peak two-week flow and load projections, averaged over a five-day operating week, with one reactor out of service; peak flows would be buffered in the centrate flow equalization basin.

In addition to the DEMON® reactors, the system includes a pre-sedimentation tank, which is intended to remove solids, cellular debris, and excess dewatering polymer from the centrate. These substances have a tendency to foul process equipment, including instruments and aeration diffusers, and can impair settling processes essential to sequencing batch reactor operation. The system also include feed pumping sized to accommodate the peak two-week flow at specific SBR cycle times, effluent pumping, and solids pumps for material collected in the pre-sedimentation basin. While all pumping systems as well as the DEMON reactors are provided with redundant units, the pre-sedimentation basin is a single basin, with a bypass to allow for basin maintenance, as needed.

A conceptual layout of the tankage requirements for the sidestream treatment system is shown in Figure 8. In addition, a room for the motor control center (MCC) and for the blowers was considered as part of the layout, shown in Figure 9. Design criteria and the layout for the MCC room are based on the equipment power rating and are included in Attachment C. The total footprint for the sidestream treatment system is shown in Figure 10.

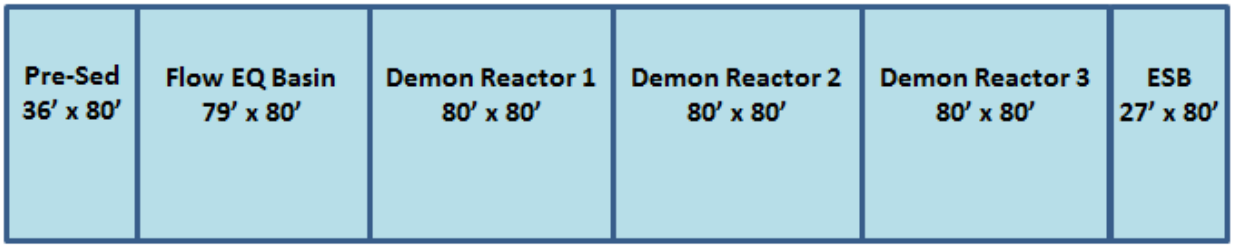

Figure 8. Footprint of sidestream tankage

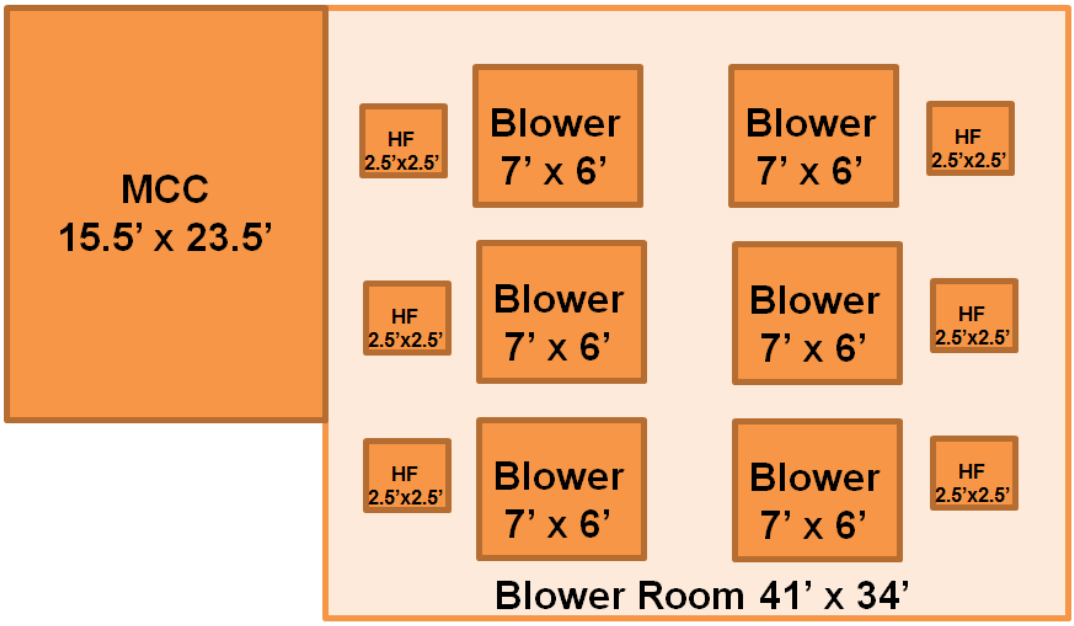

Figure 9. MCC and blower room layout

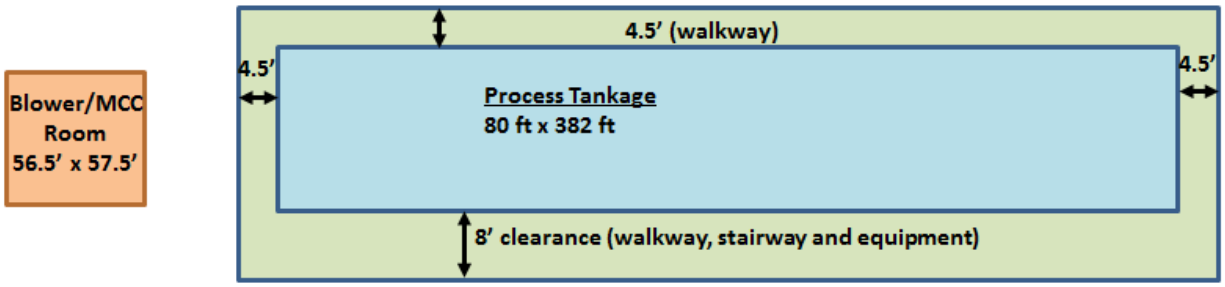

Figure 10. Overall footprint requirements for sidestream treatment system

The approximate footprint requirements for the odor control system are shown in Figure 11. The major pieces of equipment include the fan, scrubber vessel, and sulfuric acid storage tank. It is recommended that all of these items are located in the same area, though additional containment requirements will apply to the sulfuric acid storage tank.

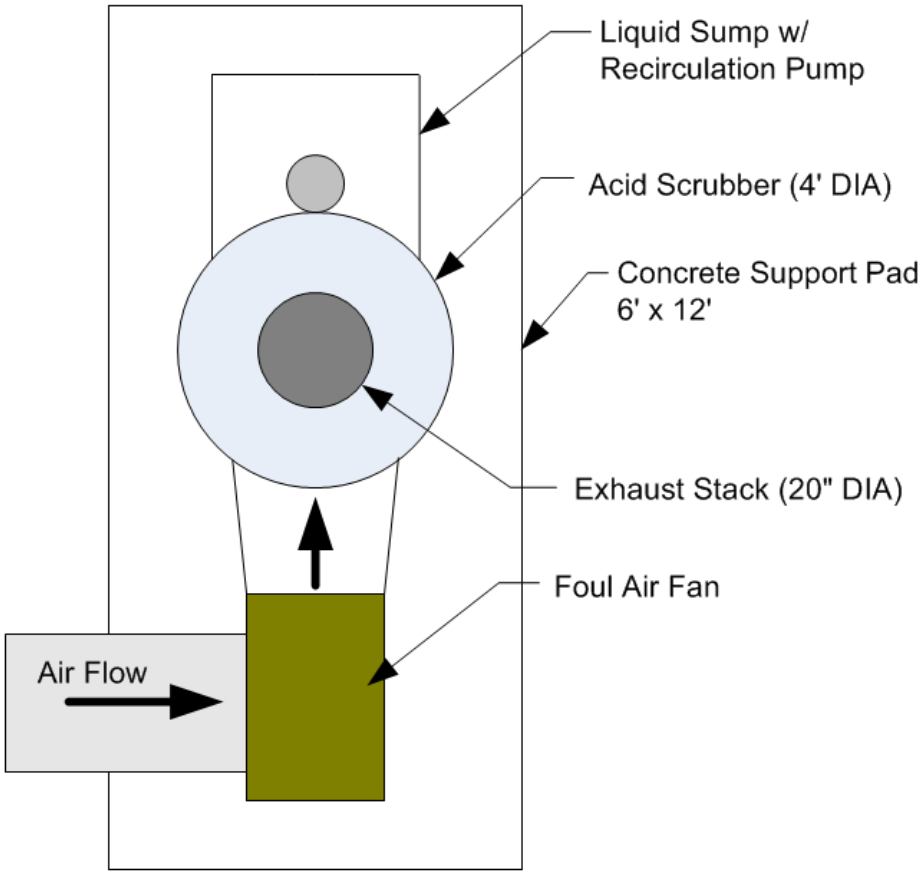

Figure 11. Footprint requirements for sidestream treatment odor control system

Additional 10' x 10' space needed for chemical storage

Section 5: Preliminary Cost Estimates

This section provides a summary of planning-level capital costs and yearly operation and maintenance (O&M) costs for the future sidestream treatment system. All capital O&M costs are based on present day quotes and consumable rates, as it is unknown when the future system may be built.

5.1 Capital Cost Estimate

The planning-level capital costs associated with the sidestream treatment system presented in this section include pumps, piping, concrete tanks for basins, tank covers, and the DEMON® system. These costs are based on a comparison with the costs developed for the Chambers Creek sidestream treatment system in Pierce County, Washington. The proposed San José system is approximately four times larger than the Chambers Creek system. Major component costs such as the pumps, piping, and internal concrete basin dividers from the Chambers Creek project ($4.5 million) were multiplied by 4 to scale up to what the RWF will require. The costs for the concrete tanks and pre-sedimentation and flow equalization covers are based on the conceptual sizing layouts presented in Section 4 and are shown in Table 5. All costs are presented as bid costs, and do not include allied costs such as design and construction management, or contingency.

The cost for the odor control system is also included in Table 5. The capital cost line item shown is representative of the complete system, including the treatment vessel, fan, chemical storage, and chemical

conveyance (metering and recirculation). The cost shown is based on budgetary quotes from system suppliers and tank manufacturers used in similar recent BC projects. No redundancy is assumed for the system. Similar to the sidestream treatment line items, no contingency is applied to the capital cost. Costs extrapolated from the Chambers Creek project are adjusted by the ENR Construction Cost Index (CCI) to account for regional differences.

Table 5. Sidestream Treatment System Preliminary Capital Cost Estimate

Parameter	Unadjusted Cost, $Million	CCI Adjusted Cost, $Million
Pumps, piping, equipment[a]	7.6	8.2
Concrete tanks[b]	16.6	17.8
Pre-sedimentation and flow equalization covers[c]	0.5	0.5
Vendor package	8.3	8.3
Odor Control System	--	0.6
Subtotal	33.0	35.4

[a]*Straight-line extrapolation from Chambers Creek bid costs.*

[b]*$400/ft^2 of tankage, extrapolated from Chambers Creek bid costs*

[c]*$50/square foot of cover*

The capital cost for the complete system is estimated to be $35.4M. Allied costs and contingency should be considered by the City and Program Management if a sidestream treatment project is pursued in the future.

5.2 Yearly O&M Costs

Planning-level yearly O&M costs for both the sidestream treatment system (DEMON assumed) and the associated odor control system are provided in Table 6.

Table 6. Sidestream Treatment System Preliminary Yearly O&M Cost Estimate

Parameter	Yearly Cost
Electricity – reactor aeration	$300,000
Electricity – other sidestream treatment equipment[a]	$12,000
Electricity – odor control system (fan, recirculation pump, metering pumps)	$6,000
Chemicals – odor control system[b]	$2,000
Labor – sidestream treatment system	$58,000
Labor – odor control system	$29,000
Water – odor control system[c]	$1,000
Total Yearly O&M Preliminary Cost Estimate	$408,000

[a]*Includes other system electrical loads (mostly pumps)*

[b]*Assumes injection of 93% sulfuric acid*

[c]*Assumes city water is needed for scrubber makeup water*

Details on some of the values in Table 6 are as follows:

- Electricity costs are calculated assuming a rate of $0.13 per kilowatt-hour (kWh).
- For the sidestream treatment system, the average day aeration demand is estimated by WWW to be approximately 6,300 standard cubic feet per minute (scfm), which translates to the yearly aeration electricity cost of approximately $300,000 at $0.13/kWh.
- For the odor control system, the sulfuric acid dose requirement is estimated at 3 gallons per day (gpd), and costs approximately $1.40/gallon.
- It is assumed that 0.75 full-time equivalents (FTE) of labor would be required, including 0.50 FTE for the sidestream treatment system and 0.25 FTE for the odor control system.

Section 6: Conclusions and Recommendations

This TM concludes that sidestream treatment is feasible and can be fit within the existing footprint should it be required at some point in the future following the installation of a new dewatering facility. If sidestream treatment were determined to be needed, the City could consider pilot testing with dewatering centrate to determine if higher than assumed nitrogen loading rates are possible, which could reduce capital costs.

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Attachment A: World Water Works Estimate

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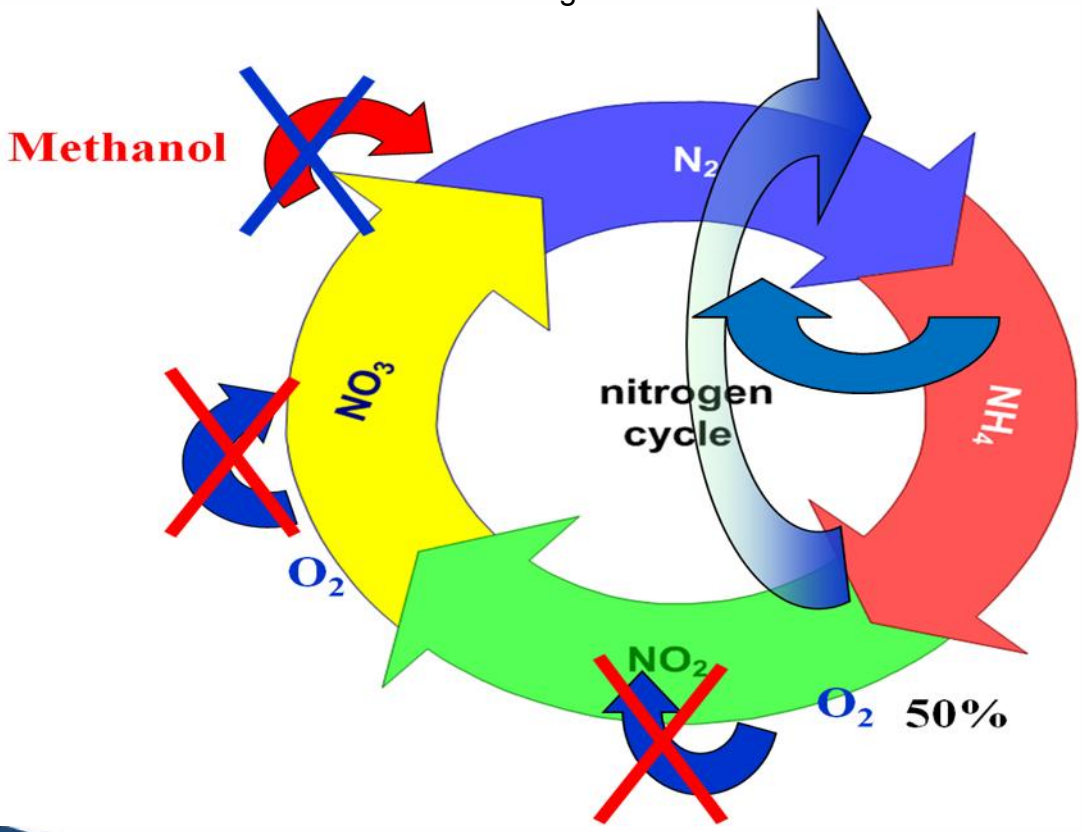
World water works
Clean Water and Energy from Wastewater

DATE: 10 October, 2014
TO: Alison Nojima – Brown & Caldwell
FROM: Chandler Johnson – World Water Works (WWW)
CC:
RE: Information on Demon® Treatment Process – San Jose, CA WWTP – Rev2

Per your request for updated sizing for a Demon® treatment system, please find below our design summary based on the updated information provided. Below are some graphs showing the typical cycle of a Demon® treatment system.

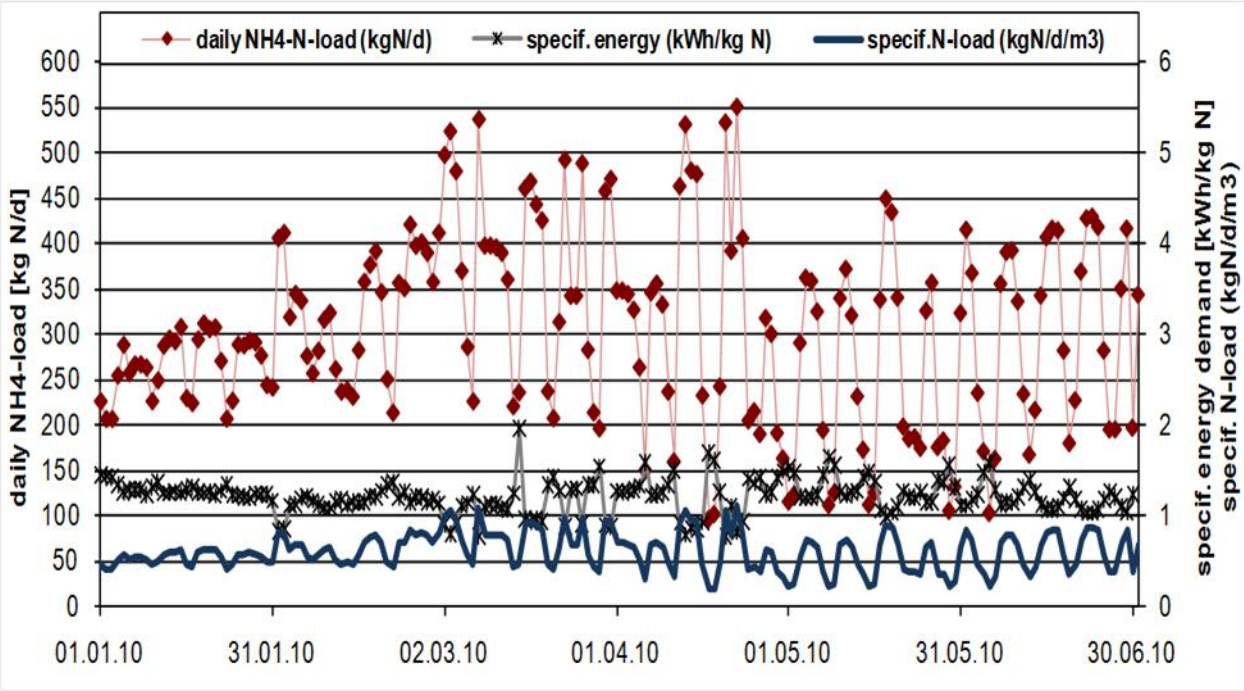
1. DEMON® TREATMENT PROCESS

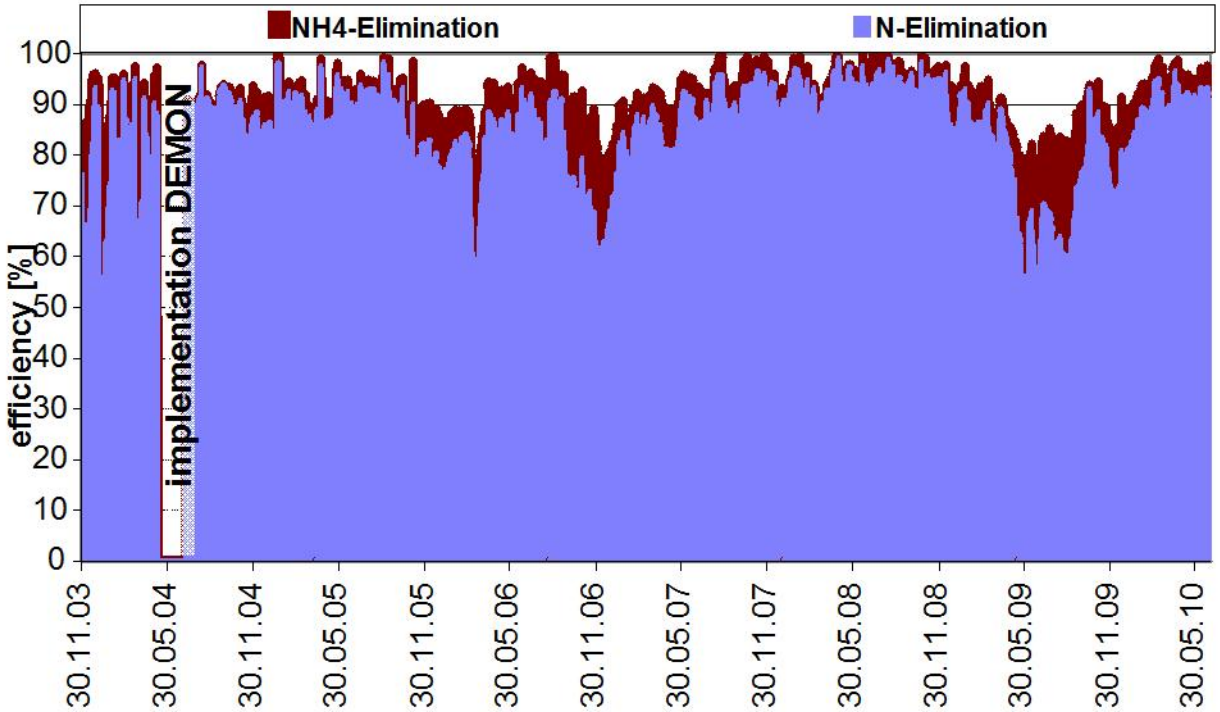
Deammonification represents a short-cut in the N-metabolism pathway and comprises of 2 steps. About half the amount of ammonia is oxidized to nitrite and then residual ammonia and nitrite is anaerobically transformed to elementary nitrogen. See this shortcut in the diagram below. By using this process there is no excess oxygen required or external carbon source to achieve nitrogen removal.



4000 SW 113th St. ~ Oklahoma City, OK 73173 ~ 1-(405)-ANAMMOX

Implementation of the pH controlled DEMON® process for deammonification of reject water in a single sludge SBR is what this design is proposed around. The **specific energy demand of the side stream process results in 1.4 kWh per kg ammonia nitrogen removed comparing to about 6.5 kWh of mainstream treatment.** This process is achieving results of greater than 90% at the Strass WWTP (see data presented below). Biomass enrichment and DEMON-start up is key for this process to achieve its results in a short period of time and this proposal provides the seed sludge and start up assistance to ensure achieving the goal of efficient nitrogen removal.





Design Concept

The overall design concept is to build three (3) new reactors to create Demon® treatment systems and another reactor to make the EQ tank. New mixers and aeration system will be placed in each reactor for providing the mixing energy for re-suspension of the granules, proper mixing distribution of the influent feed flow and provide the necessary aeration for nitritation. A decanter will be used to decant the treated wastewater after each cycle. A single control panel will be provided to control the entire process.

Multiple blowers will be provided to allow for sufficient control and operation during start up and full load design.

With an estimated influent average month ammonia load of 13,815 lb/day and Peak 2 week ammonia load of 19,282 lb/day, the estimated effluent ammonia using three (3) reactors in parallel will be roughly <700 lb/day and <1,000 lb/day respectively and total nitrogen will be < 2,100 lb/day and <2,800 lb/day respectively for Ammonia & Total Nitrogen.

DEMON® TANK COMPONENTS

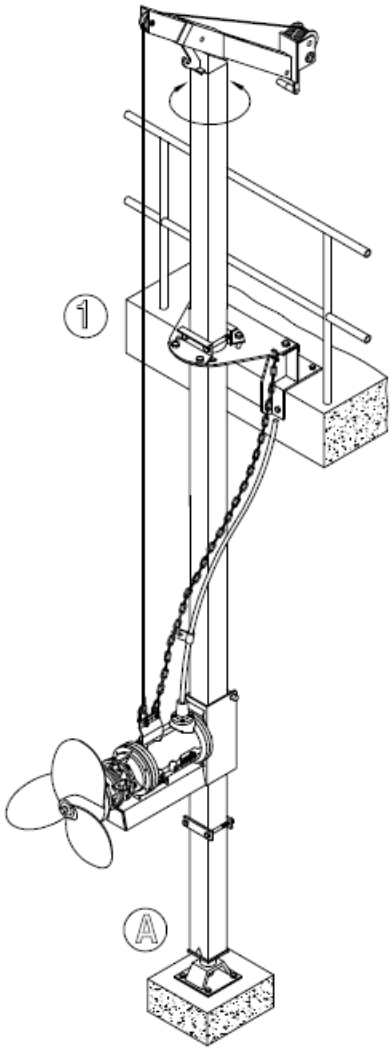
a) **Cyclone** – A cyclone will be used for this project and will have submerged pumps feeding it one time per cycle for a period time to waste out the AOB and NOB bacteria. The overflow (waste sludge of AOB and NOB bacteria) will be discharged from the system while the underflow (Anammox bacteria) will be returned to the reactor.

b) **Instrument Float** – the instruments for control of the process will be installed on a float system which will float with the level of the system. One (1) pH probe & one (1) DO probe for control of the overall operation of the process will be provided for each process train provided. Dedicated controllers for each reactor are our recommendation. The conductivity probe is also to be provided with its own controller. Spare instrument locations will be provided in the instrument float for adding additional analyzers over time.

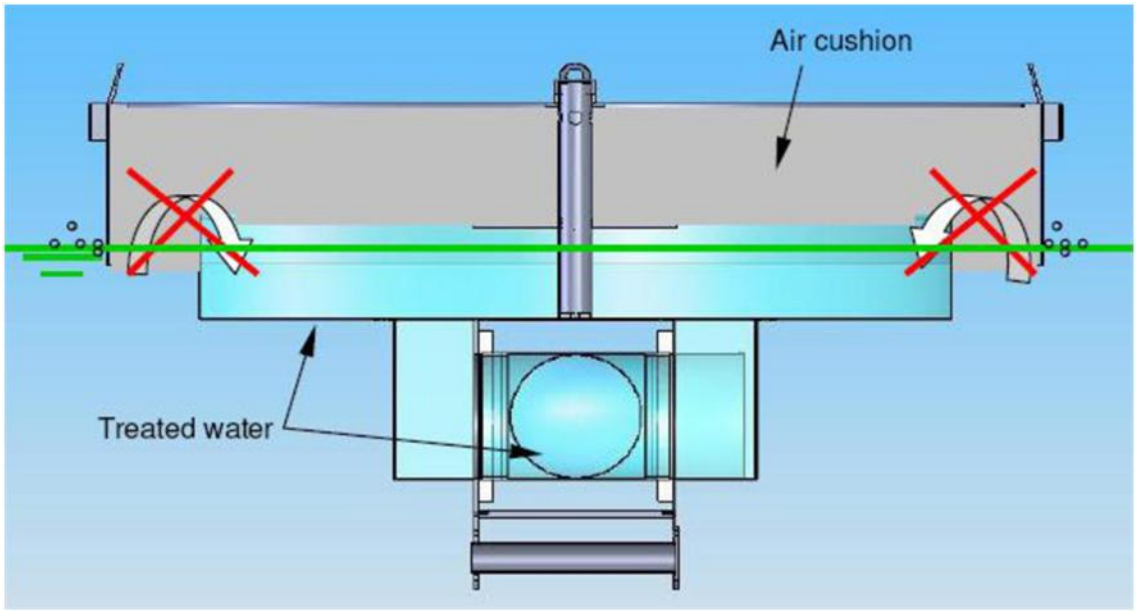
c) **Seed Sludge** – for the quick start up of the Demon treatment process, an adequate amount of seed sludge will be supplied. The seed sludge will be shipped in as dry content possible based on the harvesting technique used and will be added to the systems as they are started up.

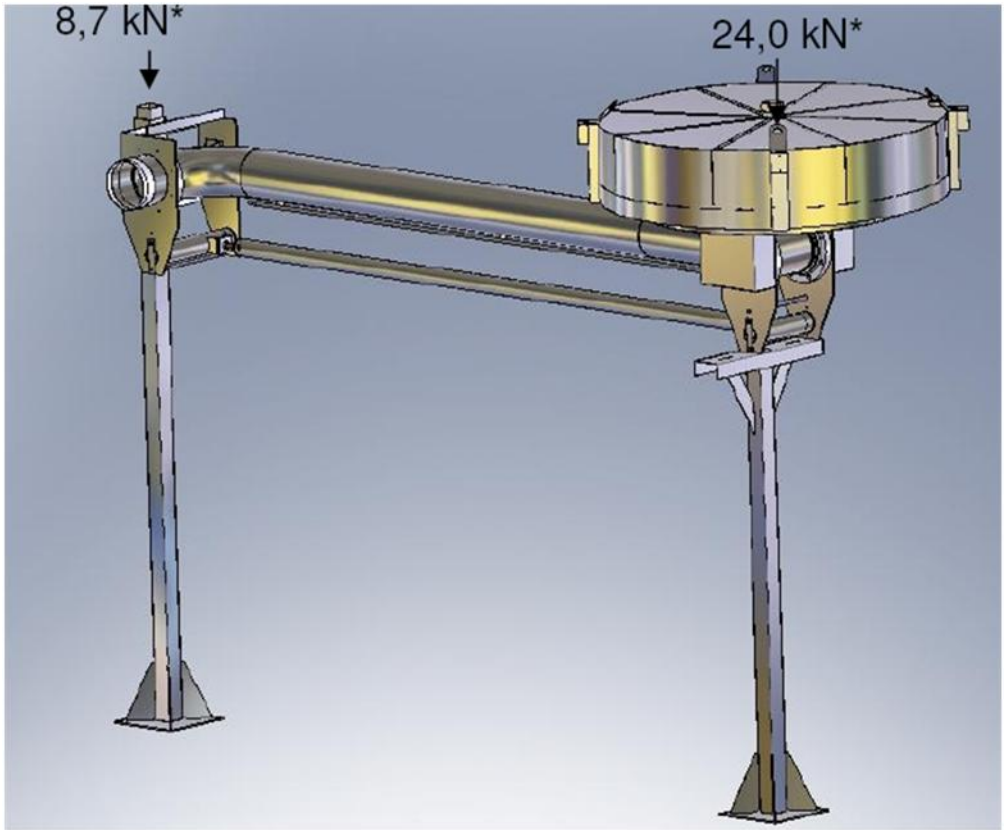
d) **<u>Aeration System</u>** – The Messner aeration system will be supplied in each tank. The amount of panels is provided in the scope of supply section and is subject to final design.

e) **<u>Side Mounted Mixers</u>** – Landia side mounted mixers will be used to maintain mixing energy within each reactor. The mixers will help re-suspend the "reds" during the start up phase of each cycle. VFD's will be provided to allow the mixers to be turned down and save on energy during the overall operation of the cycle.



f) **Decanter** – The Patented Schreiber Decanter is a specially designed decanter and is very effective for use with the Demon process and is made from very durable stainless steel. One (1) Decanter will be provided for each reactor provided.


Air cushion
Treated water


8,7 kN*
24,0 kN*

g) **Blowers** – Positive displacement blowers capable of providing the necessary turndown for operation of the Demon® system are to be provided.

Below HP is based on Peak 2 Week Loadings for 2 reactors. All other design cases will use less HP and summary of air flows can be found on the design pages.

Design Case	Model	Air Flow	Est. HP	Est. bHP
6 @ 50%	GM 50L	1,1175 SCFM	125 HP	73.7 bHP

Air flows are at high water level with maximum discharge pressure

This blower design will allow the most flexibility in allowing the system have efficient use of blower capacity during start up and low load periods of time. The blowers will each have its own sound enclosure to maintain < 70 db sound rating. Each blower will also be equipped with a variable frequency drive unit to allow efficient turndown of the blower while maintaining the proper dissolved oxygen concentration in the Demon reactor.

h) **Documentation / Design / License** – All necessary documentation and design information will be provided as well as a license for treating the Peak 2 Week Load of 19,285 lb/day average load to the system.

2. CONTROLS

World Water Works provides pre-wired control panels to optimally control all equipment provided within the scope of this proposal. World Water Works includes an Ethernet connection with the control panel to allow remote access to the program and to assist in troubleshooting.

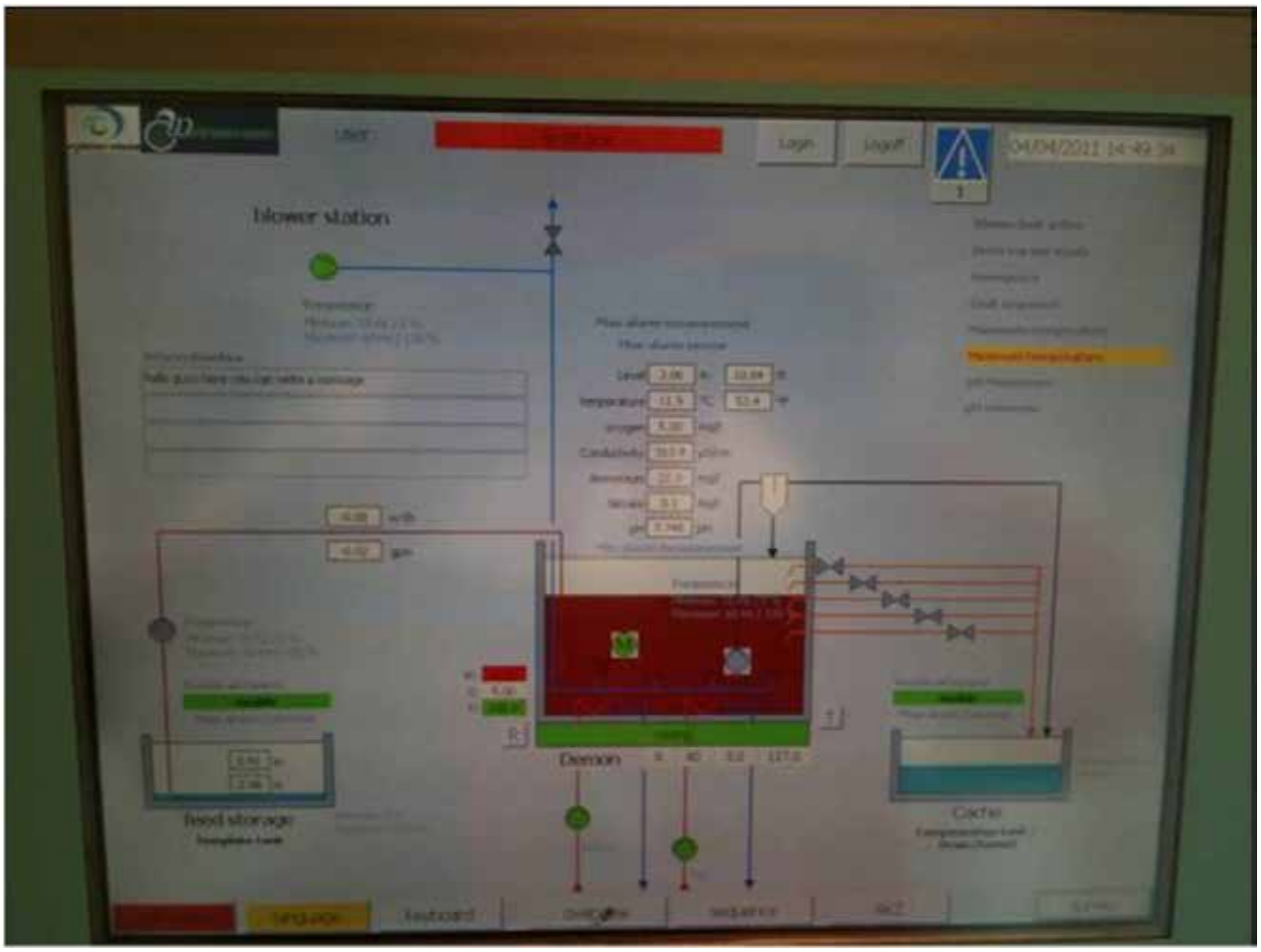
INSTRUMENTATION

Electrical Enclosure	**Hoffman, NEMA 4**
PLC	**Siemens**
Software	**Siemens**
Touchscreen	**15 inch Color Touch Screen**
Motor Starters	**Cutler Hammer or equiv**
Indicator & Stack Lights	**Cutler Hammer or equiv, Nema 4**
Control Buttons	**Cutler Hammer or equiv, Nema 4**
Local Disconnect	**Hubbell, NEMA 4**
Air Solenoids	**SMC**
Phase Protector	**SYMCON**

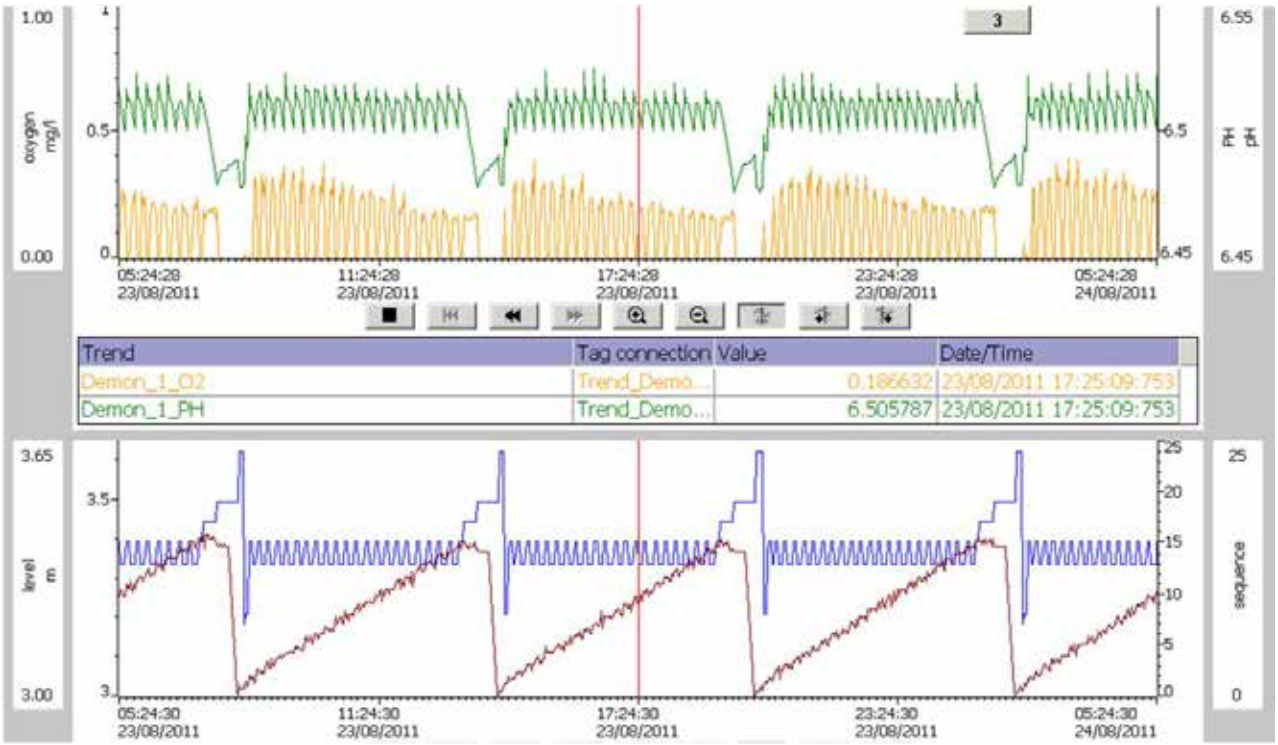
ADDITIONAL OPTIONS PROVIDED

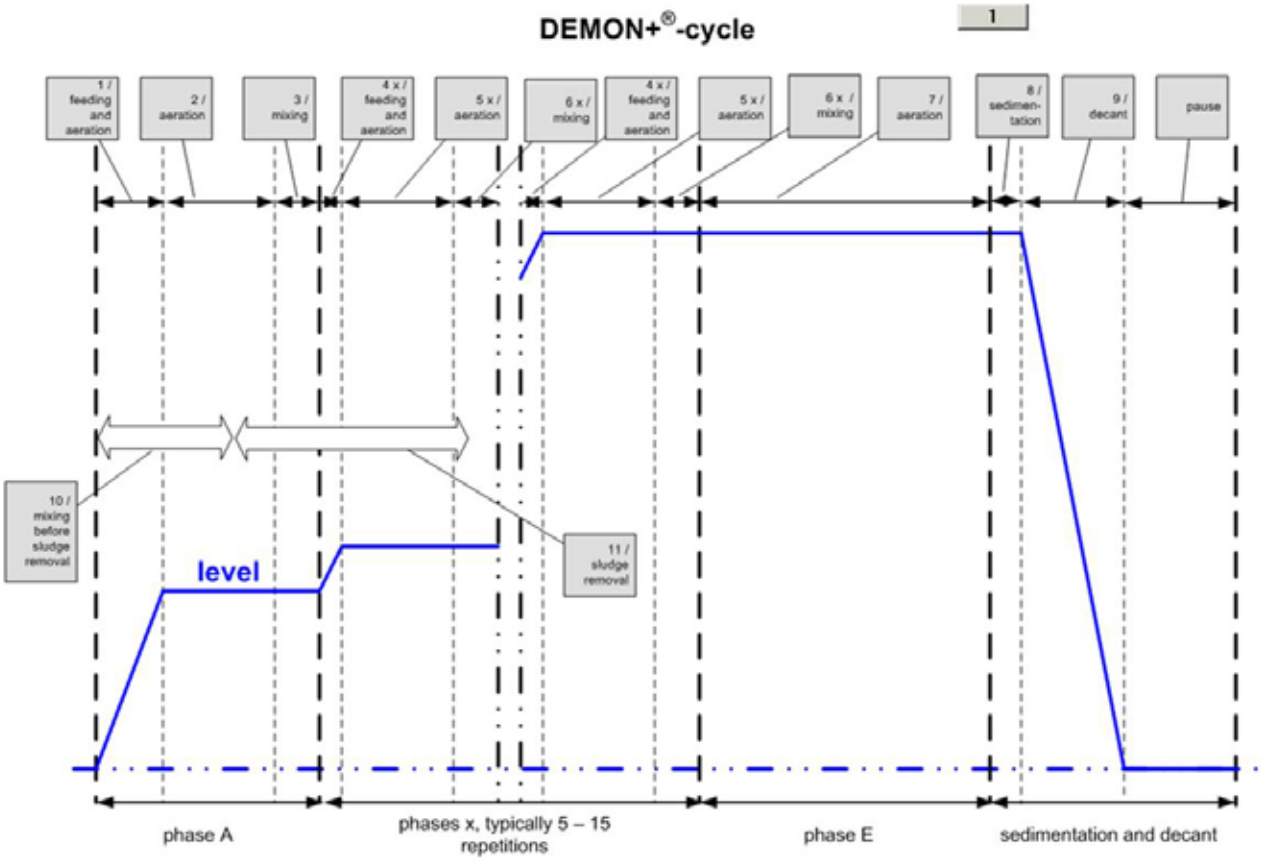
Remote Operation Capability
UL Listed Panel
Stainless Steel Electrical Enclosure

PLC Panel – The PLC panel and control program is the heart of the Demon process and its integral to our scope of supply. The PLC program will have each reactor created as a separate reactor. The reactor will have independent feed of raw centrate, aeration and mixing time. A touch panel with remote access is standard for allowing WWW and Cyklar-Stulz access to the system and provides operational oversight.



Operation of the Demon process is shown below in the screen shot of pH and DO of the system. The Demon process operates under intermittent aeration, feeding and mixing. The graph below shows 24 hours of operation and 3 - 4 cycle periods. These cycle periods show multiple sub-cycles within each 6 - 8 hour cycle. The below graph is the level within the SBR tank and the sequence of the system.




DEMON+®-cycle
1
1 / feeding and aeration
2 / aeration
3 / mixing
4 x / feeding and aeration
5 x / aeration
6 x / mixing
4 x / feeding and aeration
5 x / aeration
6 x / mixing
7 / aeration
8 / sedimen-tation
9 / decant
pause
10 / mixing before sludge removal
11 / sludge removal
level
phase A
phases x, typically 5 – 15 repetitions
phase E
sedimentation and decant

DESIGN FOR 25C – at Average Month Loads using 3 Process Trains

Basic process figures	Design		Design	
Water temperature in DEMON®-tank	25	°C	77	F
Load and concentration				
Daily water flow	3,785	m^3/d	1.000	MGD
NH4-N-load	6,266	kg/d	13,814	lb/day
NH4-N-concentration	1,656	mg/L	1,656	mg/L
COD soluble, degradable (estimate)	300	mg/L	300	mg/L
Suspended solids	300	mg/L	300	mg/L
COD soluble, degradable load	1,136	kg/d	2,503	lbday
Ssuspended solids load	1,136	kg/d	2,503	lb/day
Alkalinity Concentration	6,000	mg/L	6,000	mg/L
Alkalinity Load	22,710	kg/d	50,066	lbday
SBR-cycle				
Active time	7.0	h	7.0	h
Sedimentation	0.5	h	0.5	h
Decant	0.5	h	0.5	h
Total cycle	8.0	h	8.0	h
DEMON-tanks				
Number of tanks	3	in parallel	3	in parallel
Max. water depth	6.40	m	21.0	ft
Total volume per Demon® Reactor	3805	m^3	134,352	m^3
Length of Each Demon® Reactor	24.4	m	80	ft
Width of Each Demon® Reactor	24.4	m	80	ft
Total Treatment Volume Provided	11,415	m^3	403,056	ft^3
Min. water level	5.69	m	18.68	ft
Inlet				
Feeding pump per tank	300	m^3/h	1321	gpm
Design of aeration system				
Oxygen consumption				
Daily oxygen consumption, operating conditions	11,332	kg O2/d	24,983	lb O2/d
Oxygen consumption per hour and DEMON® tank, operating conditions	257	kg O2/h	567	lb O2/h
Fine bubble aeration				
Design air flow (per DEMON®-tank)	3,133	Nm^3/h	1,844	SCFM
Design air flow (per ALL TANKS)	9,400	Nm^3/h	5,532	SCFM

Air flows are based on minimum operating water level and discharge pressure

Rough Footprint would be three (3) basins at 80 ft wide x 80 ft long x 21 ft SWD

Volumetric Loading Rate is 0.55 kg N/m3-day

DESIGN FOR 25C – at Peak 2 Week Loads using 3 process trains

Basic process figures	Design		Design	
Water temperature in DEMON®-tank	25	°C	77	F
Load and concentration				
Daily water flow	5,413	m^3/d	1.430	MGD
NH4-N-load	8,747	kg/d	19,285	lb/day
NH4-N-concentration	1,616	mg/L	1,616	mg/L
COD soluble, degradable (estimate)	300	mg/L	300	mg/L
Suspended solids	300	mg/L	300	mg/L
COD soluble, degradable load	1,624	kg/d	3,580	lbday
Ssuspended solids load	1,624	kg/d	3,580	lb/day
Alkalinity Concentration	6,000	mg/L	6,000	mg/L
Alkalinity Load	32,478	kg/d	71,601	lbday
SBR-cycle				
Active time	7.0	h	7.0	h
Sedimentation	0.5	h	0.5	h
Decant	0.5	h	0.5	h
Total cycle	8.0	h	8.0	h
DEMON-tanks				
Number of tanks	3	in parallel	3	in parallel
Max. water depth	6.40	m	21.0	ft
Total volume per Demon® Reactor	3805	m^3	134,352	m^3
Length of Each Demon® Reactor	24.4	m	80	ft
Width of Each Demon® Reactor	24.4	m	80	ft
Total Treatment Volume Provided	11,415	m^3	403,056	ft^3
Min. water level	5.39	m	17.68	ft
Inlet				
Feeding pump per tank	300	m^3/h	1321	gpm
Design of aeration system				
Oxygen consumption				
Daily oxygen consumption, operating conditions	15,854	kg O2/d	34,953	lb O2/d
Oxygen consumption per hour and DEMON® tank, operating conditions	360	kg O2/h	793	lb O2/h
Fine bubble aeration				
Design air flow (per DEMON®-tank)	4,635	Nm^3/h	2,727	SCFM
Design air flow (per ALL TANKS)	13,904	Nm^3/h	8,182	SCFM

Volumetric Loading Rate is 0.77 kg N/m3-day

DESIGN FOR 25C – at Peak 2 Week Loads using 2 process trains

Basic process figures	Design		Design	
Water temperature in DEMON®-tank	25	°C	77	F
Load and concentration				
Daily water flow	5,413	m^3/d	1.43	MGD
NH4-N-load	8,747	kg/d	19,285	lb/day
NH4-N-concentration	1,616	mg/L	1,616	mg/L
COD soluble, degradable (estimate)	300	mg/L	300	mg/L
Suspended solids	300	mg/L	300	mg/L
COD soluble, degradable load	1,624	kg/d	3,580	lbday
Ssuspended solids load	1,624	kg/d	3,580	lb/day
Alkalinity Concentration	6,000	mg/L	6,000	mg/L
Alkalinity Load	32,478	kg/d	71,601	lbday
SBR-cycle				
Active time	5.0	h	5.0	h
Sedimentation	0.5	h	0.5	h
Decant	0.5	h	0.5	h
Total cycle	6.0	h	6.0	h
DEMON-tanks				
Number of tanks	2	in parallel	2	in parallel
Max. water depth	6.40	m	21.0	ft
Total volume per Demon® Reactor	3,805	m^3	134,352	ft^3
Length of Each Demon® Reactor	24.4	m	80	ft
Width of Each Demon® Reactor	24.4	m	80	ft
Total Treatment Volume Provided	7,610	m^3	268,704	ft^3
Min. water level	5.26	m	17.26	ft
Inlet				
Feeding pump per tank	400	m^3/h	1,761	gpm
Design of aeration system				
Average oxygen consumption				
Daily oxygen consumption, operating conditions	15,854	kg O2/d	34,953	lb O2/d
Oxygen consumption per hour and DEMON® tank, operating conditions	360	kg O2/h	793	lb O2/h
Peak oxygen consumption				
Daily oxygen consumption, operating conditions	15,205	kg O2/d	33,521	lb O2/d
Oxygen consumption per hour and DEMON® tank, operating conditions	543	kg O2/h	1,197	lb O2/h
Fine bubble aeration (per DEMON®-tank)				
Peak Design air flow	7,298	Nm^3/h	4,295	SCFM
Fine bubble aeration (TOTAL ALL TANKS)				
Peak Design air flow	14,596	Nm^3/h	8,590	SCFM

Volumetric Loading Rate is 1.15 kg N/m3-day

CONSUMABLES OF CONVENTIONAL VS. DEMON TREATMENT SYSTEM

Nitrogen-Load	19,285	lb/day
Energy costs	$0.059	USD $ /kWh
Specific energy costs	0.2268	kWh/lb O2
Methanol	$0.217	USD $ /lb
Sludge	$367	USD $ /US ton

Conventional Nitrification / Denitrification				**Specific Costs (USD $ / lb N)**	**Costs per Year**	
Oxygen	4.3	lb/lb N		0.0579	$	407,756
Methanol	2.3	lb/lb N		0.5000	$	3,519,348
Sludge	0.35	lb/lb N		0.0643	$	452,580
			TOTAL	**0.6222**	**$**	**4,379,684**

Demon® Treatment System				**Specific Costs (USD $ / lb N)**	**Costs per Year**	
Oxygen	1.6125	lb/lb N		0.0217	$	152,908
Methanol	0	lb/lb N		0.0000	$	-
Sludge	0.03	lb/lb N		0.0055	$	38,793
			TOTAL	**0.0272**	**$**	**191,701**

Savings per year on aeration	**$**	**254,847**
Savings per year on Methanol	**$**	**3,519,348**
Savings per year on Sludge disposal	**$**	**413,787**
Total Operational Savings per year	**$**	**4,187,983**

Calculation does not include any savings from alkalinity addition required in conventional vs. Demon Treatment System

Based on Peak 2 Week Loads

WWW Scope of Supply:

- Design & Engineering for System
- Three (3) SS Decanter Model 350 with 14 inch flange connection
- Three (3) 14 inch flow control values for decant control of system
- Five hundred-forty-six (546) Messner Aeration panels for both reactors (182 per tank)
- Fifteen (15) SS 304L Drop pipes with manifolds to feed Messner panels (5 per tank)
- Three (3) Demon® Cyclone Systems
- Four (4) Cyclone Pumps (Three duty + One standby) rated at 176 gpm with VFD's on each pump (operated 4 hrs per day)
- Three (3) Pressure sensors with 4-20 mA output for monitoring of Demon Cyclone system
- Four (4) Radar type level control for each Demon Tank & EQ Tank
- Four (4) influent feed pumps to the Demon reactor each rated for 1,761 gpm with VFD's on each pump. (operated 8 hrs per day)
- Six (6) Positive Displacement blowers (1,435 SCFM each) with VFD's on each blower (125 HP motors)
- Eighteen (18) – 12.2 HP side mounted mixers (6 per tank) with VFD's for each mixer (operated 21 hr/day)
- Seed Sludge for start up of system delivered to the site
- Demon ® Control program with panel with VFD's for blowers, cyclone pump and mixers
- Three (3) pH and DO probes with three (3) SC1000 controllers
- Three (3) Conductivity probes with three (3) SC200 controllers
- Three (3) Air flow insertion meters and three (3) water flow magnetic meters
- Start up and training services (4 trips / 15 days)
- 3-4 months of off-site / remote monitoring services

Items not included:

Prestorage tank – volume estimated at 4 – 8 hrs influent flow
Demon tanks at specified volumes
Foundation for Tanks
Unloading, storage, installation of equipment
Electrical connections and interconnecting piping

Alkalinity requirements:

80% Ammonia removal	– 1,293 mg/L NH3-N removal	= 4,960 mg/L as CaCO3
90% Ammonia removal	– 1,454 mg/L NH3-N removal	= 5,540 mg/L as CaCO3
95% Ammonia removal	– 1,535 mg/L NH3-N removal	= 5,830 mg/L as CaCO3

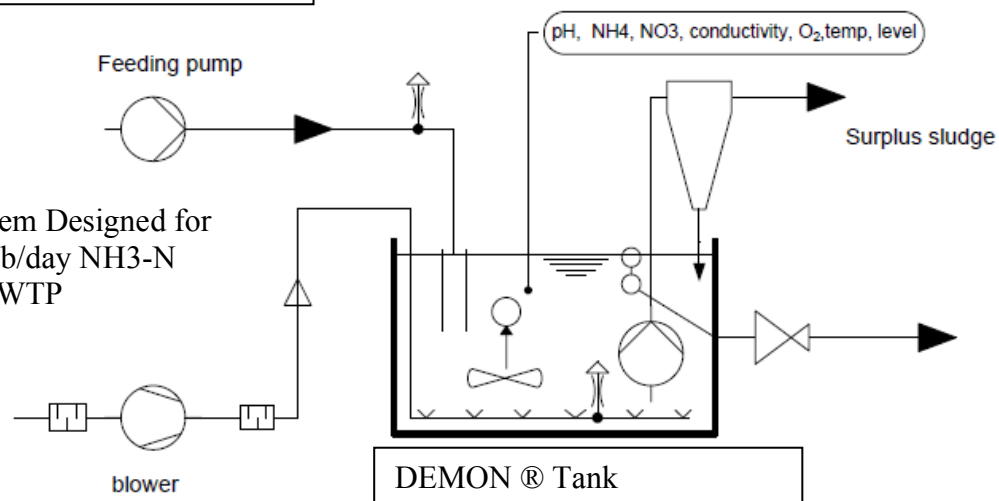
World water works

Clean Water and Energy from Wastewater

Feeding Pumps required:
3 x 1,761 gpm

Mixer Power
(6 x 12.2 HP) / tank

Decanter Capacity: 3 x 5,960 gpm (1 per tank)



DEMON ® System Designed for
Total of 19,285 lb/day NH3-N
San Jose, CA WWTP

Aeration System:
182 Aeration Grids per tank
Max Discharge Pressure: 10.5 psig
Max Air Flow: 8,600 SCFM total
(4,300 SCFM / tank)

DEMON ® Tank
Number of tanks: 3
Net Volume (ft3): 403,200
Length (ft): 80
Width (ft): 80
SWD (ft3): 21 ft (max)
17 ft (min)

Cyclone pump capacity:
176 gpm per tank

Attachment B: Mass Balance Model Equations

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The following equations were used in the mass balance model:

1. Flow: $Flow = \frac{Load*100000}{\%TS*8.34}$
2. VSR for WAS: $VSR_{WAS} = \frac{VSR_{Overall}*(PSLoad+WASLoad)-VSR_{PS}*PSLoad}{WASLoad}$
3. Total nitrogen: $TN = sN + pN$
4. Primary sludge particulate nitrogen load: $pN_{PS} = pTKN{:}VSS_{PS} * VSLoad_{PS}$
5. Primary sludge soluble nitrogen load: $sN_{PS} = \frac{TKN_{Inf}*PSFlow}{1{,}000{,}000*8.34}$
6. WAS particulate nitrogen load: $pN_{WAS} = pTKN{:}VSS_{WAS} * VSLoad_{WAS}$
7. WAS soluble nitrogen load: $sN_{WAS} = \frac{TKN_{SE}*WASFlow}{1{,}000{,}000*8.34}$
8. DAFT feed TS loading: $Load_{DAFT} = Load_{PS} + Load_{WAS}$
9. Thickened sludge TS/VS load: $Load_{TS} = Capture_{DAFT} * Load_{Feed}$
10. Thickened sludge pN load: $pN_{TS} = Capture_{DAFT} * pN_{Feed}$
11. Thickened sludge sN load: $sN_{TS} = sN_{Feed}$
12. Digested sludge load: $Load_{DS} = (Load_{FeedTS} - Load_{FeedVS}) + (1 - VSR) * Load_{FeedVS}$
13. Digested sludge sN load: $sN_{DS} = VSR * pN_{Feed} + sN_{Feed}$
14. Digested sludge pN load: $pN_{DS} = (1 - VSR) * pN_{Feed}$
15. Cake solids load: $TSLoad_{Cake} = Capture_{Centrifuge} * Load_{DS}$
16. Cake mass flow: $MassLoadCake = \frac{TSLoadCake}{\%TS_{Cake}}$
17. Sidestream TS loading: $Load_{SS} = (1 - Capture_{Centrifuge}) * Load_{DS}$
18. Sidestream flow: $Flow_{SS} = Flow_{DS} - Flow_{Cake}$
19. Sidestream particulate nitrogen load: $pN_{SS} = pN_{DS} * (1 - Capture_{Centrifuge})$
20. Sidestream total nitrogen load: $TN_{SS} = pN_{SS} + sN_{DS}$
21. Sidestream nitrogen concentration: $ConcN_{SS} = \frac{TN_{SS}*1000000}{Flow_{SS}*8.34}$

Where:

Load = TSS loading in pounds per day

%TS = percent total solids concentration

Flow = flow in gallons per day

VSR = volatile solids reduction (%)

pN = particulate nitrogen load in pounds per day

sN = soluble nitrogen load in pounds per day

VSLoad = volatile solids load in pounds per day

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pTKN:VSS = particulate TKN to volatile solids ratio

Capture = capture efficiency of process

Conc = concentration in mg/L

Subscripts for PS indicate primary sludge and WAS for waste activated sludge. Inf indicates influent and SE indicates secondary effluent.

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Attachment C: MCC Sizing and Layout

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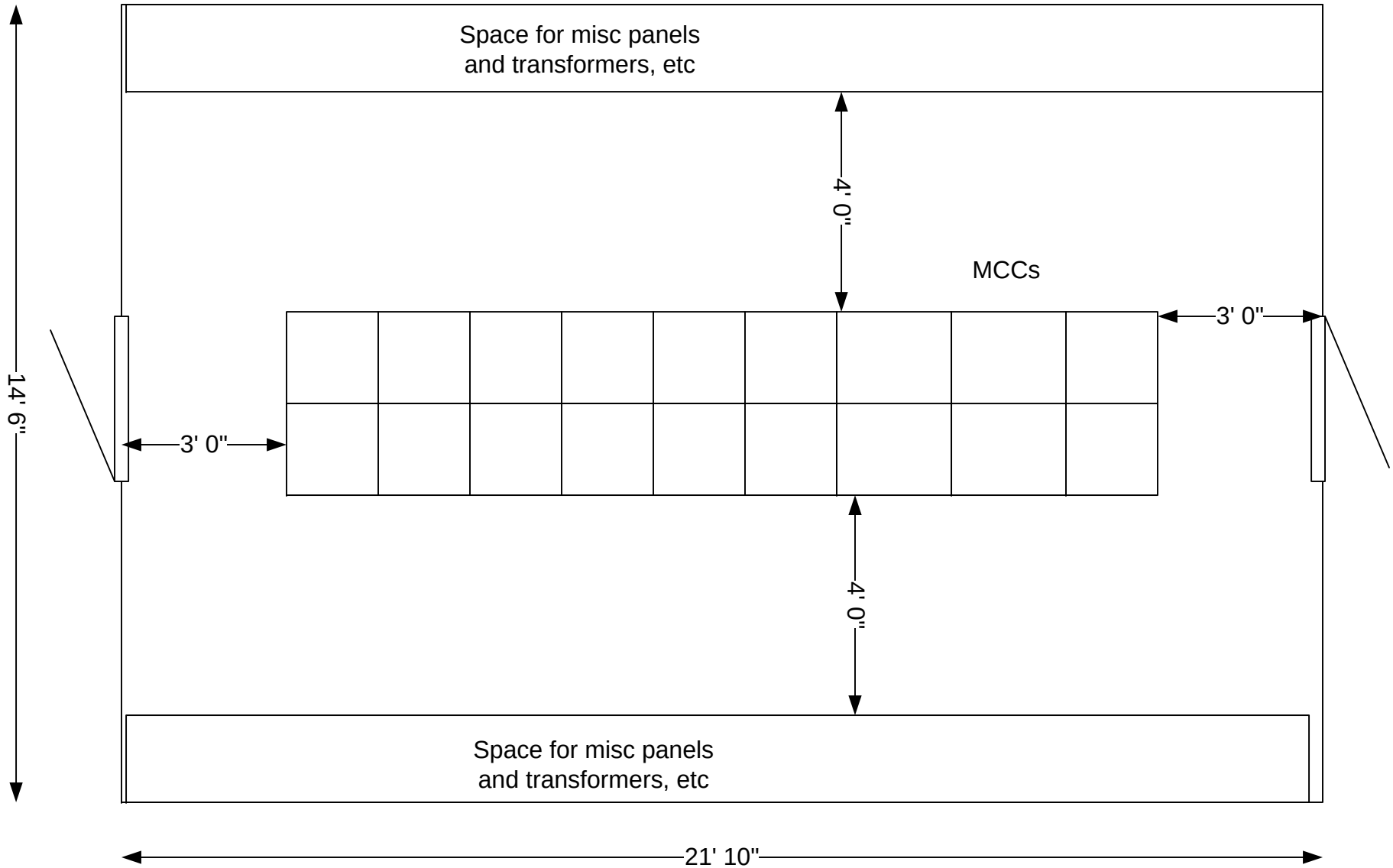

San Jose
Sidestream Electrical Layout
Greg Kumataka, Brown and Caldwell
8-18-14

Sidestream

Notes	What is the equip name?	Equip rating HP, kVA or Amps	Is the unit VFD driven? Yes/No	Number of units	MCC space (note 3)	Wall space	My est of demand amps	
	Equipment name	**Rating**	**VFD**					
note 2,3	Collector mechanisms	1.5HP	Y	2	4		6. AMPS	
	Presedimenation sludge pumps	2.HP		2	2		6.8 AMPS	
	Presedimenation float pumps	2.HP		2	2		6.8 AMPS	
3	DEMON blowers	100.HP	y	4	24		500. AMPS	
3	DEMON feed pumps	30.HP	y	2	6		80. AMPS	
3	DEMON cyclone pumps	15.HP	y	2	5	8 in	42. AMPS	
3	DEMON mixers	12.2HP	y	10	25	12 in	45. AMPS	
	DEMON control panel					72 in		
	I&C panels misc					36 in		
	Misc electrical room load	50. AMPS			2		50. AMPS	
7	MCC 800 amp mains				12			
							736.6 AMPS	Total connected loac

Notes

1 This layout assumes that the DEMON motor starters and controls are in the electrial room MCC. On our Chambers Creek project in WA, WWW's configuration is calling for their starters and VFDs in their panel with the panel located at the equipment, not in the electrical room. This layout is based conservatively on the basis that the DEMON electrical equipment is located in the electrical room.

2 Assumed 2 collector mechanisms per assumed system redundancy

3 Assumes that equipment is VFD driven as indicated from the Chambers Creek and SFPUC projects

4 MCC space based on 1X = 12 inches vertical space or 6X per vertical MCC section

5 Assume that the blowers are 6 pulse VFDs and that harmonic filters are used for harmonics mitigation

6 Assumed system redundancy here for space layout purposes, two reactor tanks, two MCC's, two sets of DEMON pa

7 MCC mains are based on a full vertical section of MCC for the main breaker, monitoring, and SPDs

8 100 hp VFD, 25 in wide section per Allen Bradley 2100 MCC

9 Assumes that this building is fed from internal plant distribution at 480 volts

note 7						note 8	note 8	note 5
Main	collector mech vfd	DEMON feed pump	DEMON cyclone pump	DEMON mixer	DEMON mixer	Blower	Blower	Active harmonic filter assume 100 amps
			misc	misc	misc			
	presed sludge pump	misc	DEMON mixer	DEMON mixer	DEMON mixer			
	presed float pump							

Sidestream motor control center layout, typical for two MCCs. Notes per the "Loads" sheet. Assumes that all DEMON equipment VFDs and starters are in the MCC.

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Brown AND Caldwell

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Technical Memorandum

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 5

Subject: Market Validation – RFI Response Summary

Date: October 21, 2014

To: Lily Zhu, Senior Engineer, City of San José

From: Pat Tangora, Managing Engineer, Brown and Caldwell

Copy to: File

Prepared by: _____
Pat Tangora, P.E., Managing Engineer

Reviewed by: _____
Steve Wilson, Chief Scientist

REGISTERED PROFESSIONAL ENGINEER
LLOYD A. SLEZAK
No. C 61492
Exp. 06/30/15
CIVIL
STATE OF CALIFORNIA

Limitations:

This document was prepared solely for City of San José in accordance with professional standards at the time the services were performed and in accordance with the contract between City of San José and Brown and Caldwell dated October 8, 2013. This document is governed by the specific scope of work authorized by City of San José; 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 City of San José 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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Section 2: RFI Objectives and Key Questions 1
Section 3: RFI Results 2
Section 4: Conclusions and Recommendations 3

List of Tables

Table 1. Recommended Follow-Up for RFI Responses 4

List of Attachments

Attachment A: Solicitation RFI 13-14-01

Attachment B: RFI Response Summary

Attachment C: Responses from Bidders

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Section 1: Purpose and Background

This Technical Memorandum No. 5 (TM 5) summarizes responses to a Request for Information issued by the City of San Jose on June 27, 2014. The overall purpose of the RFI was to gauge private sector interest in providing a range services and projects that ultimately may be implemented as part of the transition to a new biosolids management program for the San José-Santa Clara Regional Wastewater Facility (RWF).

The RWF's current biosolids management program includes mesophilic anaerobic digestion, followed by multi-year stabilization in facultative lagoons, drying in open-air drying beds, and trucking to the nearby Newby Island landfill for use as alternative daily cover (ADC). Changes to the current program are being planned to address:

- The scheduled closure of Newby Island Landfill in 2025
- The need to manage risk and foster reuse by diversifying biosolids end use
- San José City Council direction to cease discharging digested sludge to the lagoons by 2018 and to complete decommissioning of the lagoons and drying beds in order to mitigate odors and address land development issues by 2024

The RFI assumed that, at a minimum, the new biosolids management program will involve mechanical dewatering of anaerobically digested biosolids, with additional processing occurring on-site or off-site via service contracts.

Section 2: RFI Objectives and Key Questions

Attachment A includes the RFI issued by San José (RFI 13-14-01). The objectives of the RFI were to:

- Obtain information on the range of potential biosolids processing technologies that exist in the marketplace
- Obtain information on the potential types of contract structures that would be of interest to potential service providers
- Obtain information to help inform decisions regarding the type and size of biosolids processing to be developed at the RWF
- Determine if process and re-use service providers also have the capacity and interest in operating future biosolids treatment processes at the City's RWF
- Obtain information regarding outsourcing the final disposition of biosolids produced at the RWF

The RFI was intended to address a number of questions regarding market interest in services related to future management of the RWF's biosolids. Specific questions asked in the RFI were intended to:

- Confirm market interest and available capacity for a variety of off-site processing and disposition options (i.e. land application, composting, ADC, landfilling)
- Confirm costs for those options
- Gain a better understanding of the types of restrictions that might be placed on delivery / disposition of dewatered biosolids at various off-site facilities
- Determine interest in providing on-site biosolids processing facilities including thermal drying, dewatering, or other technologies that might be suggested by the market and associated costs for implementing them

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- Determine the extent to which proposed technologies are commercially proven
- Assess service / facility providers' approaches to marketing biosolids products and to managing market risk
- Gauge service / facility providers' understanding of environmental and permitting requirements

The RFI was not intended to constitute any part of a selection or prequalification process.

Section 3: RFI Results

Eleven companies submitted responses to the RFI. Responses varied from companies operating and / or providing final product disposition at existing off-site facilities, to companies specifically interested in developing thermal drying and/or dewatering facilities at the RWF, to those proposing a range of other technologies to be developed on-site and/or at off-site locations.

The following summarizes the proposed business arrangement(s) offered by the eleven companies and recommended followup strategies; a more detailed summary of each RFI response, including pricing information, is provided in Attachment B. Attachment C includes the responses received from each firm.

- Biogas Equity 2, Inc. This firm proposes development of a proprietary gasification process at the RWF site, with private financing supported by revenues from tip fees or by some form of public financing. The proposed process involves: 1) importing material, such as wood waste, to achieve the required percent solids (40%); 2) heating in a salt solution, 3) gasifying the material to create syngas; and 4) burning the syngas at the RWF's planned cogeneration facility. Only one reference facility was cited in the RFI response. The reference project appears to gasify municipal solid waste rather than biosolids and does not appear to use the salt solution process. Based on the information provided in the RFI response, this does not appear to be a commercially proven process, and there are no operating facilities in the United States.
- VitAg. This firm is proposing development of a proprietary fertilizer manufacturing facility at the RWF site that would use digested and dewatered biosolids as an additive in the production of a high nitrogen, granular fertilizer, which would be marketed and distributed by VitAg. On-site fertilizer storage facilities would also be required. They could, but would not have to, provide private financing. While VitAg cites more than 15 years of experience producing organically-modified ammonium sulfate fertilizer, from their RFI response, it appears the specific process using biosolids is not yet in commercial operation. VitAg cites a pilot plant operated from 2010-2011 in Lakeland Florida, followed by a larger demonstration plant at the same location. They also indicate that they have raised $114 M in debt and equity to commence construction of a 78,000 TPY facility in Florida. Based on the information provided, this appears to be a process that is moving toward commercialization.
- CH2MHill. CH2MHill responded to the RFI to express its interest in development of an onsite thermal dryer under a design-build (DB) or design-build-operate (DBO) type contract. They would also be interested in a similar arrangement or operating agreement for the planned dewatering facility.
- Degremont. This firm responded to the RFI in order to market their biosolids equipment. No follow-up action is recommended at this time, but San Jose may want to evaluate the acceptability of some of this equipment during design or during preparation of technical requirements for a DB or DBO type contract.
- Gate 5 Energy Partners. This firm is offering an integrated dryer, combustion and energy recovery / electricity generation process to be located at the RWF. The concept also includes private financing supported by revenues from tip fees. The RFI response states that there are no such systems yet in commercial operation. It states that a 8 wet TPD mobile facility is under development and that a 60 wet TPD facility is slated to be under construction in Orange Co. Florida.

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- **Liberty Composting.** This firm is offering a service + disposition contract for processing dewatered cake into compost and for marketing the compost product. The existing composting facility is located in Kern County, CA and has 225,000 wet TPY available capacity in 2018, declining to 175,000 wet TPY available capacity by 2028. They envision an agreement for approximately 40,000 wet TPY, and are available to arrange hauling. Liberty Composting indicates that they are able to take Class A or B material at a minimum of 12% solids. They would be willing to enter into contracts with terms as short as 5 years.
- **Lystek.** This firm is offering two options : 1) a service contract whereby San Jose can participate in a regional facility being developed for Fairfield – Suisan Sewer District; or 2) a facility developed under a DB, DBO, or DBOO contract in conjunction with the planned dewatering facility at the RWF. The process involves chemical-thermal hydrolysis to produce a liquid fertilizer for land application. Lystek references several commercial-scale facilities operating in Canada but apparently has no facilities operating in the United States.
- **NEFCO.** This firm is offering full package arrangement including financing for development, construction, and operation of dewatering, drying and pelletization facilities at the RWF, and for marketing / reuse of the pelletized product. NEFCO has 20+ years' experience operating similar facilities.
- **Synagro.** Synagro is offering a full service type arrangement where they would arrange for off-site processing and/ or disposition at various composting, land application, and landfill (alternative daily cover) sites via service plus disposition type contract(s) with terms as short as 5 years 10 to 15 years preferred). They are also interested in a DB or DBO arrangement for on-site thermal drying and dewatering. They indicate that they would consider an operations contract for on-site dewatering, and that they provide mobile dewatering services.
- **Terra Renewal West.** This firm is interested in a disposition contract for land application at existing sites in Merced County with ADC as a backup. They state they would accept a contract term as short as 3 years, but prefer 10 to 15 year terms. They also indicate that they would be possibly interested in composting and development of an on-site thermal dryer, but provide no specifics in their response.
- **Utility Service Company (USG).** This firm is interested in a DB or DBO type arrangement for an on-site low temperature thermal dryer facility. They indicate that they could (but would not have to) provide financing. They cite experience at several commercial facilities, primarily located in Spain.

Section 4: Conclusions and Recommendations

Based on the RFI responses summarized above:

- There appears to be strong interest in a thermal dryer facility located at the RWF. Companies expressed interest in DB or DBO type arrangements and some also indicated the possibility of providing private financing.
- Many of the companies interested in the dryer as well as some companies interested in disposition contracts indicated they also would be interested in developing / operating on-site dewatering facilities.
- Some companies offered processes / technologies that are not currently under consideration by San José. Most of these processes / technologies are not yet commercially proven in the United States, but some (VitAg, Lystek) are farther along in the development process. VitAg indicates that they have raised financing for a full-scale project (yet to be developed) in Florida. Lystek has several commercial scale facilities operating in Canada and is offering the potential for San José to participate in a regional facility they are developing for Fairfield Suisan Sewer District. San José may want to monitor these

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developments and, depending on the outcome, consider these technologies as potential longer term options.

- Companies offering disposition type services indicate that they would be willing to accept contract terms as short as 5 years but that they would prefer longer term (generally 10-15 year) contracts. In the short term, off-site composting offers one means of producing Class A biosolids. If San José decides on a strategic direction that would involve producing Class A biosolids on-site (but at a later date than dewatering), a shorter-term service and disposition contract for composting (i.e., 5–10 years, or 5 years with renewal options) may be preferable. Any RFP for composting (and for other disposition alternatives) should request alternative pricing for 5, 10, 15 and possibly 20-year contract terms with renewal options.
- The price-per-ton ranges indicated in the RFI responses for composting, land application, and ADC did not include transportation. When transportation at $0.10 per ton-mile (round trip miles) is added in, the resulting costs per wet ton are at least $10 higher than costs reported in recent Bay Area surveys. Under competitive bidding conditions, better pricing may be obtained, but we recommend that the Business Case Evaluations include sensitivity cases with higher disposition costs to ensure that increasing these costs would not affect the relative ranking of alternatives.

Table 1, below, summarizes recommended follow-up actions for each of the RFI responses.

Table 1. Recommended Follow-Up for RFI Responses

RFI Respondent	Recommended Strategy			
	Disposition Contracts	On-site Thermal Drying / Dewatering (1)	Monitoring with possible future consideration	No further action
Biogas Equity 2				X
VitAg			X – monitor viability of planned commercial facility in Florida	
CH2M Hill		X		
Degremont			X – evaluate equipment requirements during design or DB contracting	
Gate 5 Energy Partners				X
Liberty Composting	X – consider potential for shorter term composting agreement			
Lystek			X – potential for participation in regional plant developed for Fairfield Suisan Sewer District	
NEFCO		X		
Synagro	X – consider potential for shorter term composting or land application agreement	X		
Terra Renewal West	X – consider potential for shorter-term agreement	X		
USG		X		

(1) If DB or DBO type delivery is selected, include in outreach and consider whether proprietary process should be allowed.

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Attachment A: Solicitation RFI 13-14-01

Biosolids Transition Program

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Solicitation RFI 13-14-01

Biosolids Transition Program

Bid designation: Public

City of San Jose

Bid RFI 13-14-01
Biosolids Transition Program

Bid Number	**RFI 13-14-01**
Bid Title	**Biosolids Transition Program**
Bid Start Date	**Jun 27, 2014 2:40:51 PM PDT**
Bid End Date	**Jul 17, 2014 5:00:00 PM PDT**
Question & Answer End Date	**Jul 10, 2014 5:00:00 PM PDT**
Bid Contact	**Mark S Giovannetti**
Contract Duration	**One Time Purchase**
Contract Renewal	**Not Applicable**
Prices Good for	**Not Applicable**

Bid Comments

OVERVIEW

Over the next several years, the San José-Santa Clara Regional Wastewater Facility will be transitioning to a new biosolids program and is seeking input from potential beneficial re-use service providers.
The San José-Santa Clara Regional Wastewater Facility (Facility) currently manages its post-digestion biosolids through extended-stabilization lagoons and open-air drying beds prior to shipping 100% of the stabilized biosolids product to the nearby Newby Island Landfill for use as alternative daily cover.

The Facility treats 110 MGD from six tributary agencies. The current biosolids process includes Mesophilic Digestion, after which the sludge is stabilized in the lagoons for approximately three years and dried in the beds for an additional six months. The City of San José (City) has decided to implement advanced digestion at the Facility; depending on the extent of other biosolids improvements implemented at the Facility, approximately 130,000 wet TPY of dewatered biosolids (25% solids) will be generated requiring off-site disposition and possibly off-site processing.

DOCUMENT PURPOSE

Obtain information on the range of private sector firms interested in utilizing anaerobically digested biosolids cake for a variety of purposes and / or interested in providing processing/ beneficial re-use services for the City's biosolids;

Obtain information on the range of potential biosolids processing technologies that exist in the marketplace;
Obtain information on the potential types of contract structures that would be of interest to potential service providers;
Obtain information that might affect our decisions regarding the type and size of biosolids treatment processes to develop at our wastewater treatment plant;
Determine if processing and re-use service providers also have the capability and interest in operating biosolids treatment processes at the City's Facility location; and
Obtain information regarding the feasibility of outsourcing the final disposition of biosolids produced at the Facility.

RESPONSE

Respondents are required to submit their response to this RFI electronically. Please attach your response to the line item as indicated below. If you are required to enter a dollar amount for the line item, please enter $0.

Item Response Form

Item	**RFI 13-14-01-01-01 - RFI response line item. Enter your response by attaching to this line item**
Quantity	**1 lot**

Prices are not requested for this item.

Delivery Location **City of San Jose**
No Location Specified

Qty 1

Description

RFI response line item. Enter your response by attaching to this line item

Request for Information (RFI 13-14-01)

Biosolids Transition Program

June 27, 2014

1 BACKGROUND

1.1 OVERVIEW

Over the next several years, the San José-Santa Clara Regional Wastewater Facility will be transitioning to a new biosolids program and is seeking input from potential beneficial re-use service providers.

The San José-Santa Clara Regional Wastewater Facility (Facility) currently manages its post-digestion biosolids through extended-stabilization lagoons and open-air drying beds prior to shipping 100% of the stabilized biosolids product to the nearby Newby Island Landfill for use as alternative daily cover.

The Facility treats 110 MGD from six tributary agencies. The current biosolids process includes Mesophilic Digestion, after which the sludge is stabilized in the lagoons for approximately three years and dried in the beds for an additional six months. The City of San José (City) has decided to implement advanced digestion at the Facility; depending on the extent of other biosolids improvements implemented at the Facility, approximately 130,000 wet TPY of dewatered biosolids (25% solids) will be generated requiring off-site disposition and possibly off-site processing.

1.2 BIOSOLIDS PROGRAM OBJECTIVES

1.2.1 Provide a reliable, diversified and flexible biosolids program that can adapt to future regulatory and market changes;

1.2.2 Provide a cost effective program;

1.2.3 Reduce environmental and community impacts;

1.2.4 Maximize beneficial re-use of biosolids; and

1.2.5 Explore emerging technologies which have been successfully tested at full scale.

1.3 KEY BIOSOLIDS TRANSITION ACTIVITIES

1.3.1 The City is currently upgrading the existing Mesophilic Digestion Process to Temperature Phased Anaerobic Digestion Process;

1.3.2 Decommissioning the existing lagoons and drying beds;

1.3.3 Developing new infrastructure (with the exception of composting facilities which the City will <u>not</u> be building on-site) at the existing wastewater treatment plant site for treating biosolids and potentially contract for their operation; and

1.3.4 Contracting for transportation, additional off-site processing where applicable, and beneficial re-use of the treated biosolids.

1.3.5 The City intends to begin operating the new biosolids infrastructure by the end of 2018. Transportation of biosolids to beneficial re-use sites (including possibly intermediate processing sites) is also planned to start at the same time.

1.3.6 As part of the City's intent to provide a reliable, flexible program, the City plans to arrange for several end uses for its biosolids. This would be through a "broker-type" contract that includes a variety of end uses, or through contracts with several end-use service providers. These end-use contracts may involve intermediate processing (i.e. composting). The City may enter into service contracts for a variety of disposition options and products, including but not limited to:

- Land Application
- Compost
- Alternative Daily Landfill Cover
- Dried Pellets

2 DOCUMENT PURPOSE

2.1 Obtain information on the range of private sector firms interested in utilizing anaerobically digested biosolids cake for a variety of purposes and / or interested in providing processing/ beneficial re-use services for the City's biosolids;

2.2 Obtain information on the range of potential biosolids processing technologies that exist in the marketplace;

2.3 Obtain information on the potential types of contract structures that would be of interest to potential service providers;

2.4 Obtain information that might affect our decisions regarding the type and size of biosolids treatment processes to develop at our wastewater treatment plant;

2.5 Determine if processing and re-use service providers also have the capability and interest in operating biosolids treatment processes at the City's Facility location; and

2.6 Obtain information regarding the feasibility of outsourcing the final disposition of biosolids produced at the Facility.

3 TIMELINE

RFI Released	June 27, 2014
Deadline for Questions (please post all questions directly on the BidSync System at any time prior to the deadline)	July 10, 2014
Deadline to Respond per Sections 6 and 7	July 17, 2014, Close of Business

4 CONTACT/QUESTIONS

Please direct all inquiries and post all questions to the Bidsync system on or before July 7, 2014. The City shall respond to questions on Bidsync. City responses to all such questions shall be considered formal addenda to this RFI.

5 RESPONSE

5.1 Respondents should complete the attached Exhibit 1 and attach additional supplemental information as appropriate.

5.2 Responses will be retained by City, subject to City records retention policies. Any data submitted to City hereunder may be utilized by the City. All submittals received from Respondents will become the property of the City and will not be returned. By making submittals in response to this RFI, respondents expressly acknowledge and agree that the City will not be responsible or liable in any way for any losses that Respondent may suffer from disclosure of information or materials to third parties.

5.3 All information must be legible. The contents of the response submitted may be relied upon to create requirements for related projects, either procured or otherwise accomplished by City.

6 HOW TO SUBMIT YOUR RESPONSE

Please submit the reference information requested above by uploading your response and posting to the "RFI response line item" on the BidSync System. **Wherever possible, please consolidate your response into one file in order to facilitate distribution and review by the City.**

7 NEXT STEPS

7.1 The City is soliciting feedback from companies with recent, successful experience and present capability to provide outsourced biosolids beneficial use and resource recovery. The information received in response to this RFI will be used by the City to decide how to maximize market opportunities available. By participating in this RFI process, the Respondent expressly agrees that no contract of any kind is formed under, or arises from this RFI and that no legal obligations will arise. The City will have no obligation to enter into negotiations or a Contract with Respondent, even though one or all of the Respondents are determined to be responsive. In the future, the City may engage in formal procurement(s) including Requests for Qualification and Requests for Proposals.

7.2 The City reserves the right to contact any respondents to seek clarification or request follow-up information on their response.

8 PUBLIC NATURE OF PROPOSAL MATERIAL

All correspondence with the City including responses to this RFI will become the exclusive property of the City and will become public records under the California Public Records Act (Cal. Government Code section 6250 et seq.) All documents that you send to the City will be subject to disclosure if requested by a member of the public.

San José-Santa Clara Regional Wastewater Facility

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

_____

1.2 Contact Person, Address, Phone Number, and E-mail:

_____

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

_____

1.4 A description of the technology, service and/or bioslids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

_____

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

_____

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

_____

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

- ☐ Land Application
- ☐ Alternative Daily Landfill Cover
- ☐ Composting of Biosolids and Marketing of Product
- ☐ Soil Amendment and Marketing of Product
- ☐ Fuel
- ☐ Other (describe)

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility _____
Location of existing facility _____

☐ Yes. Name/description of planned facility _____
Anticipated operational date _____
Capacity (wet TPD) _____
How development will be funded _____

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

_____

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: _____
2018: _____
2023: _____
2028: _____

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

_____

2.6 What is your available on-site storage, both prior to and post-processing:

_____

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

- What class of biosolids do you accept?

☐ Only Class A

☐ Only Class B

☐ Both Class A and Class B (not commingled)

- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?

  _____

- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

  _____

2.7.2 Percent Solids

- Minimum percent solids of the biosolids you will accept?

  _____

- Preferred percent solids of the biosolids you will accept?

  _____

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?

  _____

- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

  _____

- Other characteristics required for delivered fuel product?

  _____

2.7.4 Other (describe)

_____

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: _____

Marketing / Reuse Approach: _____

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: _____

Approach: _____

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: _____

2.10.1 Surface Water (describe): _____
2.10.2 Odor (describe): _____
2.10.3 Noise (describe): _____
2.10.4 How close is the nearest residence to this site? _____
2.10.5 How close is the nearest business to this site? Describe the nature of the business?
_____

2.11 Are there any required permits or permit limitations at the site?

_____

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

_____

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton
- ☐ Other (please indicate amount) _____per wet ton

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

_____

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

- ☐ Service Contract (providing a direct end-use service or providing processing)
- ☐ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)
- ☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

_____

3.3 What length of contract term would you prefer? (Check one)

- ☐ 5 years
- ☐ 10-15 years
- ☐ 5-10 years
- ☐ No preference

3.4 What is the minimum contract term you would prefer (in years)? _____

4 OTHER

4.1 The City is considering buidling a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

4.1.1 Your team's experience operating this type of facility (describe):

_____

4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?

_____

4.1.3 Minimum term of operating contract that would accept?

_____

4.1.4 Please identify any concerns you would have with this type of operation?

_____

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

_____

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

_____

Question and Answers for Bid #RFI 13-14-01 - Biosolids Transition Program

OVERALL BID QUESTIONS
There are no questions associated with this bid. If you would like to submit a question, please click on the "Create New Question" button below.
Question Deadline: Jul 10, 2014 5:00:00 PM PDT

Attachment B: RFI Response Summary

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Attachment B. San Jose / Santa Clara Water Pollution Control Plant
RFI Response Summary – Future Biosolids Management Program

	Biogas Equity 2, Inc	VitAg (under Vitag San Jose)	CH2M Hill	Degremont	Gate 5 Energy Partners	Liberty Composting	Lystek	NEFCO	Synagro	Terra Renewal West	Utility Service Co (USG)
Proposed Business Arrangement (Summary)	Proposes development of a privately-owned gasification plant at the San Jose/Santa Clara RWF, with the ability to import material to obtain required % solids. Would charge tipping fee with put-or-pay arrangement to support private financing, or states that it could take advantage of low-interest public financing.	Proposes development of a proprietary fertilizer manufacturing facility with product marketing and distribution. Facility would be privately financed and supported by tip fees with put-or-pay type contract, or publicly (tax exempt) financed.	Interested in serving as design-builder or design-build-operator for publicly-owned drying and possibly dewatering facility(ies) developed with public financing. Could also coordinate final disposition.	Appears to be suggesting that San Jose specify equipment manufactured by Degremont and affiliated companies. No specific business arrangement proposed.	Gate 5 Energy Partners refer to themselves as "a new company yet to complete its first commercial scale operation." They are proposing that San Jose provide them with this opporunity by entering into long-term agreement(s) that would support private financing of an energy recovery/generation project.	Offering off-site processing (composting) at an existing facility and disposition via service agreement.	Two options are offered: 1) a service and disposition contract allowing participation at a privately funded regional facility at Fairfield Suisan Sewer District; or 2) a new on-site facility developed under a DB, DBO, or DBOO contract and sized to meet the needs of the San Jose/ Santa Clara RWF. Option 2 could be publicly or privately financed.	Offering a "full package" deal including financing, where NEFCO would take responsibility for design, building, and operating dewatering, drying, pellitization, and storage facilities as well as responsibility for reuse of pelletized product.	Offering a "full package" deal with Synagro responsible for dewatering and drying with privately-financed new facilities and for disposition using a variety of end uses and sites.	Offering land application disposition arrangement at a variety of sites in Merced Co. with ADC as backup. Also alludes to the possiblity of providing composting and thermal drying via partnership with specific dryer manufacturer, but no specifics provided.	Offering DB or DBO type arrangement for development of dryer facility. Could be privately or publicly financed.
Type of Reuse	Syngas	Fertilizer	Pelletized fuel/soil enhancement	Not applicable	Energy recovery/ electricity generation	Compost	Land application as "liquid fertilizer"	Pelletized fuel/soil enhancement	Land application, compost, ADC	Land application, ADC	Fuel/soil enhancement
Proposed Technology	Gasification process where dewatered cake is mixed with shredded construction wood and plastic scrap to achieve 40% solids (alternatively thermally dry to 40%) prior to heating in a salt solution and then gasifying to create syngas. Proposes burning the syngas at the Plant's cogeneration facility. Also states that syngas will ultimately be marketable as a chemical feedstock. Appears to be proprietary process.	Biosolids used as additive to produce high nitrogen granular fertilizer product (Class A)—proprietary process.	Thermal dryer to produce pelletized fuel or soil enhancement / fertilizer product with specific dryer technology "to be determined."	Specifically identifies makes and models for digestion, dewatering, solar drying, and thermal drying.	Technology is an integrated system including dryer, combustion, and energy recovery/ electricity generation from steam produced in a biomass boiler and from solar collectors.	Composting using windrows or membrane aerated static pile (enclosed).	Proprietary process involves low temperature thermal-chemical hydrolysis -- heating up solids with caustic in a pressure vessel to lyse cells. RFI response states that this results in material that can be used as liquid fertilizer (land applied), to enhance any biological nutrient removal process, and / or as a feedstock to enhance anaerobic digestion as a backup to TPAD in the event 65% VSR is not achieved.	RFI response states that processes employed are non-proprietary.	Would employ a variety of technologies and end uses including dewatering (permanent and / or mobile) drying, land application, composting, alternative daily cover (ADC).	Class A and B land application with ADC as backup	Low temperature belt drying system provided by AQUALOGY

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Attachment B. San Jose / Santa Clara Water Pollution Control Plant
RFI Response Summary – Future Biosolids Management Program

	Biogas Equity 2, Inc	VitAg (under Vitag San Jose)	CH2M Hill	Degremont	Gate 5 Energy Partners	Liberty Composting	Lystek	NEFCO	Synagro	Terra Renewal West	Utility Service Co (USG)
Commercially Proven	Based on information provided, this does not appear to be commercially proven. Cites only one "reference" facility in Germany and that facility does not use the proposed salt solution pretreatment. Google search also suggests that the reference facility uses municipal solid waste, not biosolids, and involves significant preprocessing. Reference facility is two 10,000-TPY modules, while five 20,000-TPY modules are proposed for the San Jose / Santa Clara RWF.	Based on information provided, this specific process does not appear to be commercially proven. The RFI response references a Process Demonstration Plant in Lakeland FL. The RFI response also states that they have raised $114M in equity and debt to commence construction of a VitAg facility in Orange County Fl; however, construction apparently has not yet commenced.	Although specific technology not identified, commercially proven thermal dryer technology is available.	Yes	No. RFI response states that there are no such systems in commercial operation. They reference a 8 wet TPD mobile facility that is in development and a 60 wet TPD facility that is slated to be under construction in Orange Co, CA.	Yes -- biosolids, foodwaste and green waste windrow composting in Kern Co since 1989. Membrane aerated static piles commissioned in 2012.	RFI response references several commercial-scale projects in Canada (3,000 to 150,000 TPY).	Yes. NEFCO has 20 + years experience operating similar facilities in various locations throughout the country. NEFCO states that they have been in continuous, sucessful, and profitable operation for 23 years.	Yes. All processes identified are commercially proven.	Yes. Has provided land application services to City of Los Angeles, East Bay MUD, LA County Sanitary District, San Diego, and Riverside	RFI response references 14 commercial facilities (mostly in Spain) plus 2 under construction
Risks	Risk issues not specifically identified by proponent. However, risks would likely include: 1) faciity not commercially proven at required scale; 2) technology not commercially proven with this feedstock (i.e. biosolids, not MSW); 3) salt solution process not commercially proven; 4) air permitting; and 5) residuals disposal.	RFI response did not fully address, and instead focused on safety risks including: 1) Ammonia storage and handling; 2) moderate temperature/ low pressure hydrolysis; 3) power system -- designed to minimize arcflash.	RFI response identifies air permit and odor controls as risks. Other risks could include those associated with commissioining and operating dryers.	Does not specifically identify risks, but RFI response states that all technologies will be provide with commercial warranties and guarantees.	RFI response identifies the following risks: Viability: states individual components proven but that the system as a whole has not been operated at commercial scale or under commercial conditions; and downtime: 3-4 days storage would be required. Response also states proposed process would avoid land application of biosolids and transport risks.	RFI response states that process risks are low since they use mature technologies. Response also states that regulatory risks are managed through a company policy of exceeding regulatory standards, and cites membrane aerated static pile technology achieving a 95% VOC reduction when 90% is required by regulation. Response states that they manage market risk by having contracts with end-users at multiple sites, and by the ability to internally re-use material at Liberty Ranch (affiliated company).	RFI response identifies: 1) risk of equipment failure, which is managed by having spare parts/ equipment inventory, and 2) poor weather can limit the ability to land-apply liquid fertilizer, which is managed by including 12 months storage. In addition, process could: 1) have odor problems due to heating and lysis process (note that similar projects in SoCal have had substantial odor issues; and 2) have side stream issues.	RFI response identifies two principal risks: 1) utility prices, which it states are managed via contract terms; and 2) market risk, which they manage by having a variety of end use agreements including bulk distribution to regional fertilizer blenders, to regional agricultural businesses, and to cement kilns.	RFI response states that risks are low because technologies are proven, but does not identify other risks such as permitting, regulatory or market risks.	RFI response states that market risk is managed through use of multiple land application sites	RFI response states that low-temperature belt dryer is inherently less risky than higher-temperature dryer technologies, but does not identify other risks such as permitting, regulatory, or market risks.

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Attachment B RFI Response Summary.docx

Attachment B. San Jose / Santa Clara Water Pollution Control Plant
RFI Response Summary – Future Biosolids Management Program

	Biogas Equity 2, Inc	VitAg (under Vitag San Jose)	CH2M Hill	Degremont	Gate 5 Energy Partners	Liberty Composting	Lystek	NEFCO	Synagro	Terra Renewal West	Utility Service Co (USG)
New or Existing Facilities?/ On or Off site? / Area required?	New facility. States that it prefers on-site and that 2.5 acres or less would be required.	New facility, presumptively on-site -- RFI response states that they would like to be near the planned dewatering facility to allow use of conveyors for dewatered cake, but also states that this would not be required. Implies that 5 to 6 acres would be required. RFI response states that they expect they could be online by 2018.	New, on-site.	No response provided.	New – on-site.	Off-site at an existing facility in Lost Hills, CA (Kern Co.)	**Regional Option:** RFI response states Lystek expects this facility to be online by 2016 with an initial capacity of 50,000 wet TPY (25% dry) expanding to 120,000 wet TPY by 2023. **On-site Option:** RFI response proposes that this be developed in conjunction with the planned dewatering facility and housed in the dewatering building. RFI response states that 1,500 to 2,000 sf would be required for 40,000 wet TPY facility.	New, on-site facilities	**New Facilities:** On-site thermal drying/ pellitzation would require 2-3 years from NTP to bring on line. Dewatering (as DB, DBO, or operator under service contract) **Existing Facilities:** 3 land application sites (Silva Ranch [Sacramento Co.], Solano Co. and Merced Co.) 1 composting site (Central Valley Composting, Merced Co. – planned to be operational by 2017) Multiple landfill ADC sites	Off-site at existing sites in Merced Co.	New, on-site thermal drying facility
Operating Experience	Based on municipal solid waste conversion and biogas plants, but not specifically this technology (i.e. with salt solution) or	Experience operating other ammonium sulfate fertilizer plants, but not with an identical process to that proposed for San Jose. References pilot plant that started operating in 2010-2011 with a larger plant operating since 2011. Not clear how closely the referenced projects mirror the process proposed for San Jose.	References Wilsonville, OR and Stamford CN dryer projects.	No response provided.	States that Gate 5 would supervise quaified operators. No commercial-scale operating experience.	Windrow composting facilities since 1989; membrane aerated static pile facility since 2012.	7 years experience of varying capacities operating six facilities in Canada.	20+ years experience operating five facilities. Staffing typically includes plant manager, management staff, mechanics, I&C technicians and operators. Specifically cite success operating a single dryer for 12 years. They state that they have been succesful achieving dryer reliability hrough measures other than a completely redundant process train, i.e. with bypass and redundant equipment.	35 years experience. Has operated 9 heat drying facilities, 3 thermal processing facilities, 4 composting facilities, 12 lime stabilization facilities, and over 70 permanent and mobile dewatering facilities.	Experienced with land application since 2003.	Experience operating 14 facilities.

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RFI Response Summary – Future Biosolids Management Program

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Proposed or Available Capacity	40,000 wet TPY (25% dry)	160 wet TPD (about 40-50% of plant output)	130,000 wet TPY or as specified by San Jose.	No response provided.	Prefers 120 wet TPD but could range from 60 to 360 wet TPD	225,000 wet TPY in 2018, declining to 175,000 wet TPY by 2028. States a preference of a 40,000 wet TPY agreement.	**Regional Option:** 50,000–120,000 wet TPY plus 400 tons pre-processing storage **On-site Option:** Proposes taking 25-50% of Plant's dewatered biosolids or up to 65,000 wet TPY. Also proposes installing 20 wet tons of pre-process storage and using surplus anaerobic digesters (RFI response assumes there would be 12, which is incorrect) to provide 12 months of liquid fertilizer product storage.	120,000 TPY+/-. Will accept digested sludge or dewatered cake, but prefers to be responsible for entire process downstream of digestion. Also proposes using existing digesters for storage, and 7-8 days of on-site pellet storage	**Land Application:** 150,000-200,000 wet TPY. **Composting:** 60,000 wet TPY by 2018 (currently 20,000 wet TPY). **ADC:** 100,000 wet tons. Envisions using ADC for 10-20% of San Jose/Santa Clara's biosolids	120,000 wet TPY in 2018, increasing to 150,000 wet TPY in 2023 RFI response states that available capacity would be 25-50% higher for Class A	As specified by San Jose
Operating Restrictions	Even flow of biosolids required. Appears to require 24/7 operation. Requires residuals disposal -- claims it can be used in concrete or asphalt mixes.	Steady state operation will be required. Required cake storage volume will depend on whether cake is delivered by truck or conveyor. Warehouse for fertilizer storage required.	Steady state conditions required. Required rated capacity must be specified.	No response provided.	24/7 operation.	Operates 24/7. RFI response states that they can accept 2153 wet TPD with a peak of 4305 wet TPD. Other restrictions include a limit of 93 trucks per 24-hour period. They can store up to 196,500 wet tons of Class B material on-site.		None specifically identified	**Land Application:** Sacramento Co: 60 truckloads per day; Solano Co: daylight deliveries, 5 days per week April 16-Oct 14; Merced Co: daylight deliveries. **Composting:** 355 wet TPD and 25 truckload limit at Central Valley Composting **ADC:** 100-300 wet TPD at any particular landfill	500 wet TPD at each land application site (could increase with additional work shifts) No storage provided at land application sites	None identified
	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B	Accepts Class A or B
	Requires 40% solids either by drying or adding wood waste	24-26% solids preferred; 20% solids minimum	22-25% solids preferred; 18% solids minimum	No response provided.	25% solids preferred, 18% solids minimum	12% solids minimum.	15-20% solids preferred	If supplied as cake, prefer greater than 25% solids If supplied as digested sludge (i.e. with NEFCO responsible for dewatering) prefer 2.5-6% solids	**Land Application Sites:** Sacramento Co (15% solids min.); Solano and Merced Co's (50% solids max.) **Composting:** 15% solids min; prefers 20-25% solids **ADC:** Prefers 20%+ **Thermal Drying:** 15% min. prefers 20-25%	12-100% solids acceptable	22-30% solids preferred; 20% solids minimum

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RFI Response Summary – Future Biosolids Management Program

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Environmental Controls	Identifies the need for 1) Non-potable surface water for brine solution -- states that excess brine would be recycled to the treatment plant, but no analysis provided on impact to treatment processes; 2) Odor -- states that in vessel process will reduce odor; 3) Noise -- states it will provide containerized engine with 6- dB at 10 feet.	States that facility will be enclosed with odor and noise control.	RFI response states this is "to be determined."	No response provided.	Use influent or effluent as heat sink to avoid cooling towers; employ odor controls; noise mitigation.	Site is contained by a perimter dike with runoff excluded. Compost area is underlain by 12-inch layer of compacted clay. Employ process odor control. Nearest residence is 6.7 miles; site is surrounded by agricultural land.	**Regional Option:** Will be installed within existing Fairfield Suisan Sewer District dewatering building, which is fully enclosed concrete. States that there is a sod farm located across the street and that the closest residence is more than 1 mile away. **On-site Option:** Will be installed within planned dewatering building.	Fully enclosing all facilities including storage; use of BACT emssion controls and treatment; loading operations use skirted silos; selection of low noise equipment; sound attenuating equipment for fans.	**Existing Facilities:** Via compliance with existing permit conditions **New Facilities:** Enclosed facilities with dust/odor control; design to minimize noise impacts.	Via compliance with permit conditions	Not provided
Permits	RFI response states that permitting will be easier because the facility will be at the WWTP, but provides no specifics or evidence that proponent understands the permitting and compliance that will be required.	References success in obtaining permits in Florida but no specific understanding of California permit requirements evident.	RFI response states this is "to be determined."	No response provided.	RFI response states that CEQA will define specific permit requirements but at a minimum will require building, air, and SWPP permits / approvals.	Existing surface water, waste discharge, and authority to construct / operate permits.	**Regional Option:** RFI response states that mitigated DNS expected for CEQA compliance. Also air permit identified. **On-site Option:** RFI response states that they assume permitting would be combined with wider permitting required at the Plant (I.e for the dewatering facility). States that time required to develop would be 1 year plus permitting.	Identifies building and air permits. Indicates they might try to permit all air emissions as a single source.	**Existing Facilities:** Already permitted. **New Facilities:** For thermal dryer, identifies air, CEP from County, CEQA, JTD, RCSI from Waste Board and Water Board, and local building permits.	Existing land application sites already permitted	Describes process controls but provides no specific information regarding permitting requirements.
Price Range (excluding transportatino)	No specific pricing identified.	$20 to $60 / wet ton depending on energy costs, location, and financing. RFI response states that they require 11 MMBTU/hr for process dryer.	RFI response states this is "to be determined."	No response provided.	$40-85/wet ton: $85/wet ton for 20,000 wet TPY facility. Potentially as low as $40/wet ton for 120,000 wet TPY facility.	$20-30/wet ton States hauling would be about another $35 / wet ton.	**Regional Option:** $50-$60 per wet ton **On-site Option:** $10-$20 per wet ton utility and alkali costs $20-$30 per wet ton other costs	$60-$70/ wet ton Assumes 120,000 wet TPY facility; 2 centrifuges; single dryer; 50,000 cfm scrubber; 800 ton storage silo; and potable water/ effluent treatment provided by City.	**Land Application:** $30-$40/wet ton **Composting:** $40-$50 / wet ton **ADC:** $40-$50 / wet ton **Thermal Drying:** $50-75 / wet ton	**Land Application:** $20-$30 / wet ton	$30-$50 / wet ton operating $20 to $25 million capital

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Attachment B. San Jose / Santa Clara Water Pollution Control Plant
RFI Response Summary – Future Biosolids Management Program

	Biogas Equity 2, Inc	VitAg (under Vitag San Jose)	CH2M Hill	Degremont	Gate 5 Energy Partners	Liberty Composting	Lystek	NEFCO	Synagro	Terra Renewal West	Utility Service Co (USG)
Contract Preferences	All options checked -- but RFI response also states that they could supply operators and charge an annual licensing fee with San Jose paying for capital and financing and permitting. Indicates that they prefer a contract term of 10 to 15 years with 10 years as a minimum.	DBOOF, DBOO, DBO, and Service / Disposition contract identified as possibilities. Prefers min. 20 year term if they provide financing for facility development. Also indicates they could enter into a lease-back type arrangement.	DB or DBO with min. 20 years for DBO type contract. Also potentially interested in service contract (i.e. dryer and possible dewatering facility operation).	No response provided.	Wants "take or pay" type agreement(s) obligating Plant Owners to deliver a specified amount of biosolids and to purchase electricity produced by the Gate 5 process. Prefer 20 year contracts, but would accept 10 to 15 years.	Service and disposition contract. 5 year minimum and preferred term.	**Regional Option:** Service + Disposition contract. 10-15 year term preferred; 5 year term minimum. **On-site Option:** DBFOM, DBOO, DBT with City operations. Lystek also proposes entering into a product marketing agreement for the liquid fertilizer produced.	Service + disposition for end use with 5 year minimum term; DBFO or DBO for on-site facilities with "longer term" contract (specific years not stated).	**Existing Facilities:** Service + disposition or service contract(s). 10-15 year term preferred; 5-year minimum. **Thermal Drying:** DBO or DBOO; 10-15 year term minimum; prefers 20 years. **Dewatering:** Operating contract with 5 year min term; 10-20 year term preferred	Service + disposition contract. 5-10 year term preferred. 3 year term min.	DB or DBO contract possibly with private financing. No minimum term identified but states it would require 5 years min. for operations-only contracts.
Product Marketing	Assumes syngas would be used in San Jose's planned cogeneration facility. Also states that use of syngas as a chemical feedstock is a potential future market.	References experience marketing organically enhanced ammonium nitrte fertilizer, and market research in CA. States that it does not expect market misalignment.	Does not want responsibility for disposition, although states it could play something like a coordinator role working with other companies that market end products.	No response provided.	San Jose would pay processing fee, enter into a surplus power purchase agreement, and market ash as soil amendment or concrete additive.	Markets compost product to large farming operations in Kings, Fresno, and Merced Counties under fixed price agreements. Product is marketed under trademark "A4-11 Compost." RFI response states that they have standing orders for 100% of their compost production and that they can use Liberty Ranch (affiliated company) as a backup if supply exceeds demand.	For liquid fertilizer product, RFI response states that Lystek's practice is to begin product marketing activities 2 years prior to having a facility on-line, and to secure agreements so that demand exceeds supply. Markets directly to growers at a fixed price. **On-site Option:** RFI response indicates material could also be used on-site as a carbon source for biological nutrient removal process or to enhance anaerobic digestion.	Approach is to cultivate a diversified end use market and customer base with a combination of fixed price contracts and spot sales to maximize revenue and obtain 100% reuse. RFI response states that NEFCO uses brokers as needed, but selectively.	Markets directly through existing sales network to agricultural end users. RFI response states they believe a supply / demand mismatch is unlikely but provides no specifics. For compost, also indicates it is expanding into fertilizer market.	RFI response states that marketing would not be needed for land application or ADC because they use existing sites / facilities	No evidence of marketing program in US provided
Other	RFI response references discussions with Palo Alto. Seems to want to bring in construction wood / debris; foodwaste; greenwaste. Unclear if they are essentially proposing a merchant facility that would be located on San Jose/ Santa Clara RWF property.	Not interested in designing, constructing or operating dewatering facility.	Interested in DB or DBO for dewatering as well. If DBO, RFI response states that they could use current City staff if they were transferred to CH2M Hill.	No response provided.	Unclear re their interest in operating dewatering. RFI response states that they have no experience but goes on to raise concerns about operations by others in terms of the quality of material that would be delivered to the Gate 5 process.	Not interested in dewatering facility.	**Regional Option:** With this option, Lystek would not be interested in operating the RWF's planned dewatering facility, but the RFI response states that they could potentially partner with another service provider. **On-site Option:** RFI response states that they would be willing to hire a dewatering contractor on behalf of San Jose / Santa Clara.	Interested in dewatering operations; 5-year minimum term.	Interested in dewatering (permanent and mobile) operations	Not interested in operating a dewatering facility	For dewatering, would entertain a DBO type contract or operations contract. 2 year minimum term for operations; 5 year minimum term for DBO.

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Attachment C: Responses from Bidders

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BIOGAS Equity 2, Inc.

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

BIOGAS Equity 2, Inc.

InterEngineering

Team Gemini

DPR Construction

1.2 Contact Person, Address, Phone Number, and E-mail:

Michael Muller, Founder, COO

130 Eleanor Dr.

Woodside, CA 94062

650-283-9555

mikemuller@biogas2.com

www.biogas2.com

www.wasteconvert.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

Yes, but with a timeline of not starting construction until two years from now for completion in 2018, we would guess what our partner's bond restrictions and amount will be.

1.4 A description of the technology, service and/or bioslids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

We are proposing our represented German technology, Selected Residue Solvolysis (SRS) wet gasification system. Your post AD biosolids cake at 25% solids is mixed with shredded dirty construction wood and plastic scrap to reach 40% solids without drying. Alternatively, we use the generated gasificatioin heat to dry the biosolids from 25% to 40% solids. The material is then heated in a salt solution at 200 degree C to prepare it for gasification at 900 degree C and generate syngas consisting of H2, CO, and air. The patented process avoids tar build up and the syngas is particle free. The syngas can be burned in a CHP to generate electric power and heat and it can be used to produce chemical base products such as polymers or renewable diesel fuel. Better than 80% of the

material's inherent energy is recovered and the material volume is being reduced to less than 10% that can be used as concrete filler or asphalt filler.

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

Since 2011 a reference plant has been operating in Mannheim, Germany that dries and then gasifies biosiolids that have not been anaerobically digested.

The proposed SRS wet gasification technology is an improvement over the reference plant and patents have been issued on the high temperature pre treatment in a salt solution. Not only is tar build-up avoided, even mercury can be captured as an unsoluable salt. Used railroad ties have been successfully eliminated. The largest scale facility processing 80,000 tons of ocean drift wood a year is coming online this year in the town of Brake north of Bremen, Germany. The plant consists of two modules each processing 10,000 dry tons a year. By end of 2014, we expect data available for material mixtures of biosolids mixed with waste wood and plastics. The systems is continuous, highly automated and burn free. Adding shredded dirty wood to achieve 40% solids avoids drying and can reduce the amount of dewatering the WWTP needs to do. It's just a question of how much dirty wood that has some 70 to 85% solids is mixed with the wet biosolid slurry.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

Gasification is well understood and the salt solution pre process not only allows more energy capture but also eliminates any tar build up that plagues existing gasifiers. The salt is recycled. With an advanced SCADA system of controlling the gasification by milliseconds, the risk of proper gasification is mitigated through sophisticated software. The air resources board will be delighted with the clean syngas properties that are maintained. The existing plants convert syngas using CHP generators to renewable electric energy while thermal energy is used by a nearby fish farm for boiling and cold storage. Steam is used by near by Omni Pac Corp. that produces biodegradable molded fiber packaging.

Much progress is being made in efficiently converting syngas to produce renewable diesel fuel and chemical base products as biodegradable polymers. While available today, by 2016 it will be a better choice than electric power because of higher profit margins.

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

1.7 Type of reuse or intermediate processing that could be provided (check one):

☐ Land Application

☐ Alternative Daily Landfill Cover

☐ Composting of Biosolids and Marketing of Product

☐ Soil Amendment and Marketing of Product

☐ Fuel

X☐ Other (describe) The dewatered biosolids can be wet gasified by itself using generated heat to dry the biosolids to 40% solids. Alternatively, shredded dirty wood can be mixed in to achieve 40% solids and much higher energy output. At present we propose generating electricity by burning the syngas in a CHP generator or pipe it to the the WWTP's CHP and mixing it with AD generated biogas. The SRS wet gasification system reduces the feedstock to 5 to 10% in form of a mineral residue for landfill daily cover or used as concrete and/or asphalt filler.

In the near future more profitable chemical base products and renewable diesel fuel generated from the H2 + CO + air syngas will become attractive.

1.8 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility _____

Location of existing facility _____

X☐ Yes. Name/description of planned facility

Ideally, the proposed facility will be located on the Santa Clara Regional Wastewater Facility property to avoid hauling biosolids in tanker trucks off site.

The SRS Waste Conversion plant can wet gasify the 130,000 tons of dewatered biosolid cake at 25% solids. Heat from the gasification will be used to dry the biosolids to 40% solids.

As an alternative, we can supplement to biosolids with shredded dirty wood that is at 75% solids to get the mixture up to 40% solids. Adding more shredded dirty wood will allow the WWTP to save energy and cost by dewatering below 25% and gain more energy from the dirty wood. As much as 100,000 tons of shredded dirty wood is available within 30 miles at $.30 per ton.

Based on the German SRS reference plant size, the Waste Conversion plant will consist of 5 modules each processing 20,000 tons of dried biosolids a year (at 40% solids).

The generated electricity and heat depends on the organic content of the biosolids.

The total acreage required for the 5 modules is less than 2.5 acres. The biosolids need to be continuously pumped from the anaerobic digesters and dewatering system to the SRS location where the biosolids are centrally dried and distributed to the 5 SRS modules.

The remaining residue after wet gasification is between 2,500 and 5,000 tons a year that will be disseminated to concrete and/or asphalt plants as mineral filler.

Basic facts and Design Criteria

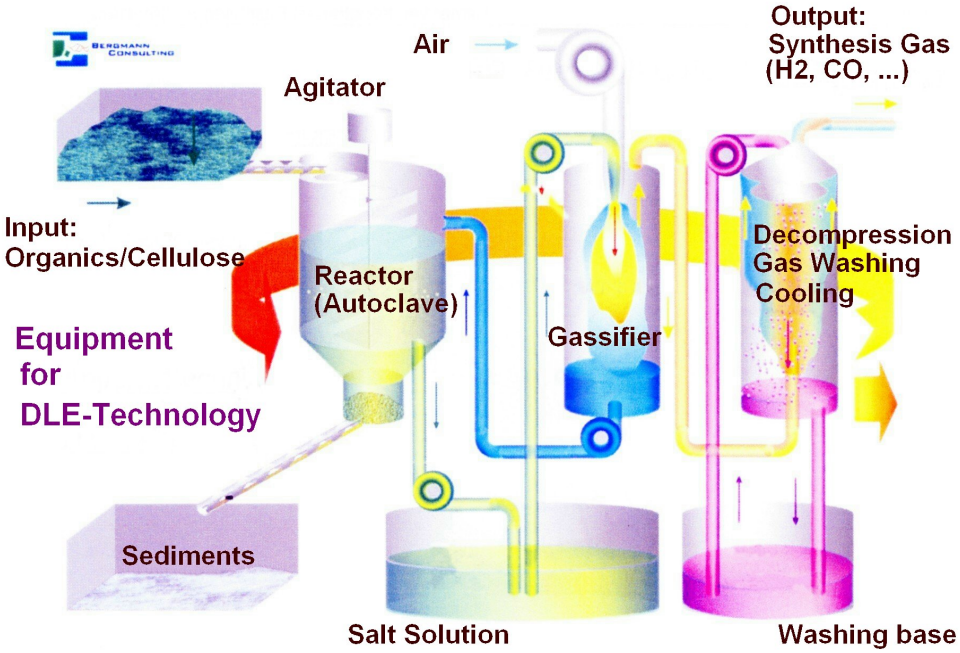
Gasification of plastic and dirty cellulose waste offers the highest efficiency of all technologies available. The usual proposed technology starts from solid material that does not allow the elimination of toxic ingredients such as chlorine, heavy metals, etc. As result, these toxic compounds (such as dioxins) end up in the chimney and subsequently in the environment.

The proposed technology offers a completely different approach: The input materials don't have to be dried and are dissolved in a concentrated salt solution that provides the following advantages:

- By adding specific additives to the generated slurry the hazardous components such as chlorine, mercury and other heavy metals are converted with simple chemical buffering reactions into insoluble inorganic salts that are eliminated from the process as sediments. This avoids the installation of expensive filters as well as the disposal of heavily contaminated filter dust.
- The safe removal of halogens (chlorine) definitely avoids the formation of dioxins during combustion in the CHP engine.
- All metals will be 100% recovered from the initial slurry, which – especially in the case of non-ferrous metals - assures considerable additional revenues in recyclables.
- A considerably increased energetic efficiency; approx. 80% of the energy contained in the input materials will be recovered!
- No-burn, no-emission technology
- CO_2 – neutral, eligible for Carbon Credits
- Moderate process conditions (200 °C, 6 bar)
- Entire process takes place in liquid phase, which allows easy automation and control
- Low preparation effort required; input materials may be wet, contaminated, up to ¾ inch in size
- Output in form of clean synthesis gases ($CO + H_2 +$ air), free from tar, free from particles
- Solid residues (only 4 – 8%, depending on the input material) consisting of sand and other mineral residues plus insoluble and accordingly non-toxic salts, which can be disposed without danger of environmental pollution on landfills or used as concrete filler.

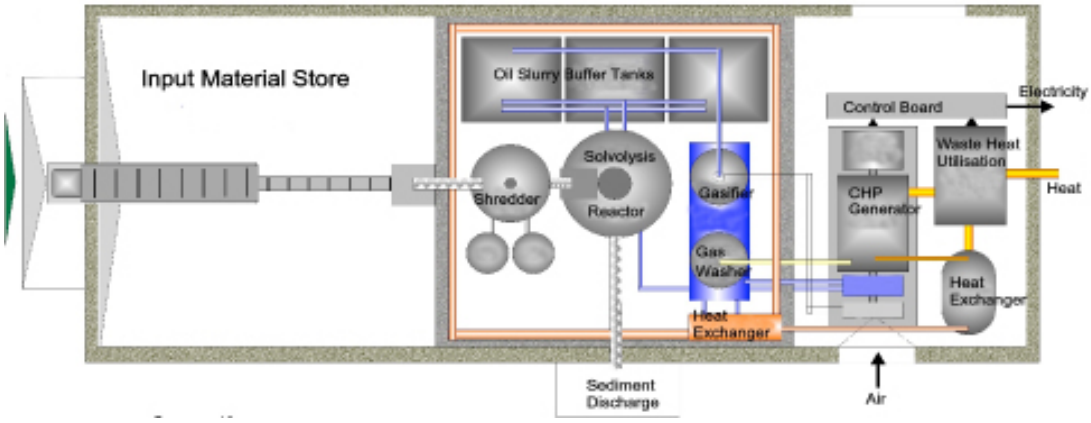
Schematic and Module Layout

The generated synthesis gas is decompressed and cooled down and taken to a CHP motor-generator. Overall energy conversion efficiency is 80% of which 40% will be recovered inform of electricity.
Excess heat amounting to 60% of the recovered energy is available for the process itself, but also for external use with various applications.



SRS Module

The proposed plant will require 5 modules as shown at less than1/2 acre size each as no input material storage is required id no shredded dirty wood is added.



Anticipated operational date

The SRS Waste Conversion plant could be permitted in 2015 and constructed in 2016 and be operational in early 2017.

Capacity (wet TPD)

360 TPD of dewatered biosolids at 25% solids 7 days a week plus

potential shredded dirty wood at 75% solids 6 days a week

How development will be funded

Potential equity investment by Energy Power Partners and low interest bearing loans based on Santa Clara's S&P rating and guaranteed tipping fees.

1.9 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Operations experience is based on some 10 MSW conversion plants and some 60 biogas plants. All of the operations are highly automated and remotely monitored. The SRS system is a new process and operations people will be hired and trained by experienced German operations managers.

1.10 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: no SRS system exists in the North America at this time. The SRS Waste Conversion plant is expandable by adding additional modules that process 20,000 tons at 40% solids a year.

2018: _____

2023: _____

2028: _____

1.11 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

The SRS plant layout will be designed to meet the reflected capacities above.
Modules can be added or idled to adjust to biosolids quantities. Also, the mix between biosolids and potentially added shredded dirty wood is adjustable within a range.

1.12 What is your available on-site storage, both prior to and post-processing:

We will look for the WWTP to provide an even flow of dewatered biosolids and if necessary a buffer tank. The potentiall added shredded dirty wood will be procured on a just in time delivery schedule with three days of provided storage on site to allow for holidays.

1.13 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

1.13.1 Class of Biosolids

What class of biosolids do you accept?

☐ Only Class A

☐ Only Class B

☐ Both Class A and Class B (not commingled)

The SRS Waste Conversion wet gasification plant accepts all classes of biosolids. The change in inherent organics will influence the amount of energy extracted.

If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?

Not that we anticipate at this stage

If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

Not that we anticipate at this stage

1.13.2 Percent Solids

Minimum percent solids of the biosolids you will accept?

As stated above, the SRS et gasification system requires 40% solids to be effective. If the solids drop to 15%, we will require to use up more thermal energy to dry the material. Optionally, we would recommend using shredded dirty wood as filler to maintain the 40% solids and gain significantly more energy as the salt solution boils the cellulose and over 80% of inherent energy is extracted. (Typical gasifiers convert only the energy from the surface of the woodchips after they have been totally dried.

Preferred percent solids of the biosolids you will accept?

25% solids seems to be an achievable number with belt and centrifuge dewatering equipment. As the system generates much heat, it will take some negotiations and analysis if it is more cost effective to use the heat to dry the biosolids or only rely on dewatering equipment. The SRS system is flexible and the optional dirty wood filler provides flexibility.

1.13.3 Energy–Related Processes

Are biosolids processed (dried) to fuel at your location?

The location will be your WWTP and the preferred use of the generated syngas at the moment is to be burned in a CHP generator included in each module or piped to your existing CHPs and mixed with digester biogas.

The SRS system reduces the volume to 5 to 10%. In other words, the mass gets gasified together with the optional dirty wood and all that remains is sand, rocks and minerals that can be used as concrete and or asphalt filler.

If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

We have not seen an analysis of your improved anaerobic digestion digestate output. We would like to assume your energy content is 4kW per kg while dirty wood is around 5kW per kg.

Other characteristics required for delivered fuel product?

Continuous flow of the dewatered biosolids to avoid adding a buffer tank.

1.13.4 Other (describe)

N/A

1.14 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: As 100% of the input material is gasified, the remaining potential 5 to 10% consist of minerals and unsoluable salt encased heavy metals.

Marketing / Reuse Approach: These residues will be taken off site to concrete and/or asphalt mixers as filler.

.

1.15 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: As the residues are used as fillers, the mixing companies have the ability to cope with quantity variations as the quantities are small.

Approach: keep multiple off takers interested to assure that we don't stockpile material. It is something to work out in time.

1.16 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: SRS Waste Conversion plant located at the WWTP

1.16.1 Surface Water (describe): As we propose that the optimum site for the Waste Conversion plant is at the WWTP, we will need some access to some non potable water to create the salt brine that will be recycled. Any surplus would need to flow to the waste water treatment plant.
1.16.2 Odor (describe): The pumped in biosolid cake is mixed with the salt into a slurry that gets heated in a sealed autoclave. There will be no noticeable odor,
1.16.3 Noise (describe): The CHP engine generator will be containerized and noise is held below 60 db from 10ft distance
1.16.4 How close is the nearest residence to this site? The location on the WWTP site needs to be selected and can be a mile away from residences because of the large area that the WWTP covers.
1.16.5 How close is the nearest business to this site? Describe the nature of the business? It's the WWTP and potential businesses developed in the existing drying bed areas.

1.17 Are there any required permits or permit limitations at the site?

Being at an existing WWTP will make permitting significantly easier.

1.17.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

The minimum of biosolid cake to justify a SRS Waste Conversion plant is 40,000 tons at 25% solids a year.

1.17.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton
- ☐ Other (please indicate amount) _____per wet ton

The outline stated that no $ are named and where they appear one should add $0

In order to quote price ranges, we need to know if the WWTP will accept renewable electricity at what price or if it prefers to mix the generated syngas with the digester gas to burn it in existing CHPs. We also would require the analysis to the improved AD digestate as the % of organics influences the generated energy amount.

As we require some 2.5 acres of suitable building land, we would need to know the yearly lease amount.

1.18 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

N/A as the SRS plant is proposed to be located at the WWTP

2 POTENTIAL CONTRACT STRUCTURES

2.1 Please indicate your preference with respect to contracting options (check all that apply):

- X☐ Service Contract (providing a direct end-use service or providing processing)
- X☐ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)
- X☐ Disposition Contract (providing marketing / sales of end product)

2.2 What type of commercial agreement / business model would most interest you?

Based on our experience in Palo Alto for the past year, it is most likely that San Jose ends up wanting to finance, permit and operate the facility themselves. The WWTP can get lower cost financing, has the lab and technical personal on staff and wants to be in control. We are happy to provide the technology, construction supervision and training. We then charge a yearly licensing fee for the technology.

Also, as it makes most sense to build the SRS Waste Conversion plant on WWTP land, you might have sufficient CHP capacity to mix the produced syngas with your biogas.

Also, as WWTP are increasingly interested to take on additional feedstock, adding shredded dirty wood should be of interest and taking delivery of shredded dirty wood would substantially increase the syngas production .

What length of contract term would you prefer? (Check one)

☐	5 years	X☐	10-15 years
☐	5-10 years	☐	No preference

2.3 What is the minimum contract term you would prefer (in years)?

10 years

3 OTHER

3.1 The City is considering building a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

3.1.1 Your team's experience operating this type of facility (describe):

We assume that your sludge is around 4% solids. We could adjust the amount of shredded dirty wood filler at 75% plus solid content to get to 40% solids in which case no dewatering is required for the SRS wet gasification system. It would increase the plant size and energy output.

3.1.2 Term of operating contract that you would prefer and potential impact on service pricing?

Palo Alto is in the process to build a dewatering system at 4x the cost we had proposed. If you are serious in considering a service provider, let us know and we will make a proposal.

3.1.3 Minimum term of operating contract that would accept?

10 year

3.1.4 Please identify any concerns you would have with this type of operation?

We are familiar with the belt presses that Palo Alto's incinerator has been using…. Quite messy. SMUD has been dewatering with decanter centrifuges, a better technology.

3.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

We would love to get involved in greenhouses and then supply farmers markets. BIOGAS Equity's biogas plant in Southern Germany supplies one of Europe's largest green house facilities with heat from a 1.4MW CHP. It's another reason to install the SRS Waste Conversion plant and take in dirty wood to produce more electricity and thermal that can be used for green house operations, office heating and cooling.

3.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

We represent the most advanced German feedstock pre processing and AD system and it would make sense for the WWTP to accept SSO from restaurants and commercial entities…. Universities, CISCo etc. We would provide the pre processing using a bioextruder and our UDR upflow and downflow tanks and utilize one of your large digesters as reflow tank. We would expect to double your biogas production…. See UDR AD at www.biogas2.com

Also, the SRS Waste Conversion plant can easily except any greenwaste to avoid trucking it to expensive and long winded composting facilities. You should consider leveraging your land and infrastructure and keep all city generated waste close to home and become a microgrid.

CH2M HILL Engineers, Inc.

Request for Information (RFI 13-14-01)

Biosolids Transition Program

June 27, 2014

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

CH2M HILL Engineers, Inc.

1.2 Contact Person, Address, Phone Number, and E-mail:

CH2M HILL Engineers, Inc.

Contact: Susan Dennis

Address: 1737 North 1st. Street Suite 300, San Jose, CA 95112-4524

Tel: +1 (669) 800-1010 x31010

E-mail: Susan.Dennis@CH2M.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

Yes.

For construction activity, Payment and Performance bonds would be provided for the value of the contract. The duration of the bonds would be for the construction period based on an agreed-to contract. Our bonding capacity would be sufficient to provide the necessary coverage requirements for this project.

For operations services, our bonds are typically issued for our projects on an annual basis and subject to market conditions dictated by the sureties issuing this type of bond. The value of this bond would be based on the compensation for a one year period and the bond would be renewed annually. Acceptable terms and conditions in the contract are required.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

To Be Determined (TBD).

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

CH2M HILL's approach is to construct a facility to process the 130,000 wet tons per year to a useable by-product in the form of pellets using an alternate delivery approach of either a Design/Build (DB) or Design/Build/Operate (DBO). An example of this technology and DB is the Stamford, CT sludge dryer installed at the Stamford WWPC Plant. Also our Wilsonville, OR project is a DBO of the complete updated

WWTP and incorporates a small sludge dryer.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

One of the key constraints is the requirements for an air emission permit for the dryer and the potential impact to the surrounding area. Mitigation would be to provide air emission control technology capable of achieving the required removal efficiency required for the San José-Santa Clara Regional Wastewater Facility (Facility) and surrounding area.

Another key area of concern is odor emitting from the operations. CH2M HILL has successfully implemented the breadth of biosolids technologies that achieve site-specific odor control requirements.

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

☐ Land Application

☐ Alternative Daily Landfill Cover

☐ Composting of Biosolids and Marketing of Product

☐ Soil Amendment and Marketing of Product

☐ Fuel

X Other (describe) Sludge dryer approach opens opportunities to use product as a renewable fuel and or soil enhancement/fertilizer product. CH2M HILL knows how to select the correct drying system which will produce a high quality product (uniform pellets) suitable for marketing as for land application or for fuel. For the renewable fuel market, a pellet with higher calorific value and lower ash content will enhance the attractiveness of the product. For the soil enhancement/fertilizer product, the NPK values from the source sludge will help determine the best potential end use.

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility Not Applicable (NA)

Location of existing facility _____

☐ Yes. Name/description of planned facility NA

Anticipated operational date _____

Capacity (wet TPD) _____

How development will be funded _____

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

CH2M HILL normally would work with companies that market the resulting product(s).

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: NA
2018: _____
2023: _____
2028: _____

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

TBD

2.6 What is your available on-site storage, both prior to and post-processing:

NA

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

- What class of biosolids do you accept?
  - ☐ Only Class A
  - ☐ Only Class B
  - ☐ Both Class A and Class B (not commingled)
- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?
  Dryer will convert any TPAD sludge generated by the Facility to Class A if it is not already Class A.
- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

  NA

2.7.2 Percent Solids

- Minimum percent solids of the biosolids you will accept?
  18% with the necessary adjustment for fuel cost. Size of facility will be dictated by % solids in feed to dryer system. Note: if desired, we could receive liquid sludge and perform the necessary dewatering.
- Preferred percent solids of the biosolids you will accept?
  22-25%

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?
  NA
- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?
  TBD
- Other characteristics required for delivered fuel product?
  TBD

2.7.4 Other (describe)

NA

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: TBD

Marketing / Reuse Approach: TBD

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: TBD

Approach: TBD

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: TDB

2.10.1 Surface Water (describe): _____
2.10.2 Odor (describe): _____
2.10.3 Noise (describe): _____
2.10.4 How close is the nearest residence to this site? _____

2.10.5 How close is the nearest business to this site? Describe the nature of the business?

_____

2.11 Are there any required permits or permit limitations at the site?

TBD

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

TBD

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton
- ☐ Other (please indicate amount) TBD $XX per wet ton

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

TBD

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

- X Service Contract (providing a direct end-use service or providing processing)
- ☐ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)
- ☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

DB or DBO

3.3 What length of contract term would you prefer? (Check one)

☐ 5 years ☐ 10-15 years

☐ 5-10 years ☐ No preference

For DBO prefer 20 years

3.4 What is the minimum contract term you would prefer (in years)? 20

4 OTHER

4.1 The City is considering building a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

4.1.1 Your team's experience operating this type of facility (describe):
As a provider of O&M services to many wastewater treatment plants in the USA, CH2M HILL provides these very services of dewatering sewage sludge and loading cake for conveyance offsite. Our current facilities are smaller in capacity than required by the Facility, but the very same O&M issues apply. Also CH2M HILL has designed loadout facilities for such applications as the Detroit Metro Wastewater Facilities. This facility provides lime addition/mixing to the dewatered sludge (centrifuged and belt filtered) for transporting offsite by truck.

4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?
TBD

4.1.3 Minimum term of operating contract that would accept?
TBD

4.1.4 Please identify any concerns you would have with this type of operation?
TBD

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

A- CH2M HILL would be interested in the O&M for such facilities.

B- Concerns

1) Capacity – System has been properly installed and the rated capacity demonstrated over a steady state condition for a sufficient period of time

2) Safety - System has necessary safety protection mechanisms and systems to meet CH2M HILL's safety criteria

3) Maintenance – System has been installed and maintained per the manufacturers' requirements

4) Personnel – Ability to transition existing City personnel from these facilities to our operation or other City positions.

5) Permits – All required permits are in place and current.

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

As the City considers their options, control of sludge production and the resulting product(s) will be very important for both short term and long term stability in the ultimate disposal of the Facility's sludge. There are many concepts for sludge reuse but many of these concepts have not proven themselves in the market place. CH2M HILL looks forward to working with the City on this endeavor to make it happen.

Degremont Technologies

Request for Information (RFI 13-14-01)

Biosolids Transition Program

June 27, 2014

1 BACKGROUND

1.1 OVERVIEW

Over the next several years, the San José-Santa Clara Regional Wastewater Facility will be transitioning to a new biosolids program and is seeking input from potential beneficial re-use service providers.

The San José-Santa Clara Regional Wastewater Facility (Facility) currently manages its post-digestion biosolids through extended-stabilization lagoons and open-air drying beds prior to shipping 100% of the stabilized biosolids product to the nearby Newby Island Landfill for use as alternative daily cover.

The Facility treats 110 MGD from six tributary agencies. The current biosolids process includes Mesophilic Digestion, after which the sludge is stabilized in the lagoons for approximately three years and dried in the beds for an additional six months. The City of San José (City) has decided to implement advanced digestion at the Facility; depending on the extent of other biosolids improvements implemented at the Facility, approximately 130,000 wet TPY of dewatered biosolids (25% solids) will be generated requiring off-site disposition and possibly off-site processing.

1.2 BIOSOLIDS PROGRAM OBJECTIVES

1.2.1 Provide a reliable, diversified and flexible biosolids program that can adapt to future regulatory and market changes;

1.2.2 Provide a cost effective program;

1.2.3 Reduce environmental and community impacts;

1.2.4 Maximize beneficial re-use of biosolids; and

1.2.5 Explore emerging technologies which have been successfully tested at full scale.

1.3 KEY BIOSOLIDS TRANSITION ACTIVITIES

1.3.1 The City is currently upgrading the existing Mesophilic Digestion Process to Temperature Phased Anaerobic Digestion Process;

1.3.2 Decommissioning the existing lagoons and drying beds;

1.3.3 Developing new infrastructure (with the exception of composting facilities which the City will <u>not</u> be building on-site) at the existing wastewater treatment plant site for treating biosolids and potentially contract for their operation; and

1.3.4 Contracting for transportation, additional off-site processing where applicable, and beneficial re-use of the treated biosolids.

1.3.5 The City intends to begin operating the new biosolids infrastructure by the end of 2018. Transportation of biosolids to beneficial re-use sites (including possibly intermediate processing sites) is also planned to start at the same time.

1.3.6 As part of the City's intent to provide a reliable, flexible program, the City plans to arrange for several end uses for its biosolids. This would be through a "broker-type" contract that includes a variety of end uses, or through contracts with several end-use service providers. These end-use contracts may involve intermediate processing (i.e. composting). The City may enter into service contracts for a variety of disposition options and products, including but not limited to:

- Land Application
- Compost
- Alternative Daily Landfill Cover
- Dried Pellets

2 DOCUMENT PURPOSE

2.1 Obtain information on the range of private sector firms interested in utilizing anaerobically digested biosolids cake for a variety of purposes and / or interested in providing processing/ beneficial re-use services for the City's biosolids;

2.2 Obtain information on the range of potential biosolids processing technologies that exist in the marketplace;

2.3 Obtain information on the potential types of contract structures that would be of interest to potential service providers;

2.4 Obtain information that might affect our decisions regarding the type and size of biosolids treatment processes to develop at our wastewater treatment plant;

2.5 Determine if processing and re-use service providers also have the capability and interest in operating biosolids treatment processes at the City's Facility location; and

2.6 Obtain information regarding the feasibility of outsourcing the final disposition of biosolids produced at the Facility.

3 TIMELINE

RFI Released	June 27, 2014
Deadline for Questions (please post all questions directly on the BidSync System at any time prior to the deadline)	July 10, 2014
Deadline to Respond per Sections 6 and 7	July 17, 2014, Close of Business

4 CONTACT/QUESTIONS

Please direct all inquiries and post all questions to the Bidsync system on or before July 7, 2014. The City shall respond to questions on Bidsync. City responses to all such questions shall be considered formal addenda to this RFI.

5 RESPONSE

5.1 Respondents should complete the attached Exhibit 1 and attach additional supplemental information as appropriate.

5.2 Responses will be retained by City, subject to City records retention policies. Any data submitted to City hereunder may be utilized by the City. All submittals received from Respondents will become the property of the City and will not be returned. By making submittals in response to this RFI, respondents expressly acknowledge and agree that the City will not be responsible or liable in any way for any losses that Respondent may suffer from disclosure of information or materials to third parties.

5.3 All information must be legible. The contents of the response submitted may be relied upon to create requirements for related projects, either procured or otherwise accomplished by City.

6 HOW TO SUBMIT YOUR RESPONSE

Please submit the reference information requested above by uploading your response and posting to the "RFI response line item" on the BidSync System. **Wherever possible, please consolidate your response into one file in order to facilitate distribution and review by the City.**

7 NEXT STEPS

7.1 The City is soliciting feedback from companies with recent, successful experience and present capability to provide outsourced biosolids beneficial use and resource recovery. The information received in response to this RFI will be used by the City to decide how to maximize market opportunities available. By participating in this RFI process, the Respondent expressly agrees that no contract of any kind is formed under, or arises from this RFI and that no legal obligations will arise. The City will have no obligation to enter into negotiations or a Contract with Respondent, even though one or all of the Respondents are determined to be responsive. In the future, the City may engage in formal procurement(s) including Requests for Qualification and Requests for Proposals.

7.2 The City reserves the right to contact any respondents to seek clarification or request follow-up information on their response.

8 PUBLIC NATURE OF PROPOSAL MATERIAL

All correspondence with the City including responses to this RFI will become the exclusive property of the City and will become public records under the California Public Records Act (Cal. Government Code section 6250 et seq.) All documents that you send to the City will be subject to disclosure if requested by a member of the public.

San José-Santa Clara Regional Wastewater Facility

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

Degremont Technologies

- Infilco
- Innoplana

1.2 Contact Person, Address, Phone Number, and E-mail:

Hao Pham
8007 Discovery Drive
Richmond, VA 23229
804-339-6699
hao.pham@infilcodegremont.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

We are an equipment supplier. Bonding would be for the equipment supply contract as opposed to a service contract.

1.4 A description of the technology, service and/or bioslids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

For this RFI, we are presenting our range of sludge treatment technologies for consideration. Our sludge processing technologies include advance two-phase anaerobic digestion, advance dewatering, two-stage thermal drying with energy recovery, solar drying, and thermal oxidation with energy recovery including electricity production. Our technologies are highlighted herein.

- **2PAD** – Two-phase anaerobic digestion with 12-day retention time and greater than 60% VSR. Class A biosolid.
- **Canon Mixer** – Bubble mixer for retrofit with greater than 90% active mixing
- **Tecon Cover** – Cost effective double membrane gasholder system for digesters
- **Dehydris Twist** – Low energy high solids dewatering. Greater than 40% DS for advance digestion sludge.
- **Heliantis** – Solar dryer producing 85% DS pellet
- **Innodry 2E** – Two-stage drying with energy recovery that is dust free and safe.
- **Thermylis** – High temperature fluidized bed incineration with energy recovery. Complete and final disposal with up to 93% sludge reduction.

	DIGESTION			DEWATERING	DRYING		OXIDATION
	2PAD	CANNON® MIXER	TECON	DEHYDRIS™ TWIST	HELIANTIS™	INNODRY® 2E	THERMYLIS®
FEED SOLIDS (%TS)	2 to 8	2 to 8	Double Membrane Biogas Holder	1 to 6	≥ 15	≥ 18	≥ 20
END PRODUCT (%TS)	2 to 8	2 to 8		25 to 50	+ 90	+ 90	Ash
VS DESTRUCTION (%)	+ 60	+ 45					100
MASS REDUCTION (%)	> 40	> 30		> 90	> 70	> 70	> 90
BIOSOLIDS CLASSIFICATION	A	A or B		A or B	A or B	A	
RETROFIT	✓	✓	✓				✓
AUXILIARY FUEL						✓	
ENERGY RECOVERY	✓	✓	✓			✓	✓
UTILITIES REQUIREMENT	Low	Low	Low	Low	Low	Low	Low
FOOT PRINT	Small			Medium	High	Small	Small

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

Infilco Degremont, Inc., a subsidiary of Suez Environnement, in partnership with Innoplana provide high performance water, wastewater, and sludge treatment solutions for any size population and virtually any condition. We are involved in every stage of a project, from process design to equipment supply to operations and training and support. We have installations worldwide including North America for sludge stabilization and processing. We offer advanced and forward thinking solutions for clients who are seeking energy effiencient and sustainable solutions. Infilco, located in Richmond Virginia have recently been awarded Frost and Sullivan's North American Municipal Biosolids Company of the Year for 2013.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

All of the technologies presented are commercially bonded projects for the performance of the product. Warranties and guarantees are included as part of the project scope.

These are energy efficient as well as safe to operate technologies. For example, the Innodry 2E dryer is virtually dust free, making the environment safe from explosion. Since this can be proven during performance testing, no oxygen monitoring is required.

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

- ☒ Land Application
- ☒ Alternative Daily Landfill Cover
- ☒ Composting of Biosolids and Marketing of Product
- ☒ Soil Amendment and Marketing of Product
- ☒ Fuel
- ☐ Other (describe)

We offer technologies that will produce a beneficial re-use product. As we are an equipment provider, Degremont Technologies does not own or operate processing facilities nor do we provide these services. As such, we have not provided responses to the remaining questions.

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility _____
Location of existing facility _____

☐ Yes. Name/description of planned facility _____
Anticipated operational date _____
Capacity (wet TPD) _____
How development will be funded _____

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

_____

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: _____
2018: _____
2023: _____
2028: _____

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

_____

2.6 What is your available on-site storage, both prior to and post-processing:

_____

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

- What class of biosolids do you accept?
  - ☐ Only Class A
  - ☐ Only Class B
  - ☐ Both Class A and Class B (not commingled)
- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?

  _____
- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

  _____

2.7.2 Percent Solids

- Minimum percent solids of the biosolids you will accept?

  _____
- Preferred percent solids of the biosolids you will accept?

  _____

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?

  _____
- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

  _____
- Other characteristics required for delivered fuel product?

  _____

2.7.4 Other (describe)

_____

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: _____

Marketing / Reuse Approach: _____

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: _____

Approach: _____

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: _____

2.10.1 Surface Water (describe): _____
2.10.2 Odor (describe): _____
2.10.3 Noise (describe): _____
2.10.4 How close is the nearest residence to this site? _____
2.10.5 How close is the nearest business to this site? Describe the nature of the business?
_____

2.11 Are there any required permits or permit limitations at the site?

_____

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

_____

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

☐ $10-$20 / wet ton

☐ $20-$30 / wet ton

☐ $30-$40 / wet ton

☐ $40-$50 / wet ton

☐ $50-$60 / wet ton

☐ $60-$70 / wet ton

☐ Other (please indicate amount) _____ per wet ton

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

_____

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

☐ Service Contract (providing a direct end-use service or providing processing)

☐ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)

☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

_____

3.3 What length of contract term would you prefer? (Check one)

☐ 5 years ☐ 10-15 years

☐ 5-10 years ☐ No preference

3.4 What is the minimum contract term you would prefer (in years)? _____

4 OTHER

4.1 The City is considering buidling a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

4.1.1 Your team's experience operating this type of facility (describe):

_____

4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?

_____

4.1.3 Minimum term of operating contract that would accept?

_____

4.1.4 Please identify any concerns you would have with this type of operation?

_____

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

_____

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

_____

Gate 5 Energy Partners, Inc.

San José-Santa Clara Regional Wastewater Facility

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

Gate 5 Energy Partners, Inc.

1.2 Contact Person, Address, Phone Number, and E-mail:

Steve Delson, CEO
Gate 5 Energy Partners, Inc.
65 Enterprise
Aliso Viejo, CA 92653
949/330-7010
s.delson@gate5energypartners.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

Gate 5 is willing to discuss such a bond or other arrangements that will meet the City's objectives. The amount and duration would depend on factors that have yet to be determines, such a size and scope of the project and contract for and duration.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

Gate 5 Energy System ("G5ES") will transform sludge or biosolids into renewable energy onsite at San Jose Santa Clara Regional Wastewater Facility ("RWWF"). The G5ES consists of a **drying stage** wherein primary sludge/WAS or biosolids from the RWWF are milled and dried with circulating steam to produce a biofuel; a **combustion stage** where biofuel is combusted in a biomass boiler to create steam; and an **energy recovery stage** where steam generated in boiler and steam produced by solar collectors on canopy over G5ES power a turbine to generate electricity. USEPA has determined the use of biofuel in a biomass boiler to produce power avoids classification and regulation as incineration. The combination of these three stages produces a complete, self-sustaining and energy positive biosolids management solution that runs without fossil fuel; eliminates the need to produce Class A or B biosolids and haul biosolids for land-based management or disposal.

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

There are no G5ESs in operation today. An 8 wtpd mobile G5ES is in development and a 60 wtpd commercial scale G5ES is slated to get under construction by the end of the year in Orange County, California. Gate 5's biosolids reduction technology was selected

by an Orange County water and sanitation district asa over other invitee in an RFP process. For our first commercial project, Gate 5 will design, finance, build, own and operate a G5ES on +/- ½ acres at the district's WWTP. A term sheet has been negotiated and CEQA has been completed. Operation is expected to commence in late 2015 or early 2016.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

RISK: "Will it work?" (given lack of operating commercial G5ES) **Mitigation**: Individual components well-proven, tested and certified.
RISK: Dryer breakdown. **Mitigation**: G5ES uses ring dryers which have no internal moving parts
RISK: Concerns over impact to public health and environment from land-based biosolids management. **Mitigation**: G5ES reduced biosolids to ash; there is no need to produce Class A or B biosolids to protect public health and environment
RISK: Biosolids spillage during transport. **Mitigation**: After our process there are no biosolids to transport; only small volume of sterile, non-hazardous ash (6% of feedstock volume
RISK: less electricity could be produced because lower than expected solids content meaning: more energy used dry; less to power turbine. **Mitigation**: G5ES could do additional dewatering or run on primary sludge/WAS.
RISK: G5ES down for maintenance or repair. **Mitigation**: G5ES headworks includes 3 to 4 days feedstock storage; longer term, would have standby contracts with haulers.

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

☐ Land Application
☐ Alternative Daily Landfill Cover
☐ Composting of Biosolids and Marketing of Product
☐ Soil Amendment and Marketing of Product
☐ Fuel

X Other (describe) **RE-USES**

- **Renewable electricity:** generated via combustion of powdered biofuel that is consumed in the G5ES. Electricity would be sold to City, presumable for use at the RWWF. This will further the City's goal of 100% renewable electricity by 2022
- **Heat:** generated by G5ES would be available for use by City, most likely at the RWWF
- **Water:** that is recovered from sludge would purified in in process scrubbers and returned to the plant headworks to be recycled

- **Sterile ash:** (6% of feedstock volume) end product could be usable as a building material (a substitute for fly ash in concrete), it would be marketed by Gate 5
- **Sterile ash:** (6% of feedstock volume) end product could be usable as soil amendment, it would be marketed by Gate 5

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility _____

Location of existing facility _____

X Yes. Name/description of planned facility Gate 5 Energy System at San Jose Santa Clara Regional Wastewater Facility – **see response to 1.4 for description**

Anticipated operational date 2018

Capacity (wet TPD) As determined by City and Gate 5; assuming 25% solids content and digested biosolids our preference would be 120 wtpd, however a G5ES could be sized between 60 and 360 wtpd capacity

How development will be funded? Funding would be by Gate 5, using underlying long-term agreements with City for (i) Biosolids Processing Fee and (ii) purchase of electricity as collateral. The Processing Fee would replace costs incurred by City for producing Class A or B biosolids (including savings to operating costs from being able to reduce digester residence time by up to 50%), biosolids hauling and tipping fee. The price for electricity would be comparable to what is paid to PG&E

2.3 PLEASE PROVIDE INFORMATION RELATED TO YOUR EXPERIENCE OPERATING THIS TYPE OF PROCESSING OR BENEFICIAL REUSE FACILITY.

Currently the design and our customer agreement are being finalized and construction is slated to begin in later 2015/early 2016. By the time this project is under construction, we will have a contractual arrangement in place with a qualified operation, who will be supervised by gate 5 personnel.

2.4 WHAT IS THE AVAILABLE AND ESTIMATED CAPACITY AT YOUR FACILITY OR SITE (MINUS DEDICATED CAPACITY)?

Current: 0
2018: TBD
2023: TBD
2028: TBD Gate 5 would build biosolids management facilities to the specific needs of the City, as it is determined.

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

No, the equipment has not been sized.

2.6 What is your available on-site storage, both prior to and post-processing:

The G5ES is designed to run 24/7.

- Cake bin will be able to store 3 to 4 days' supply of "feedstock" (dewatered biosolids or sludge).
- The dried biosolids/sludge becomes biofuel; there is no need for significant biofuel storage because in the G5ES the biofuel is immediately combusted.
- Ash remaining after combustion is about 6% the volume of the feedstock, two trailers' worth of storage will be provided.

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

In order of Gate 5's preference**: (1)** primary sludge/WAS that Gate 5 would dewater **(2)** digested sludge with a minimum of digester residence time (on the order of 10-12 days (?) whatever is adequate to produce the volume of digester gas the RWWP needs **(3)** digested sludge with the residence time adequate to produce Class A or B biosolids.

2.7.1 Class of Biosolids

- What class of biosolids do you accept?
  - ☐ Only Class A
  - ☐ Only Class B
  - X Both Class A and Class B (not commingled)
- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?
  - No restriction because all biosolids or sludge is transformed to biofuel and combusted within the G5ES; there are no biosolids that require land-based management or disposal.
- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A? N/A

2.7.2 Percent Solids

- Minimum percent solids of the biosolids you will accept?
  18%, however the cost structure to the City would reflect additional dewatering by within the G5ES (and the RWWF would need to accept the waste stream.

- Preferred percent solids of the biosolids you will accept?

  For digested sludge our preference is 25%; there is no restriction for primary sludge/WAS as we would include dewatering (and the RWWF would need to accept the waste stream).

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?

  Yes, transforming biosolids to biofuel in a ring dryer is an integral part of our process.

- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

  N/A

- Other characteristics required for delivered fuel product?

  The G5ES could use waste heat from RWWF processing such as co-generation, digester heating and flaring as heat sources for the dryer; we would welcome being able to utilize the combusted air and treat it prior to discharge.

2.7.4 Other (describe)

<u>The G5ES would utilize WRRF influent or effluent as a heat sink; this will avoid the need for a cooling tower</u>

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: Biosolids/Sludge Processing

Marketing / Reuse Approach: Gate 5 will transform the RWWF's biosolids (or sludge) into renewable energy (parasitic load and surplus). Gate 5 would charge the City a to-be determined Processing Fee per wet ton of feedstock, pursuant to a long-term Biosolids Supply Agreement.

Material: Renewable Electricity

Marketing / Reuse Approach: The G5ES will produce more renewable electricity than its parasitic load; Gate 5 would expect the City to enter into a long-term Power Purchase Agreement to purchase the surplus renewable electricity for use at the RWWF at a rate comparable to the rate it would pay PG&E for power at the RWWF.

Material: Process Water

Marketing / Reuse Approach: Water removed from the dewatered biosolids (sludge) in the drying process would be re-condensed and conveyed by Gate 5 to the RWWF headworks for reclamation. There would be no costs or charges to either party associated with the process water.

Material: Process Heat

Marketing / Reuse Approach: As noted above, the G5ES would use combusted air waste heat from various RWWF sources and waste heat (not combusted air) from the G5ES turbine would be available for the RWWF's use. There would be no costs or charges to either party associated with the Process Heat.

Material: Ash

Marketing / Reuse Approach: The ash remaining after biofuel combustion (approx. 6% the volume of incoming biosolids, assumed as digested and 25% solids) would be marketed as a soil additive or a building material by Gate 5. Gate 5 expects its primary customer for this valuable substitute for fly ash sterile and non-hazardous ash material would be with a local concrete batch plant operator.

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: Biosolids/Sludge Processing

Approach: The Biosolids Processing Agreement will be "take or pay" in that if, on a monthly prorated basis, the RWWF delivers less than the contracted volume, the City will pay based on the minimum. If a greater than monthly prorated volume is delivered, then the per ton rate will be applied to the greater amount (The G5ES will be designed to accommodate a minimum of 110% of its rated capacity and more by varying the characteristics of its drying gas)

Material: Renewable Electricity

Approach: The amount of renewable electricity produced by the G5ES vary based on the quantity and quality of biosolids/sludge delivered by RWWF to the G5ES (and the amount of sunlight to the solar collectors), therefore the amount of renewable electricity available for the City could vary. The City would only be obligated to purchase and Gate 5 would only be obligated to provide as much renewable electricity as would be available after the G5ES parasitic load has been satisfied (i.e. Surplus Renewable Electricity"). In the event the RWWF would be unable to use the Surplus Renewable Electricity, the Gate 5 would expect the City to be the back up customer.

Material: Process Water

Approach: No alternate provisions are proposed as the make up of this process water will be no different than the waste stream from the RWWF's dewatering facilities.

Material: Process Heat

Approach: To the extent that Gate 5 does not take the hot combusted air from the RWWF, it would be the RWWF's responsibility to deal with it (as it is now). To the extent that the RWWF is not able to utilize the process heat from the G5ES turbine , the waste heat would radiate into the atmosphere

Material: Ash

Approach: In the event that local cement batch plants are not willing to accept the ash, and soil amendment markets cannot be developed, the ash can by landfilled, as it is a sterile and non-hazardous material.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: planned Gate 5 Energy System at San Jose Santa Clara Regional Wastewater Facility

2.10.1 Surface Water (describe): The G5ES would be constructed within RWWF property and therefore subject to its surface water management practices. We envision preparing an addendum to the site's SWPPP and working with RWWF staff to assure compatible management. There should be no change in off RWWF property impacts.

2.10.2 Odor (describe): All conveyance systems and storage bins will include odor control provisions, be enclosed and vented to the G5ES boiler; this will insure complete deodorization by processing through G5ES's pollution control system the air before is discharged to the atmosphere .

2.10.3 Noise (describe): Provisions would be included to mitigate any noise impact to less than significant levels; likely in a manner similar to those being incorporated into the G5ES at Santa Margarita Water District's Chiquita WRP. Please see attachment #1 at end of this material (pages 96-98 of Mitigate Negative Declaration for Chiquita Water Reclamation Plant Expansion {SCH#2012071095}).

2.10.4 How close is the nearest residence to this site?
Approx. one and one half miles

2.10.5 How close is the nearest business to this site? Describe the nature of the business?
Business park (flex-tech and office) one half mile (or more).

2.11 Are there any required permits or permit limitations at the site?

CEQA process will identify requirements and limitations, however, at a minimum: building permits, air quality permits and SWPPP.

2.12 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

While the G5ES can be sized to process any quantity of biosolids from 15 wtpd (25% solids) to more than 500 wtpd (with multiple dryers in parallel); our preference for this project would be no less than 120 wtpd.

2.13 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton
- X Other (please indicate amount) $85 per wet ton - for such a small quantity, however with a 120wtpd capacity G5ES, our pricing could be as low as $40 pwt.

2.14 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

No. Our business model is to build a "right-sized" facility for a community's wastewater needs, so there is no transportation, biosolids are processed onsite and there is no biosolids transportation cost built into our structure or incurred by our customers.

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

- ☐ Service Contract (providing a direct end-use service or providing processing)
- X Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)
- ☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

Design, build, own and operate.

3.3 What length of contract term would you prefer? (Check one)

- ☐ 5 years
- **X** 10-15 years
- ☐ 5-10 years
- ☐ No preference

3.4 What is the minimum contract term you would prefer (in years)?

Gate 5 believe a 20 year term will provide the optimal process fee structure for our customers.

4 OTHER

4.1 The City is considering building a dewatering and load-out facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

2.11.1 Your team's experience operating this type of facility (describe):

As a new company, yet to complete our first commercial scale project we have yet to staff this function.

2.11.2 Term of operating contract that you would prefer and potential impact on service pricing?

Same term as biosolids management arrangement.

2.11.3 Minimum term of operating contract that would accept?

Same term as biosolids management arrangement.

2.011.4 Please identify any concerns you would have with this type of operation?

If dewatering operation is managed by other, Gate 5's concern would be that the operator would deliver the contracted quantity and quality of biosolids to the G5ES.

If dewatering operation were managed by Gate 5 and if Gate 5 did not have a management contract for 100% of the WRRF's biosolids, our concern would be that other biosolids "vendors" would remove their portion of the biosolids as the dewatering occurs.

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

We would be interested in incorporating drying of all of the RWWF's biosolids into the G5ES we would operate at the RWWF.

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

Gate 5 is assuming (hoping) that it will be 2018 when the City needs to make a decision regarding biosolids management, so one or more G5ES will be in commerical operation. Meanwhile we believe it is advantagous to keep in a dialogue regarding Gate 5's approach to biosolids management.

Please visit our website (www.gate5energypartners.com) for information about

Gate 5 believe transforming bioslids/sludge into renewable energy is the best solution in the marketplace and that our innovative and priooriatary technology is the best solution in the marketplace. Once the City has had an opportunity to go through Gate 5's and the other submittals, Steve Delson, Gate 5 CEO and Michael D. Moore, Gate 5 Scientific Advisory Board Member would be pleased to meet with the City for a more comprehensive presentation and explanation of our technology and business approach.

BonTerra PSOMAS

Final Initial Study and Mitigated Negative Declaration

Chiquita Water Reclamation Plant Expansion

Prepared for

Santa Margarita Water District
26111 Antonio Parkway
Rancho Santa Margarita, California 92688
Contact: Don Bunts, Chief Engineer
(949) 459-6602

Prepared by

BonTerra Psomas
2 Executive Circle, Suite 175
Irvine, California 92614

December 20, 2013
(Revised February 5, 2014)

Balancing the Natural and Built Environment

www.Psomas.com

Construction Noise

Project construction would not occur between 8:00 PM and 7:00 AM on weekdays or Saturdays, nor would it occur on Sundays or federal holidays, consistent with County standards (refer to mitigation measure (MM) NOI 12-1).

Construction would occur over a period of approximately 30 months. Construction noise would be generated by construction equipment during the development of the various elements of the reclamation plant expansion. Construction activities are expected to require use of bulldozers, graders, dump trucks, front-end loaders, backhoes, welders, forklifts, cranes, and similar equipment. No pile driving, blasting, or high-impact demolition is anticipated. Based on this list of equipment, maximum noise levels (L_{max}) measured at a distance of 50 feet from a piece of equipment can reach as high as 85 dBA. Because the equipment power levels vary during operation, maximum noise levels would occur intermittently. Construction equipment of the types mentioned are typically at full power approximately 40 percent of their operating time; thus, average noise levels are less than maximum noise levels. During construction of the CWRP expansion, it is likely that two or three pieces of equipment would be operating at one time. With multiple pieces of equipment, noise levels are analyzed from the center of the construction area. Average noise levels at a distance of 100 feet would be approximately 80 dBA. Noise would be reduced over distance at between 6.0 and 7.5 dBA per doubling of distance, depending on the nature of the ground surface. Thus, 80 dBA at 100 feet would be 72.5 to 74 dBA at 200 feet and 65 to 68 dBA at 400 feet from the center of the plant site. Construction noise would be heard off site, but would not impact any sensitive noise receptors. The impact would be less than significant and no mitigation is required.

Operation Noise

The proposed CWRP expansion would add noise sources similar to those now operating on the project site; that is, pumps, blowers, and microturbines. The new equipment would be distributed around the site, as depicted in Exhibits 4a and 4b. If the number of similar noise sources increase by 50 percent, the combined noise levels would increase by less than 2 dBA. Average noise levels at 200 feet from the CWRP, without consideration of topography, are estimated at 52 dBA Leq or less.

The BRP would be an additional source of noise located at the northeast end of the project site. Because the specific equipment for the BRP has not been identified, this noise source is considered a potential significant impact. MM NOI-2 would be incorporated into the project to ensure that noise from the BRP would not cause a significant impact to planned residential development near the CWRP site. MM NOI-2 requires that noise from the BRP, when added to existing and anticipated CWRP noise, not exceed 55 dBA Leq at any CWRP property line. As previously noted, future residences would be located more than 600 feet from the CWRP site boundaries and approximately 50 feet higher than the CWRP site. Additionally, based on the Subarea Plans that have been approved for Planning Area 2 of the Ranch Plan, there would be a berm constructed along the southern and eastern boundaries of the SMWD property line. Because of distance and topography, there would be additional reduction of at least 5 dBA, and the resulting noise at residential property would be 50 dBA Leq or less. The 50 Leq value is consistent with Orange County standards for exterior noise levels at residential properties. With the implementation of MM NOI-2, the impact would be less than significant.

Noise would also be generated by trucks bringing biosolids and other materials to the CWRP facility and taking ash and biosolids from the facility. As described in the project description and Section 16, Traffic/Transportation, the change in truck traffic from the existing operations may vary from one or two truck trips per day increase to a decrease in truck trips depending on

CWRP operations and the rate of generation of wastewater in the service area. The noise impacts of the variation in truck trips would be negligible. Similarly, the increase in employee commute trips would be nominal and the noise impact would be negligible and less than significant. No mitigation is required.

b) Would the project expose persons to or generation of excessive ground borne vibration or ground borne noise levels?

No Impact. Vibration affects structures and persons located relatively close to the source of the vibration. For heavy construction equipment operations, vibration would not be perceptible at distances of 200 feet and greater. There would be no sensitive receptors within 600 feet of the CWRP construction or operational activities. There would be no impact.

c) Would the project result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

Less than Significant. As discussed in response to impact question a. above, permanent, operational noise levels are anticipated to increase by less than 2 dBA. The increase would not be substantial. The impact would be less than significant; no mitigation is required.

d) Would the project result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

Less than Significant. As discussed in response to impact question a. above, construction activities would cause temporary noise increases for a period of approximately 30 months. There are no noise sensitive receptors in the areas that would be impacted by construction noise. The impact would be less than significant; no mitigation is required.

e) For a project located within an airport land use plan or, where such plan has not been adopted, within two miles of a private or public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

No Impact. The project is not located within an airport land use plan or within the vicinity of a private airstrip or heliport and would not expose people to excessive noise levels associated with airport operations or aircraft travel. The closest airport to any of the project sites is the John Wayne Airport, located approximately 17.5 miles to the northwest. No impacts would result, and no mitigation is required.

MITIGATION PROGRAM

<u>Mitigation Measures</u>

MM NOI-1 Operation of heavy equipment, trucks, and other noise-generating activities associated with project construction shall be limited to the hours of 7:00 AM to 8:00 PM, Monday through Saturday; there shall be no construction on Sundays or federal holidays.

MM NOI-2 The BRP equipment and facility shall be designed to limit noise such that noise from the BRP, when combined with noise from the other CWRP facilities, does

not exceed 55 dBA at any CWRP property line. The BRP design may include the following:

- Equipment may be housed in enclosed structures or below ground galleries.
- Sound enclosures may be included for high noise level equipment.
- Ventilation intake and exhaust for equipment may be placed facing away from sensitive receptors where reasonably possible. Louvers, duct silencers, and other sound attenuation measures may also be included.
- Noise sources with tonal qualities, such as engines, turbines, fans, and blowers, could be of a special design. The design should include noise reductions in the appropriate frequency bands to reduce tonal components of the spectrum to limited levels over the existing minimum hour ambient noise levels in the same band as the tonal source. This will result in very low contribution of tonal sources to the overall noise level and difficulty in discerning the tone, even during the quietest nighttime periods

XIII. POPULATION AND HOUSING

IMPACT ANALYSIS

Would the project:

a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?

b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?

c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?

No Impact. The proposed Project involves the expansion of an existing water reclamation plant to better serve the region's project population increase associated with future development within the SMWD service area based on the SCAG adopted population projections. Implementation of the project would create approximately three new employment positions, which would not generate substantial growth in the area or would it impact local or regional population and housing growth. Further, no residential development exists within or adjacent to the project site; therefore, project implementation would not displace people or housing. No impact would occur.

XIV. PUBLIC SERVICES

IMPACT ANALYSIS

a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services: fire protection, police protection, schools, parks, and other public facilities?

Liberty Composting, Inc.

Request for Information (RFI 13-14-01)

Biosolids Transition Program

June 27, 2014

San José-Santa Clara Regional Wastewater Facility

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

Liberty Composting, Inc.

1.2 Contact Person, Address, Phone Number, and E-mail:

Wilson E. Nolan, CEO, PO Box 5, Lost Hills, CA 93249. 661-619-7320. Wnolan@libertyrecyc.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

Yes. No restrictions on the amount or duration of any bonding required.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

Liberty Composting employs two proven methods of biosolids mono-composting for the production of high nitrogen compost product which is sold in bulk form to large agricultural operations in the Central Valley. Compost produced is also used in crop production at nearby Liberty Ranch, a 20,000 acre farm owned by a related company. Liberty Composting is a well-established biosolids composting facility in continuous operation since 1989 and has composted over four million tons of biosolids. The facility employs both the windrow composting method and an enclosed positive aeration Membrane Aerated Static Pile (MASP) system based on expanded polytetrafluoroethylene micro pore technology. The newer MASP enclosed composting system was commissioned in 2012 for VOC control and was found to achieve 95% control during the composting process. The MASP system is stable with over 250,000 tons of biosolids composted.

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

Liberty Composting has been composting biosolids, food waste and green waste in Kern County since 1989 and is open 24/7/365. Liberty Composting operates a 162-acre composting facility remotely located northwest of Lost Hills with an annual permitted capacity of 786,000 tons. Liberty Composting services over 81 municipal, state, federal and private facilities and is entitled to accept Class A, Class B and Class Sub-B biosolids as well as liquid biosolids, food waste and green waste. Liberty agreements for biosolids processing and reuse services are generally multi-year agreements, include reuse and often include transportation.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

Liberty Composting's process risk is low using mature technologies. Feedstock composition risks are mitigated by sourcing feedstock from a large number of sources. Regulatory process risk has been addressed through a conservative policy of exceeding regulatory standards. For example the MASP composting process provides 95 percent VOC control, only 90 percent control is required. Compost product end use risk is mitigated through multiple end users in several counties and through failsafe internal reuse at Liberty Ranch.

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

- ☐ Land Application
- ☐ Alternative Daily Landfill Cover
- X Composting of Biosolids and Marketing of Product
- ☐ Soil Amendment and Marketing of Product
- ☐ Fuel
- ☐ Other (describe)

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

X No. Name of existing facility **Liberty Composting, Inc.**
Location of existing facility **12421 Holloway Road, Lost Hills, CA 93249**

☐ Yes. Name/description of planned facility _____
Anticipated operational date _____
Capacity (wet TPD) _____
How development will be funded _____

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Liberty Composting has been in continuous operation since 1989 and has composted over four million tons of biosolids. Liberty's management is experienced in the reuse of biosolids. Pat McCarthy, President, has 20 years' executive management experience with biosolids processing and reuse. Wilson Nolan, Chief Executive Officer, has 36 years of

executive management experience in the reuse of biosolids with regional and national biosolids reuse companies.

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: **275,000 tons**
2018: **225,000 tons**
2023: **200,000 tons**
2028: **175,000 tons**

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

Liberty Composting, Inc.'s permit allows for 2,153 tons of feedstock per day with a peak loading capacity of 4,305 tons per day. Liberty may accept up to 93 truckloads of material within each 24-hour period.

2.6 What is your available on-site storage, both prior to and post-processing:

Liberty Composting is also permitted as a Storage and Transfer Facility capable of storing up to 196,500 tons of Class B biosolids. There is no direct limitation on the onsite storage of post-processing compost.

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

- What class of biosolids do you accept?
  - ☐ Only Class A
  - ☐ Only Class B
  - **X** Both Class A and Class B (not commingled)
- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?

No restrictions apply to the Class B biosolids portion other than general site tonnage limitations described in response.

If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

- **N/A**

2.7.2 Percent Solids

- Minimum percent solids of the biosolids you will accept?
  A small amount of liquid biosolids can be accepted with no minimum percent solids however 12 percent solids would be required for any continuous significant tonnage
- Preferred percent solids of the biosolids you will accept?
  No preference, any solids percentage above 12 percent is acceptable and desired

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?
  No.
- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?
  N/A
- Other characteristics required for delivered fuel product?
  N/A

2.7.4 Other (describe)
N/A

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: Liberty Composting has developed a customer base for 100% of its annual compost production, sold to large farming operations in Kings, Fresno and Merced Counties. Liberty Composting also internally consumes compost produced through use for crop production on related Liberty Ranch.

Marketing / Reuse Approach: Delivery of product to end users under a fixed price agreement.

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: Liberty's Compost is marketed under the trademark of AY-II Compost and has standing orders for 100% of its annual compost production.

Approach: If Liberty Composting could not market the entire annual production of AY-II Compost, Liberty Composting also has Liberty Ranch in Kings County where the full compost production can be consumed internally for crop production, as a fail-safe backup.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: **Liberty Composting, Inc.,**

2.10.1 Surface Water (describe): **Site is totally contained with a perimeter dike per WDR No. R5-2009-0018, California Water Quality Control Board, Central Valley Region. Run-on water from external sources is excluded. Run-off water internally is contained and directed to four storm water ponds where is run-off water is stored and used for dust control and process water. The entire processing/storage area is protected with a 12 inch layer of clay compacted to a hydraulic conductivity of 1 x 10^{-6} cm/sec.**
2.10.2 Odor (describe): **Odor is controlled through processing. Odiferous feedstock is immediately processed at reception to mitigate odors. The composting process design and operation reduces the potential for odors and the MASP enclosed composting system essentially eliminates odors from that portion of the process.**
2.10.3 Noise (describe): **All processing equipment is equipped with manufacturer specified mufflers to control noise and mufflers are maintained to manufacturer's specifications. Additionally, 1800 mature hybrid poplar trees surround the site serving as a noise barrier, further mitigating facility noise.**
2.10.4 How close is the nearest residence to this site? **The nearest residence is 6.7 miles southeast of the facility.**
2.10.5 How close is the nearest business to this site? Describe the nature of the business? **Liberty Composting is surrounded by agriculture to the north and west, surface mining on the south and the Lost Hills Oil Filed on the east. The Lost Hills Field is the 18th largest oil field in California based on size but ranks 6th largest in California based on remaining reserves. The nearest business location to Liberty Composting is Holloway Gypsum located 4.65 miles southeast where surface mining is conducted and a landfill operation is conducted.**

2.11 Are there any required permits or permit limitations at the site?

Liberty Composting is an existing transfer/processing facility holding the following primary permits which govern facility operations. Relevant permit restrictions have been stated elsewhere in the response document.

- **Solid Waste Facilities Permit**
- **Waste Discharge Requirements**
- **Authority to Construct/Permit to Operate (air)**

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

Liberty Composting can manage a portion or all of the City's biosolids. A preferred quantity is any amount over 40,000 tons per year.

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

☐ $10-$20 / wet ton

X $20-$30 / wet ton

☐ $30-$40 / wet ton

☐ $40-$50 / wet ton

☐ $50-$60 / wet ton

☐ $60-$70 / wet ton

☐ Other (please indicate amount) _____per wet ton

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

Yes, Liberty Composting typically includes transportations services within its scope of services. Pricing is based on haul distance, ability to load seven per week during off-peak traffic hours and fuel cost. A likely transportation cost in 2014 dollars is $35 per wet ton. Liberty Composting is committed to working with its municipal partners in reducing the air emission factor and green house intensity of its transportation operations. Mitigation measures include well maintained CARB compliant trucks, light weight equipment for greater pay loads and early adoption of alternative fuels. Liberty management has significant experience with biosolids transportation using alternative fuels.

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

☐ Service Contract (providing a direct end-use service or providing processing)

X Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)

☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

Service and Disposition Contract

3.3 What length of contract term would you prefer? (Check one)

X	5 years	☐	10-15 years
☐	5-10 years	☐	No preference

3.4 What is the minimum contract term you would prefer (in years)? **5 years**

4 OTHER

4.1 The City is considering building a dewatering and load-out facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions: **No.**

4.1.1 Your team's experience operating this type of facility (describe):

_____

4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?

_____

4.1.3 Minimum term of operating contract that would accept?

_____

4.1.4 Please identify any concerns you would have with this type of operation?

_____

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? **No.** What concerns would you have with operating these types of facilities? **N/A**

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

Liberty Composting, Inc., has always been on the cutting edge of technology. Liberty pioneered the use of mono-composting for biosolids, eliminating the need to incorporate green waste into the biosolids composting process.

On September 15, 2012, San Joaquin Valley Air Pollution Control District Rule 4565 went into effect requiring Liberty Composting to change the method of composting to include "in vessel" composting to reduce VOC emissions by 90% for any compost received in excess of 100,000 tons per year. Liberty Composting developed a Membrane Aerated Static Pile composting method that achieved an Air-Board monitored VOC reduction of greater than 95%. Studies have indicated that uncontrolled biosolids composting produces 3.5 pounds of VOC's for each wet ton of biosolids composted.

Liberty Composting has 13 MASP units in current operation and fully complies with local air rule 4565. Liberty has composted well over 250,000 gate tons of biosolids through the enclosed system which is now fully integrated with facility operations and has the infracture installed to significantly increase the number of MASP units when needed.

When CNG power units or electric power units come onto the market and become a viable option to diesel power units, Liberty Composting will be an early adopter of that technology as well for the transport of biosolids and finished compost.

Lystek International Limited

1425 Bishop St. N., Unit 16, Cambridge, ON N1R 6J9
T. 226.444.0186 TF. 888.501.6508 E. info@lystek.com

Mark Giovannetti

City of San Jose

RE: RFI 13-14-01 - Biosolids Transition Program

Dear Mr Giovannetti:

Please find attached Lystek's response to this RFI that contains two separate options:

Section 1 – OFF SITE PROCESSING OPTION

Section 2 – ON SITE PROCESSING OPTION

Kindly contact me at 226-444-0186 (x301) or Bill Mullin (x105) if you have any questions or would like to arrange a visit to any of our sites.

Best Regards,

Ward Janssens

City of San José

RFI 13-14-01 - Biosolids Transition Program

Section 1

OFF SITE PROCESSING OPTION

Prepared By:

Lystek

Nothing wasted.
Everything to gain.

San José-Santa Clara Regional Wastewater Facility

EXHIBIT A
RESPONSE INFORMATION

Note please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

Lystek International Limited,
A US Company

(Lystek Response #1 – Offsite Processing / Regional Facility Option)

1.2 Contact Person, Address, Phone Number, and E-mail:

Ward Janssens
Executive Vice President
1425 Bishop St. N., Unit 16, Cambridge, ON N1R 6J9 Canada
Tel: 226.444.0186 Cell: 519.500.8176
Email: wjanssens@lystek.com
www.lystek.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

Yes, Lystek is able to provide performance under a service contract with the City. We can provide a performance bond up to 100% of the annual value of the contract that is renewed annually prior to the anniversary date. These performance bonds would be valid for the lifetime of the contract.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

Lystek's biosolids treatment process is a patented, energy efficient and cost effective low temperature thermal-chemical hydrolysis process, which utilizes a proprietary combination of heat (~165°F), alkali (pH 9.5-10.0) and high shear mixing treatment to convert biosolids. Lystek technology creates a product with multiple applications including:

- Class A EQ High Solids Liquid Fertilizer
- Carbon Source for BNR
- Hydrolyzed feedstock that can enhance anaerobic digestion

The Lystek process is very easy to operate and only requires about 1500 sq. ft. for a system capable of treating 40,000 wet tons/year (25% solids). No dust will be generated and odors

are mitigated. The technology operates at ambient pressure and uses low pressure steam (10 psi).

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

DBT, City of Guelph, Ontario, Canada: 18,000 t/year @ 22%, back end biosolids processing solution. Including Re-feeding into digesters. Fertilizer product marketing and application included.

City of Peterborough ON Canada 7,000 tons/year @ 26% solids Transport of biosolids from Peterborough wastewater treatment plant to Lystek Regional processing facility in Eastern Ontario (Iroquois), processing to Class A EQ fertilizer, fertilizer storage, fertilizer marketing and land application.

DBT, City of St Marys, Ontario, Canada: 3,500 t/year @ 15% biosolids processing solution including re-feeding into BNR as well as digesters

DBOO, Regional facility in Dundalk, Ontario, Canada: 150,000 t/ facility 3%-30% biosolids, organics. Multiple contracts. Product haulage, marketing and application included. The site serves also Toronto

DBT, Third High Farms, Iroquois, Ontario, Canada; 20,000 t/year biosolids processing facility. The site serves the City of Ottawa.

DBT, City of Elora, Ontario, Canada: 3,000 t/year @ 15% biosolids processing facility

DBT, North Battleford, Saskatchewan, Canada: 3,400 t/year @ 15%, biosolids processing solution. Lystek to market the end fertilizer product

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

The Lystek technology is proven biosolids processing system with over seven years of operating experience processing wastewater biosolids into a Class A EQ fertilizer. It is easy to operate and maintain because it uses readily available equipment (boilers, progressive cavity pumps, PLCs, mixers) from suppliers (Cleaver Brooks, Netzsch, Allen Bradley, Bowen) with an extensive US distribution and parts network.
At the Fairfield / Regional facility, we will install redundant equipment and stock important spare parts so the system should never be down due to unexpected equipment failure. We also operate an extensive preventative and predictive maintenance program and replace any component before the end of its life.

Occasionally, poor weather can create a storage constraint for land applying the fertilizer product. In order to overcome this risk, Lystek will install 12 months of fertilizer product storage to fully mitigate the potential risk of poor weather. Since the product is Class A EQ, additional storage will also be available at the farm sites.

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

☐ Land Application

☐ Alternative Daily Landfill Cover

☐ Composting of Biosolids and Marketing of Product

☐ Soil Amendment and Marketing of Product

☐ Fuel

☒ Other (describe)
Production of a Class A EQ fertilizer product and marketing of the product.

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility no existing facility
Location of existing facility _____

☒ Yes. Name/description of planned facility; Regional multi customer facility, to be located at FSSD site (Fairfield Suisun Sewer District) in Fairfield California. LOI will be signed in July 2014. Please contact. Greg Baatrup, PE, General Manager, Fairfield-Suisun Sewer District; Tel: (707) 428 9162; gbaatrup@fssd.com
- Anticipated operational date: 2016
- Capacity (wet TPD): initial capacity 50,000 t/year, ultimate capacity 150,000 t/year
- How development will be funded: Lystek will pay for the development

☒ Yes. Name/description of planned facility; Lystek willing to discuss DBFOM or DBOO of a facility at or near the San José Santa Clara Regional Wastewater Facility if this preferable to the City
- Anticipated operational date: TBD
- Capacity (wet TPD): TBD
- How development will be funded: Lystek will pay for the development

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Lystek's technology is proven with six installations (five DBT and, one DBOO / Regional Facility). Collectively these facilities have over 20 years of proven and compliant operating experience. Lystek is owned by its experienced management and a 60-year-old family owned construction and environmental services company (R.W. Tomlinson) with over 1,000 employees and annual revenues in excess of $500 million.
See also 1.5

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Proposed: Fairfield facility is in development
2018: >50,000 tons/year @ 25% solids (estimated available capacity minus dedicated capacity)
2023: >120,000 tons/Year @ 25% solids (estimated available capacity minus dedicated capacity)
2028: >120,000 tons/Year @ 25% solids (estimated available capacity minus dedicated capacity

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

Fairfield: Lystek's systems are modular by nature. The system can be expanded, and/or moved when/if necessary. For the planned system in Fairfield, the daily capacity limit on processing is 410 wet tons/day. While our standard operating procedure is to process all of the biosolids the same day that we receive, we will have an additional storage capacity for 400 tons of dewatered biosolids (pre-processing).

2.6 What is your available on-site storage, both prior to and post-processing:

Fairfield: 150,000 tons of finished product storage and 400 tons of unprocessed material storage at full capacity
The LysteGro Class A EQ product can also be stored offsite at the individual farm site. Lystek will arrange for additional off-site storage as well

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

- What class of biosolids do you accept?

☐ Only Class A

☐ Only Class B

☒ Both Class A and Class B (not commingled)

- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?
  No – as long as the material meets the applicable regulatory guidelines.

- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

  _____

2.7.2 Percent Solids

- Minimum percent solids of the biosolids you will accept?
  3 % solids
- Preferred percent solids of the biosolids you will accept?
  15% - 20% (We can process biosolids at levels up to 35% solids at this facility)

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?
  N/A
- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?
  N/A
- Other characteristics required for delivered fuel product?
  N/A

2.7.4 Other (describe)

N/A

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: LysteGro Class A EQ Fertilizer (High Solids Liquid). EPA Region 9, has confirmed Lystek LysteGro product to be Class A EQ

Marketing / Reuse Approach: The fertilizer product produced at the Fairfield facility will primarily be marketed directly to farmers, growers, ranchers, sod growers by Lystek's Agronomist. Lystek will begin its marketing program for the Fairfield facility in early 2015 and will be able to show successful proven experience in the local market in 2017-2018. Lystek will construct sufficient storage to provide at least 12 months of storage but will also expect to establish existing/new storage facilities at some of the sites of its customers.

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: LysteGro Class A EQ Fertilizer (High Solids Liquid)

Approach: Our Corporate Policy is to secure three times more than land that is needed to take our annual production of fertilizer. This ensures that demand will always out-strip supply. We employ trained Agronomists to establish relationship with local growers. This marketing activity is expected to begin in early 2015. We will also construct 12 months of fertilizer product storage to accommodate any poor weather conditions that may limit land application. Lystek will provide a bond to Fairfield Suisun Sewer District to guarantee a no risk situation in this field.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: Fairfield (Regional Site)
Surface Water (describe): A surface water management system is already in place for the facility to collect any precipitation from the property and may be utilized in the process to address process water needs, as required. Lystek process itself does not generate any waste- or surface water.

2.10.1 Odor (describe): The Lystek processing equipment will be installed inside the existing dewatering building at FSSD, Fairfield, with existing facilities in place. The biosolids will be emptied indoors. From this point on, the biosolids will not be exposed to open air during processing, covered storage, tanker truck loading, transport, and application through sub surface injection.

2.10.2 Noise (describe): The Lystek processing equipment will be installed in an existing fully enclosed, concrete dewatering building at FSSD, Fairfield.

2.10.3 How close is the nearest residence to this site? Over 1 mile

2.10.4 How close is the nearest business to this site? Describe the nature of the business? The closest business is a sod farm located across the street. Their office building is about 500 yards away from the Lystek biosolids processing building. The other closest neighbor is a manufacturing business. Their building is about 900 yards from the Lystek biosolids processing building.

2.11 Are there any required permits or permit limitations at the site?

The Fairfield Suisun Sewer District (FSSD) already has a permit (WDR) to process and store biosolids. They will have to amend the Standard Operating Procedures of this to allow receiving of 3rd party biosolids.
A CEQA will also be required. FSSD will be the lead agency and it is expected that this project will be a Mitigated Negative Declaration

An air permit will be required from the Bay Area Air Quality Management District to cover the odor control, boiler and greenhouse gases. From an odor standpoint, it is expected that the offsite odors should be reduced after the installation of the Lystek system; because FSSD will abandon their existing drying beds will occasionally generate offsite odor complaints. Since the air quantity being treated by odor control device will be low, less than 1500 CFM, odors from the Lystek processing facility should not have be detectable off the plant property. If permitting of the natural gas boiler causes any delays with the air permit, an electric boiler can be used.

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

Lystek would be able to accept and process a minimum of 10,000 wet tons/year and up to a maximum of 130,000 wet tons/year

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

☐ $10-$20 / wet ton

☐ $20-$30 / wet ton

☐ $30-$40 / wet ton

☐$40-$50 / wet ton

☒ $50-$60 / wet ton

☐ $60-$70 / wet ton

☐ Other (please indicate amount) _____ per wet ton

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

Typically, Lystek will not provide/arrange biosolids transportation, since most of its customers organize this. Lystek is willing to provide these services if necessary working with a sub-contractor. Pricing is usually based on the per mile transported with a time allowance for loading and unloading.

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

☐ Service Contract (providing a direct end-use service or providing processing)

☒ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the Class A EQ fertilizer product)

☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

Service and Disposition Contract

3.3 What length of contract term would you prefer? (Check one)

☐	5 years	☒	10-15 years
☐	5-10 years	☐	No preference

3.4 What is the minimum contract term you would prefer (in years)? 5 years

4 OTHER

4.1 The City is considering building a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

4.1.1 Your team's experience operating this type of facility (describe):
Lystek does not currently operate dewatering equipment, but would be willing to partner with an experienced dewatering contractor, that is approved by the City, if this is requirement of a long term service contract for biosolids reuse.

4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?
10-15 years

4.1.3 Minimum term of operating contract that would accept?
5 Years

4.1.4 Please identify any concerns you would have with this type of operation?

Additional Considerations for a dewatering service contract include:

Who pays for the cost of dewatering polymers, utilities (electricity etc.)?

Who takes responsibility for the solids capture of the dewatering equipment?

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

We would be very interested in operating a Lystek biosolids processing facility at the City's wastewater treatment plant. Lystek has submitted a separate RFI response for an "onsite" Lystek processing option. Lystek for that solution proposes to install a back end Lystek processing solution (after dewatering, when desired, including dewatering) as well as to use digester capacity to store the Class A EQ LysteGro product. Lystek proposes to take full responsibility for product and product marketing. We would also be willing to provide bonds for the operating phase of the project, storage included.

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

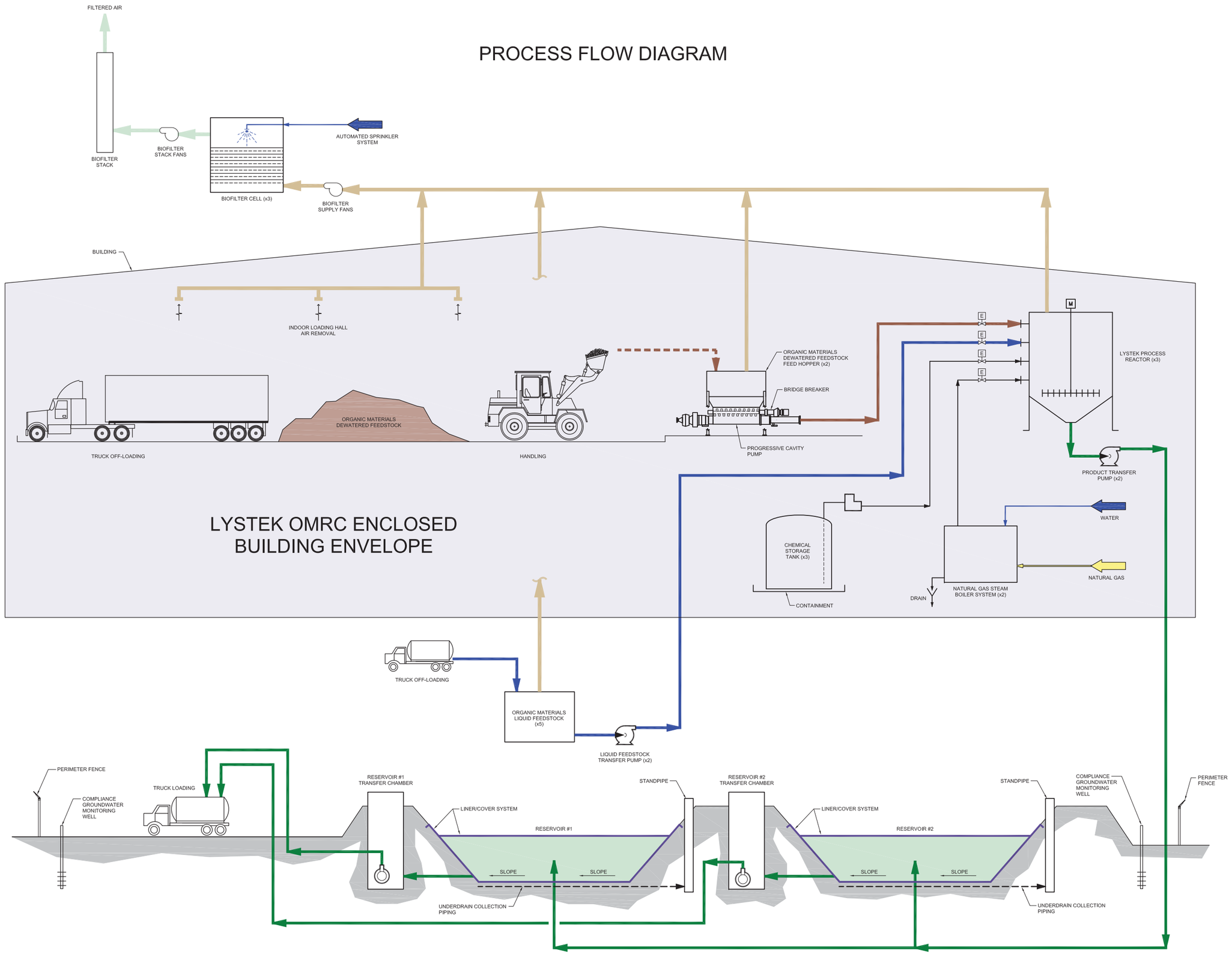
The Lystek process produces a high value Class A EQ high solids liquid fertilizer (confirmed by the US EPA, Region 9). This product is in high demand by growers. The product is easy to to store, transport and land apply using conventional equipment. It is high in in available nitrogen, which makes it very attractive as a fertilizer product. Since it is a liquid, it can be injected into the soil at the root zone of the plant where is it more available for uptake by the roots of the plant. It also does not produce any dust and or any offsite odors when injected into the soil.

These features significantly increase the value and demand for the Lystek product when compared to a dewatered biosolid cake material.

APPENDIX

I – Schematic of Lystek Off-site Solution

PROCESS FLOW DIAGRAM



Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

No.	REVISION	DATE

APPROVED BY:

LYSTEK SOUTHGATE ORGANIC MATERIALS RECOVERY CENTRE

PROCESS FLOW DIAGRAM OVERVIEW

LYSTEK INTERNATIONAL INC. CAMBRIDGE, ONTARIO

Lystek International Inc.
Unit 16 – 1425 Bishop Street,
Cambridge, Ont., Can., N1R 6J9
Phone: 1–888–501–6508
Fax: 1–888–501–7429
Web: www.lystek.com

DESIGNED BY:	REVIEWED BY:	DRAWN BY:	DATE:
R.C.	G.T.	P.V.	JUL 2011
SCALE: N.T.S.	PROJECT No. 108	DRAWING No. PFD–00	

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APPENDIX

II – Letter US EPA Region 9
(Lauren Fondahl) about Lystek Class A EQ status

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

February 27, 2014

Ward Janssens
Lystek International Inc.
1425 Bishop St. N. Unit 16
Cambridge, Ontario, N1R 6J9

Re: Demonstration of Vector Attraction Reduction using Option 2 for Lystek Thermo-Alkaline Treatment

Dear Mr. Janssens,

Thank you for your e-mail and attached paper from Dr. George Nahkla of February 3, 2014 with results of volatile solids reduction tests on anaerobically digested biosolids treated with the Lystek Thermo-Alkaline treatment process.

The results showed that for the sampling periods in question, VAR Option 2 was met, as the volatile solids were reduced by less than 17% during additional digestion. This option may be used in the future to demonstrate vector attraction reduction.

The frequency at which the test must be run is specified in 40 CFR 503.16, ranging from once per year for facilities producing less than 290 dry metric tons of biosolids per year, to once per month for facilities producing over 15,000 dry metric tons per year.

Demonstration of VAR using this method, in conjunction with demonstration of Class A pathogen reduction and pollutant concentrations meeting 40 CFR 503.13 Tables 1 and 3 limits, demonstrates "exceptional quality" biosolids that may be distributed without further restrictions.

Please contact me at 415 972-3514 or Fondahl.lauren@epa.gov with any questions regarding this.

Thank you,

Lauren Fondahl

Lauren Fondahl
Biosolids Coordinator, WTR-5

APPENDIX

III – Pictures of Lystek Equipment & Land Application

Figure 1 – Lystek's Regional Facility in Dundalk ON Canada (Biosolids are unloaded inside in a totally enclosed and ventilated receiving area, then processed in the totally enclosed Lystek reactors shown in Figure 2. Odors are collected and treated in a biofilter so that no offsite odors are detectable.)

Figure 2 – Three * 2,400 Gallon Fully Enclosed Lystek Reactors

Figure 3 – Filling LysteGro Class A EQ Liquid Fertilizer Product into an Enclosed Tanker for Sub-Surface Injection

Figure 4 – Sub-Surface injection of LysteGro Class A EQ Fertilizer (High solids liquid @ 15% solids is injected into the soil, so there is no dust. No biosolids are left on the soil surface so there are no offsite odors)

City of San José

RFI 13-14-01 - Biosolids Transition Program

Section 2

ON SITE PROCESSING OPTION

Prepared By:

Lystek

Nothing wasted.
Everything to gain.

San José-Santa Clara Regional Wastewater Facility

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

Lystek International Limited,
A US Company

(Lystek Response #2 – Onsite Processing @ San José Santa Clara Regional Wastewater Facility)

1.2 Contact Person, Address, Phone Number, and E-mail:

Ward Janssens
Executive Vice President
1425 Bishop St. N., Unit 16, Cambridge, ON N1R 6J9 Canada
Tel: 226.444.0186 Cell: 519.500.8176
Email: wjanssens@lystek.com
www.lystek.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

Yes, Lystek is able to provide performance under a service contract with the City. We can provide a performance bond up to 100% of the annual value of the contract that is renewed annually prior to the anniversary date. These performance bonds would be valid for the duration of the contract.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

Lystek's biosolids treatment process is a patented, energy efficient and cost effective low temperature thermal-chemical hydrolysis process, which utilizes a proprietary combination of heat (~165°F), alkali (pH 9.5-10.0) and high shear mixing treatment to convert biosolids. Lystek technology creates a product with multiple applications including:

- Class A EQ High Solids Liquid Fertilizer
- Carbon Source for BNR
- Hydrolyzed feedstock that can enhance anaerobic digestion

The Lystek process is very easy to operate and only requires about 1500 sq. ft. for a system capable of treating 40,000 wet tons/year (25% solids). No dust or offensive odors will be

generated. The technology operates at ambient pressure and uses low pressure steam (10 psi).

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

DBT, City of Guelph, Ontario, Canada: 18,000 t/year @ 22%, back end biosolids processing solution. Including Re-feeding into digesters. Product marketing and application included

DBT, City of St Marys, Ontario, Canada: 3,500 t/year @ 15% biosolids processing solution including refeeding into BNR as well as digesters

DBOO, Regional facility in Dundalk, Ontario, Canada: 150,000 t/ facility 3%-30% biosolids, organics. Multiple contracts. Product haulage, marketing and application included. The site serves also Toronto

DBT, Third High Farms, Iroquois, Ontario, Canada; 20,000 t/year biosolids processing facility. The site also services Ottawa

DBT, City of Elora, Ontario, Canada: 3,000 t/year @ 15% biosolids processing facility

DBT, North Battleford, Saskatchewan, Canada: 3,400 t/year @ 15%, biosolids processing solution. Lystek to market the product

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

The Lystek technology is proven biosolids processing system with over seven years of operating experience processing wastewater biosolids into a Class A EQ fertilizer. It is easy to operate and maintain because it uses readily available equipment (boilers, progressive cavity pumps, PLCs, mixers) from suppliers (Cleaver Brooks, Netzsch, Allen Bradley, Bowen) with an extensive US distribution and parts network.

Redundant equipment can be installed and/or critical spare parts can be stocked so the system should never be down due to any unexpected equipment failure.
Occasionally, poor weather can create a storage constraint for land applying the fertilizer product. In order to overcome this risk, Lystek is proposing to that the City use their surplus anaerobic digesters that will provide 12 months of fertilizer product storage. This will fully mitigate the potential risk of poor weather on land application. Additional storage is also available at the farm site because the LysteGro product is Class A EQ.

Lystek is willing to provide performance bonds that will include product storage.

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

☒ Land Application

☐ Alternative Daily Landfill Cover

☐ Composting of Biosolids and Marketing of Product

☐ Soil Amendment and Marketing of Product

☐ Fuel

☒Other (describe)

Fertilizer production and Marketing of Product (Class A EQ)

☐ Land Application

☐ Alternative Daily Landfill Cover

☐ Composting of Biosolids and Marketing of Product

☐ Soil Amendment and Marketing of Product

☐ Fuel

☒Other (describe)

Production of hydrolyzed biosolid that can be used as a carbon source in the BNR system

Land Application

☐ Alternative Daily Landfill Cover

☐ Composting of Biosolids and Marketing of Product

☐ Soil Amendment and Marketing of Product

☐ Fuel

☒Other (describe)

Hydrolyzed biosolids feedstock that can be fed back to anaerobic digesters to increase volatile solids reduction (VSR) above 65% and increased biogas generation

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☒ Yes. Name/description of planned facility:

Onsite installation at the San José - Santa Clara Regional Wastewater facility
Size of the facilities: to be discussed, see 2.4
Expected time frame: excluding permitting Lystek is able to supply and install within a 1 year timeframe

How development will be funded: Lystek is able/ willing to negotiate DBT as well as DBFOM and DBOO agreements. Lystek proposes to take full responsibility of product, product marketing, and product application in all cases

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Lystek's technology is proven with six installations (five DBT and one DBOO Regional Facilities). Collectively these facilities have over 20 years of proven and compliant operating experience. Lystek is owned by its experienced management and a 60-year-old family owned construction and environmental services company (R.W. Tomlinson) with over 1,000 employees and annual revenues in excess of $500 million.

See also 1.5

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

2.5 Lystek proposes to install a Lystek system after dewatering at the San José Santa Clara Regional Wastewater facility capable of treating about 25% - 50% of their biosolids production. A system capable of treating 50% of the City's biosolids (65,000 wet tons at 25% solids) can be installed for under $10,000,000 and it will provide three diverse outlets for reusing the City's biosolids.

- Class A EQ High Solids Liquid Fertilizer
- Carbon Source for BNR
- Hydrolyzed feedstock that can enhance anaerobic digestion

The City's has indicated that it will have 12 surplus anaerobic digesters with a total capacity of about 32 million gallons. This will provide over 12 months of storage for 65,000 wet tons of 25% biosolids if they were all processed into a Class A EQ high solids liquid fertilizer.

Current: None
2018: Up to 65,000 wet tons/year (25% solids) Proposed
2023: Up to 65,000 wet tons/year (25% solids) Proposed
2028: Up to 65,000 wet tons/year (25% solids) Proposed

2.6 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

All of Lystek's systems are modular by nature. It is proposed that the City install three Lystek processing reactors (2,400 gallons each). Two operating and one standby to provide redundancy. Two Lystek reactors would be able to process about 12 tons/hour or about 288 wet tons/day @ 25% solids (semi continuous batch operation). This is enough capacity to treat over 90,000 wet tons per year using the two Lystek reactors and still have a redundant standby unit available.

2.7 What is your available on-site storage, both prior to and post-processing:

Lystek's technology allows for immediate/ just in time processing. Lystek's system would include an interim (pre-processing) storage) of about 20 tons to ensure a smooth continuous process.

The City's twelve (12) surplus anaerobic digesters would provide about 32 million gallons of storage, which would be over 12 months if 65,000 wet tons of biosolids were processed annually and all of it was used as fertilizer. If some of the Lystek product was used as a carbon source for a BNR or as a hydrolyzed biosolids feedstock that can be fed back to anaerobic digesters to increase volatile solids reduction (VSR) above 65% then the onsite post processing storage for the Class A EQ fertilizer will be longer than 12 months.

2.8 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

- Class of Biosolids

- What class of biosolids do you accept?

  ☐ Only Class A

  ☐ Only Class B

  ☒ Both Class A and Class B (not commingled)

NOTE: While we understand that the City is planning to install TPADs, it was not clear whether the City is planning to run the themophilic stage long enough in order to meet Class A requirements. The Lystek process will provide the City with a very low cost means to meet Class A EQ that can be used either as a contingency to the TPADs or as a means to provide a number of diverse reuses including a high solids Class A EQ fertilizer, a carbon source for the BNR and as a hydrolyzed biosolids feedstock that can be fed back to anaerobic digesters to increase volatile solids reduction (VSR) above 65%

- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?
  No

- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?
  N / A

- Percent Solids

- Minimum percent solids of the biosolids you will accept?
  The Lystek process can accept both liquid biosolids and dewatered biosolids, with the goal of making a blend that is 15% - 20% solids. Ideally the dewatering equipment can be selected to produce a dewatered material that is 15% - 20% solids. This will reduce the polymer costs for the City.

- Preferred percent solids of the biosolids you will accept?
  15% - 20% (The Lystek technology can accept biosolids at higher solids levels by blending the biosolids down to 15% - 20% by blending in raw sewage, plant effluent, liquid biosolids etc.)

- Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?
  NO

- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

  _____

- Other characteristics required for delivered fuel product?

  _____

- Other (describe)

  Hydrolyzed feedstock that can enhance anaerobic digestion
  Hydrolyzed biosolids feedstock that can be fed back to anaerobic digesters to increase volatile solids reduction (VSR) above 65%. While we understand that the City is planning to go TPADs, this Lystek system can provide a contingent option in the event there is a process upset with TPADs or they are not able to provide 65% volatile solids reduction.

2.9 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: LysteGro Class A EQ Fertilizer (High Solids Liquid). EPA Region 9, has confirmed Lystek LysteGro product to be Class A EQ

Marketing / Reuse Approach: There are also significant acreages of hay available in the region and Merced County has significant acreages of silage corn. If successful. Lystek's liquid fertilizer can also be used in Nursery Crops. Lystek will begin our marketing program in the region two years in advance of the system start up. Lystek normally sells the product directly to the grower usually at a fixed price that is based on the current fertilizer values.

Material: Carbon Source for BNR

BNR processes require specific COD: N:P ratios as organic matter are used for denitrification and enhanced biological phosphorus removal (EBPR). Thus, BNR processes requires availability of carbon, with approximately 6.6 mg COD to remove 1 mg nitrogen and 10 g COD to remove 1 mg P. Furthermore, BNR processes require readily biodegradable COD (rbCOD) i.e. short chain or volatile fatty acids (VFA) such as acetic, butyric, propionic acids, as well as sugars (glucose), and alcohols (methanol, ethanol, etc.) that either comes from the raw wastewater or when insufficient by addition of carbon-rich chemicals such as glycerol or methanol to the system.
The processing conditions involved in the Lystek process cause the liquefaction resulting in disintegration of microbial cells and hydrolysis of particulate organic matter. Lysed biosolids can provide a cost effective source of readily available carbon for denitrification and EBPR, as not only do they contain a much higher COD:N:P ratio than raw wastewaters, but also because of much higher rbCOD concentration . When Lystek processed biosolids are recycled to the BNR system, it helps enhance denitrification and improve performance significantly.

Marketing / Reuse Approach: This is an internal reuse option should the City require a free source of external carbon for their denitrification stage of a BNR installation.

Material: Hydrolyzed feedstock that can enhance anaerobic digestion

The processing conditions involved in the Lystek process cause the liquefaction resulting in disintegration and hydrolysis of microbial cells and particulate organic matter. The hydrolysis process breaks down complex organic molecules into simpler units, e.g. starch and cellulose into glucose, proteins into amino acids, and lipids into fatty acids etc., which are rapidly degradable carbon sources. While particulate organic matter in Lystek biosolids range from around 53%-58%, total COD (TCOD) and soluble COD range between 100,000 – 120,000 mg/L and 30,000 – 40,000 mg/L, respectively. Lystek processed biosolids contain around 30% SCOD of TCOD, compared to only 10% SCOD of TCOD in dewatered cake biosolids. Furthermore, VFA concentrations in Lystek biosolids are typically about two orders of magnitude higher than raw municipal wastewater.

Marketing / Reuse Approach: This is an internal reuse option. While we understand that the City is planning to go TPADs, this Lystek system can provide a contingent option in the event there is a process upset with TPADs or they are not able to provide 65% volatile solids reduction.

2.10 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: LysteGro Class A EQ Fertilizer (High Solids Liquid)

Approach: Our Corporate Policy is to secure three times more land than is needed to take our annual production of fertilizer. This ensures that demand will always out-strip supply. We employ trained Agronomists to establish relationship with local growers. This marketing activity is expected to begin two years before the Lystek facility is operational. Our market research has indicated that there is more than sufficient acreages of hay, silage corn and nursery crops in the region to easily support this quantity of fertilizer production. The City will also have 32,000,000 gallons of storage in their surplus anaerobic digester that can provide in excess of 12 months of fertilizer product storage to accommodate any poor weather conditions that may limit fertilizer sales

2.11 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: San José Santa Clara Regional Wastewater Facility

- Surface Water (describe): It is proposed that the Lystek equipment will be installed inside the planned dewatering building so the surface water management plan for the dewatering building will cover this. Lystek product is applied using subsurface injection and simultaneous incorporation in the soil for land application. This minimizes the risks of any runoffs and surface water contaminations.
- Odor (describe): It is proposed that the Lystek processing equipment will be installed inside the planned dewatering building at San José Santa Clara Regional Wastewater Facility. A small foot print of about 1,500 to 2,000 square feet is required for the Lystek equipment. Ideally the dewatering equipment would be installed above the Lystek biosolids storage hopper that will be used to feed the Lystek reactor (See attached schematic). The biosolids will drop by gravity into the covered unloading bin where the odors will be collected and directed to the odor control device. From this point on, the biosolids will be totally enclosed through processing, to covered storage and then loading into takes so odors will be released to the environment. Any odors collected during processing, storage and loading of the Lystek fertilizer product will be directed to an odor control device. Since the Lystek, process is fully enclosed and there is no large area needed for storage for pre-processed biosolids prior to Lystek treatment only a very small quantity of odorous air that has to be treated. Normally the odor control system used for the dewatering building can also accommodate the low flow from the Lystek process. We do not anticipate that any offensive offsite odors will be detected from the Lystek processing equipment. During land application, the Lystek product will be transported to site in a fully enclosed tanker (See attached pictures) then injected into the soil so no offensive odors will be detected offsite.

- Noise (describe): It is proposed that the Lystek processing equipment will be installed in a fully enclosed; dewatering building that should mitigate any offsite noise emissions.

- How close is the nearest residence to this site? TBA

- How close is the nearest business to this site? Describe the nature of the business? TBA

2.12 Are there any required permits or permit limitations at the site?

It is expected that the onsite Lystek processing system will be part of the larger upgrade planned for the San José – Santa Clara Regional Wastewater Facility and hence the permitting would be done as a part of that wider facility permitting application.

From the air permitting perspective, the Lystek process should be easy to permit. The Lystek process does not require combustion equipment. While low pressure steam is

required, this can be produced from an electric boiler or a waste heat recovery boiler if required.

- The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

Lystek is proposing that the City install a Lystek system that is capable of treating 25% - 50% of their anticipated biosolids production. A system capable of treating 50% of the City's biosolids (65,000 wet tons at 25% solids) can be installed for under $10,000,000 and it will provide three diverse outlets for reusing the City's biosolids as well as contingency in the event any of their other biosolids processing malfunctions. A Lystek solution also will allow the City to use its empty digesters.
During ongoing operation, Lystek proposes that City dedicate about 25% -30% of their biosolids production (32,000 – 40,000 wet tons) to the Lystek system for processing and reuse.

- Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

☒ $10-$20 / wet ton (utility and alkali costs processing costs)

☒ $20-$30 / wet ton

☐ $30-$40 / wet ton

☐$40-$50 / wet ton

☐ $50-$60 / wet ton

☐ $60-$70 / wet ton

☐ Other (please indicate amount) _____ per wet ton

2.13 Do you typically provide or arrange for biosolids transportation services to your facility/site?

Please describe and indicate basis of pricing.

Not applicable for an onsite installation

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

☒ Service Contract (providing a direct end-use service or providing processing)

☒ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)

☒ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

The most cost effective solution would be for the City to contract with Lystek under a Design Build Transfer (DBT) mode to supply, install and commission the Lystek process at the City's Regional Wastewater Facility. The Lystek system is easy to operate so that it can either be operated by City staff or the Contract Operations staff that will be operating the dewatering equipment. Lystek would then take responsibility for product marketing and transportation of the end product under a long term Disposition Contract.

3.3 What length of contract term would you prefer? (Check one) For marketing, selling, application of the LysteGro product

☐	5 years	☒	10-15 years
☐	5-10 years	☐	No preference

3.4 What is the minimum contract term you would prefer (in years)? 5 years

4 OTHER

4.1 The City is considering building a dewatering and load out facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

- Your team's experience operating this type of facility (describe):
  Lystek does not currently operate dewatering equipment, but would be willing to hire an experienced dewatering contractor, that is approved by the City, if this is requirement of a long term service contract for biosolids reuse.
- Term of operating contract that you would prefer and potential impact on service pricing?
  Operating Contract Terms of 10 years or longer will provide the lowest cost
- Minimum term of operating contract that would accept?
  5 Years
- Please identify any concerns you would have with this type of operation?
  Some important considerations on a contracted dewatering operation include:
- Who pays for the cost of dewatering polymers, utilities (electricity etc.)?
- Who takes responsibility for the solids capture of the dewatering equipment?

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

We would be very interested in operating a Lystek biosolids processing facility at the City's wastewater treatment plant. Lystek proposes to install the Lystek processing equipment after dewatering, as well as to use existing surplus digester capacity to store its finished LysteGro product. Lystek proposes to take full responsibility for product and product marketing would be willing to bonds for the operating phase of the project, storage included

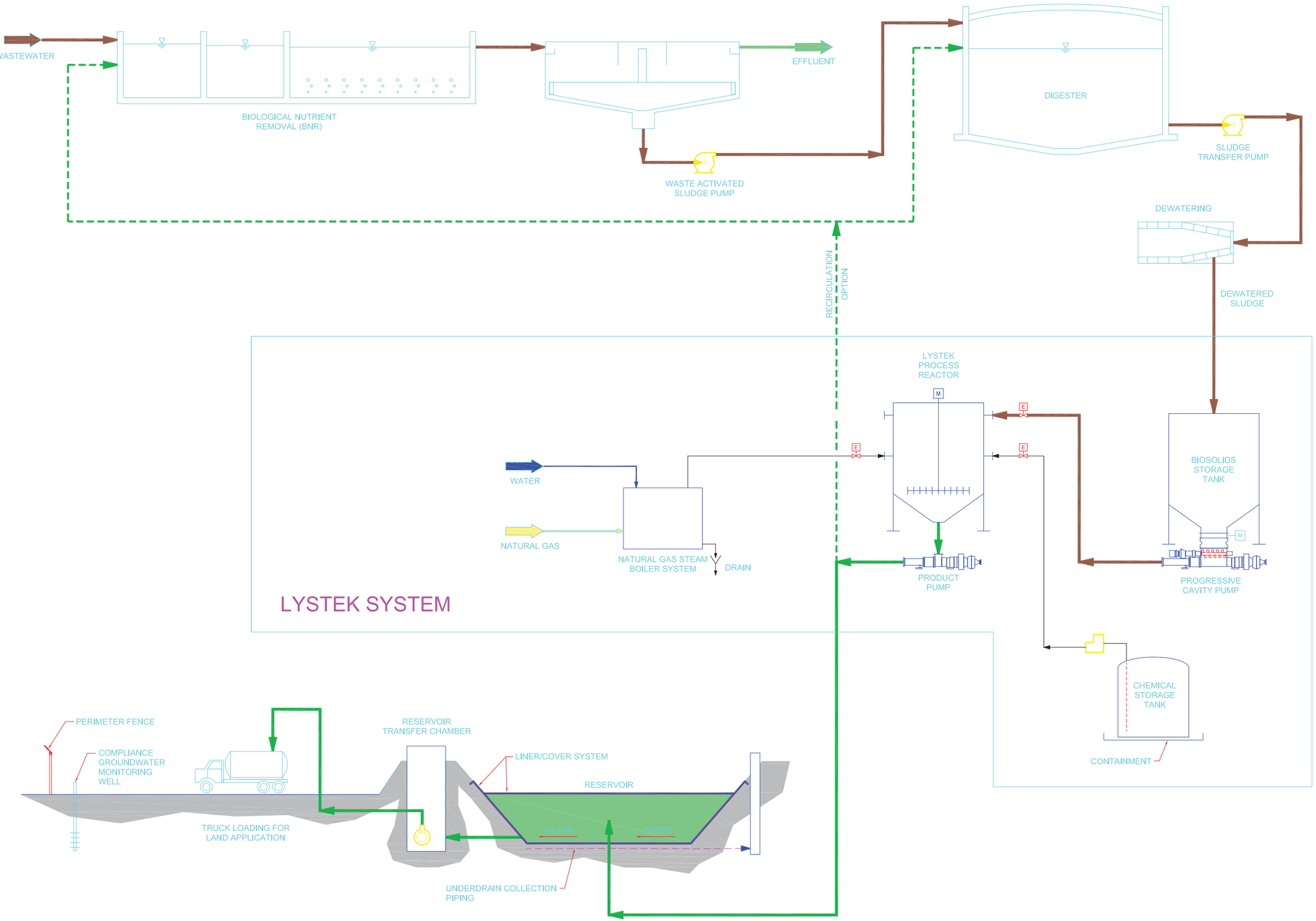
4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

The Lystek process produces a high value Class A EQ high solids liquid fertilizer (confirmed by EPA, Region 9 see attached letter in Appendix) that is high demand by growers. The Lystek Class A EQ product is a liquid. This makes it much easier to store, transport and land apply using conventional farm equipment. It is much higher in plant available nitrogen, which makes it much more attractive as fertilizer. Since it is a liquid, it can be injected into the soil at the root zone of the plant where is it more available for uptake by the roots of the plant. It also does not produce any dust and or any offsite odors when injected into the soil. These features significantly increase the value and demand for the Lystek product over a Class A EQ dewatered biosolid cake material.

Lystek is able and willing to provide reports demonstrating proven experienece as well as improved performance refeeding its product into BNR as well as digesters.

APPENDIX

I – Schematic of Lystek On-site Solution



PROCESS FLOW DIAGRAM

Automated Engineering Technologies Ltd.
91A Duke Street , Guelph, Ontario N1E 5L1 (519)821-8644
397 Romeo Street S., Stratford, ON, N5A 4V1 (519)273-9318 WEB: www.autoengtech.on.ca

No.	REVISION	DATE

APPROVED BY:

LYSTEK ORGANIC MATERIALS RECOVERY SYSTEM

PROCESS FLOW DIAGRAM OVERVIEW

LYSTEK INTERNATIONAL INC. CAMBRIDGE, ONTARIO

Lystek International Inc.
Unit 16 – 1425 Bishop Street,
Cambridge, Ont., Can., N1R 6J9
Phone: 1-888-501-6508
Fax: 1-888-501-7429
Web: www.lystek.com

T:\Pete\Lystek International\Lystek-logo.tif

DESIGNED BY:	REVIEWED BY:	DRAWN BY:	DATE:
M.B.	K.W.	P.V.	MAY 2014
SCALE: N.T.S.	PROJECT No.	DRAWING No. PFD-00	

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APPENDIX

II – Letter US EPA Region 9
(Lauren Fondahl) about Lystek Class A EQ status

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

February 27, 2014

Ward Janssens
Lystek International Inc.
1425 Bishop St. N. Unit 16
Cambridge, Ontario, N1R 6J9

Re: Demonstration of Vector Attraction Reduction using Option 2 for Lystek Thermo-Alkaline Treatment

Dear Mr. Janssens,

Thank you for your e-mail and attached paper from Dr. George Nahkla of February 3, 2014 with results of volatile solids reduction tests on anaerobically digested biosolids treated with the Lystek Thermo-Alkaline treatment process.

The results showed that for the sampling periods in question, VAR Option 2 was met, as the volatile solids were reduced by less than 17% during additional digestion. This option may be used in the future to demonstrate vector attraction reduction.

The frequency at which the test must be run is specified in 40 CFR 503.16, ranging from once per year for facilities producing less than 290 dry metric tons of biosolids per year, to once per month for facilities producing over 15,000 dry metric tons per year.

Demonstration of VAR using this method, in conjunction with demonstration of Class A pathogen reduction and pollutant concentrations meeting 40 CFR 503.13 Tables 1 and 3 limits, demonstrates "exceptional quality" biosolids that may be distributed without further restrictions.

Please contact me at 415 972-3514 or Fondahl.lauren@epa.gov with any questions regarding this.

Thank you,

Lauren Fondahl

Lauren Fondahl
Biosolids Coordinator, WTR-5

APPENDIX

III – Pictures of Lystek Equipment & Land Application

Figure 1 – Proposed Layout for Onsite Installation at the San Jose – Santa Clara Regional Wastewater Facility. Three * 2,400 Gallon Fully Enclosed Lystek Reactors. Two of these reactors can treat 90,000 wet tons/year with the third reactor used as a back-up. The system is fully enclosed and the odors are collected in an 8” duct from each reactor (100 CFM/reactor) and conveyed to an odor control device for treatment.

Figure 2 – Filling LysteGro Class A EQ Liquid Fertilizer Product into an Enclosed Tanker for Sub-Surface Injection

Figure 3 – Sub-Surface injection of LysteGro Class A EQ Fertilizer. High solids liquid @ 15% solids is injected into the soil, so there is no dust. Since no biosolids are left on the soil surface, there are no offsite odors.

New England Fertilizer Company (NEFCO)

San José-Santa Clara Regional Wastewater Facility

EXHIBIT A
RESPONSE INFORMATION
NEFCO

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

New England Fertilizer Company (NEFCO)

1.2 Contact Person, Address, Phone Number, and E-mail:

Larry Bishop, P.E.
500 Victory Road
North Quincy, Massachusetts 02171
(617) 773-3131
lbishop@nefcobiosolids.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

NEFCO, as a privately held company, focuses on sound financial decisions that have resulted in a company with the highest rating achievable with strong financial resources. NEFCO, and it managing general partner, O'Connell's, maintains a very strong balance sheet, ample liquidity, and sound financial fundamentals.

NEFCO has obtained both design-build bonds and operations bonds during the previous 23 years for its many biosolids projects. NEFCO obtained a performance and payment bond for the design-build project with the City of Detroit in the amount of $142 million. In addition, NEFCO maintains annual renewable operations bonds ranging from $1 million to $25 million.

From a construction perspective, we have posted performance and payment bonds totaling well in excess of a billion dollars over the last twenty years. We have enjoyed a long-term relationship with Travelers, spanning nearly 75 years, and is considered to be one of Travelers most respected clients in the country.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

NEFCO is a prominent national developer and operator of biosolids management facilities. NEFCO has the project development, engineering, construction, financing, and operating skill set and experience to ensure the successful execution of design-build-operate-maintain (DBO) and design-build-finance-operate-maintain (DBFO) projects. NEFCO has over two decades operating similar biosolids facilities around the country.

NEFCO utilizes a non-proprietary process to convert liquid sludge to a beneficial product that is used for fertilizer and fuel. The process includes equipment to dewater, dry, pelletize, store and distribute the finished product. NEFCO has complete responsibility to beneficially reuse the product. The client has no responsibility once the liquid sludge or dewatered cake is received by NEFCO.

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

NEFCO is a prominent national developer and operator of biosolids management facilities. NEFCO has the project development, engineering, construction, financing, and operating skill set and experience to ensure the successful execution of DBO and DBFO projects. NEFCO has over two decades operating similar biosolids facilities around the country.

In 1991, NEFCO's team permitted and designed one of the world's premier dewatering, drying, and pelletizing facilities. For more than two decades, we have operated this 240 dtpd facility, which is located in Quincy, Massachusetts. NEFCO also permitted, designed, and constructed (and operates) facilities in Shakopee, Minnesota; North Andover, Massachusetts; the Solid Waste Authority of Palm Beach County, Florida; and the City of Cumberland, Maryland. NEFCO is currently constructing the largest facility in North America for the City of Detroit, a 420 dry ton per day facility.

All of our facilities are responsible for managing 100% of the respective clients' biosolids production including the marketing and distribution of the final product.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

With any long-term contract, the primary risk is escalation of utility prices. NEFCO works with our clients to develop contract terms that address this risk and provides utility consumption guarantees to help manage it.

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

- ☒ Land Application
- ☐ Alternative Daily Landfill Cover
- ☐ Composting of Biosolids and Marketing of Product
- ☐ Soil Amendment and Marketing of Product
- ☒ Fuel
- ☐ Other (describe)

NEFCO's biosolids management process produces a high quality, low odor Class A EQ product with proven fuel and fertilizer value. It is anticipated that the advanced digestion process being implemented at the Facility in conjunction with a drying process will produce

biosolids pellets with particle size and density favorable for use as a commodity fertilizer. While land application is the beneficial reuse of choice the high quality product will also be used as a high value-add ingredient in fertilizer blend manufacturing.

In order to continually move product from the City of San Jose's facility, our targeted beneficial use markets for the end product will be as follows:

- Bulk Distribution to regional agricultural markets, including field and seed crops, turf farms and nursery crops. The focus will be to identify and develop the local markets in California and nearby states.
- Bulk Distribution to our existing base of fertilizer blenders and manufacturers
- Bulk Distribution for use as an Alternate Fuel/ Energy Source.

NEFCO currently beneficially reuses over 65,000 dry tons annually of pelletized biosolids generated from our five facilities nationwide. This quantity will almost triple as our new facility in Detroit, Michigan is brought online in the second half of 2015.

Fertilizer Blenders and Manufacturers

It is anticipated that the dried biosolids product from the drying facility will have a relatively high value not only as a stand-alone fertilizer, but also as a constituent in dry blended products. The blended fertilizer market includes end products that are sold at wholesale and retail for turf grass management programs and as garden fertilizers.

In the agricultural sector, specific bulk fertilizer blends are typically developed regionally for various vegetable and fruit crops. Often times fertilizer blenders incorporate biosolids as an ingredient in some of these blends to offset the costs of other more expensive ingredients. The fertilizer blenders have come to realize the plant food and soil enrichment attributes of the biosolids, in addition to their use as bulking agent.

Energy/Alternative Fuel

NEFCO understands that energy and sustainability are very important issues to the City of San Jose. These issues are very important to NEFCO as well. Dried biosolids represent an important potential form of fuel energy, in addition to their fertilizer value. Depending on the digested feedstock that we receive from the City of San Jose, the energy value of the finished product may be as high as 10 MMBTU per ton.

NEFCO has been a leader in the development of the beneficial use of biosolids as an alternative renewable energy source to fossil fuels in the energy intensive cement manufacturing process. NEFCO has been sending product to various cement kilns as an alternate to fossil fuel since January 2007. This is a ready market that has been established, and it is expected that this outlet will expand in response to upcoming legislation throughout the Country requiring power plants to utilize renewable fuels.

The NEFCO product is used as a fuel source.

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility _____
Location of existing facility _____

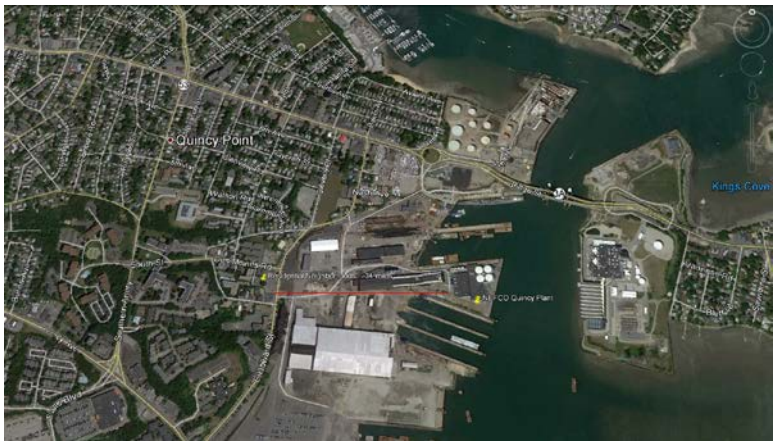
☒ Yes.

Name/description of planned facility	San Jose Biosolids Processing Facility
Anticipated operational date	2018
Capacity (wet TPD)	Approximately 398
How development will be funded	By the City or NEFCO

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

NEFCO brings a single point of responsibility and is able to provide all the services necessary to design. Construct, manage, operate and maintain the City's assets.

NEFCO will bring the following benefits to the City:



- We are experts in biosolids management.
- We offer proven odor control techniques – several of our facilities are located in highly urbanized areas.
- We provide stewardship of client assets – proper operation and maintenance leads to lower cost and longer equipment life.
- We are a privately held company – this leads to financial stability, quicker decisions, more involvement by leadership and a better partner for the City of San Jose.

We have been in continuous, successful and profitable operation since our inception in 1991, during which time we have constantly expanded our base of customer contracts.

NEFCO has extensive experience in the design, construction, and operation of biosolids drying facilities. The following table also illustrates this experience and provides references for each project.

Project Name/Location	Reference Contact
Biosolids Processing Facility Quincy, Massachusetts 280 dry tons per day (design) In operation since 1991	Massachusetts Water Resources Authority Dave Duest Director of the Deer Island Treatment Plant (617) 660-7680 Dave.Duest@mwra.state.ma.us
Blue Lake Final Stabilization Facility Shakopee, Minnesota 55 dry tons per day (design) In operation since 2000	Metropolitan Council Environmental Services Leisa Thompson, General Manager (651) 602-1131 Leisa.Thompson@metc.state.mn.us
Biosolids Drying Facility North Andover, Massachusetts 42 dry tons per day (design) In operation since 2002	Greater Lawrence Sanitary District Cheri Cousens, Executive Director (978) 685-1612 ccousens@GLSD.org
Biosolids Processing Facility West Palm Beach, Florida 675 wet tons per day (design) In operation since 2009	Solid Waste Authority of Palm Beach County Florida Amber Batson, Senior Operations Engineer (561) 640-8904 abatson@swa.org
Heat Drying Facility Cumberland, Maryland 11 dry tons per day (design) In operation since 2010	City of Cumberland John DiFonzo, Director, Engineering Division (301) 759-6601 - Telephone jdifonzo@allconet.org
Biosolids Drying Facility Detroit, Michigan 240 wet tons per day (design) Under construction	Detroit Water & Sewerage Department Philip Kora, Head Engineer of Water Systems (313) 297-5909 kora@dwsd.org

Operations, Maintenance, Repair and Replacement Approach

NEFCO has many years of operations experience in its five operating plants. Staff generally consists of a Plant Manager and management staff, Mechanics, Instrument & Electric Technicians, and Operators. Across NEFCO's facilities, staff have over 500 years of cumulative experience in biosolids management operations.

The Plant Manager will be the formal contact with the City on a day-to day basis. The Plant Manager will perform general managerial tasks, including personnel management, scheduling of training, inventory management, development of operational and regulatory reports, and monitoring the operation and maintenance of the facility. The Plant manager will also interact with the public as required. Both the Plant Manager and Operators will be responsible for recording process data, making adjustments to plant operations, collecting samples for State and Federal regulatory analyses, and analyzing feed and product samples for moisture for process control.

The deep pool of NEFCO operations and maintenance talent at our several existing facilities allows us to propose an economical staffing plan, while assuring complete continuity of operations.

NEFCO takes pride in its maintenance services and the reliable facilities that an effective maintenance program provides. A prime example of this is our drying facility located in

Shakopee, Minnesota. This facility is equipped with a single large dryer that has processed 100% of our client's sludge for the last 12 years.

Adequate preventive maintenance is the key to achieving such economical and reliable operation. To this end, the City Of San Jose's facility will be maintained according to all of the equipment manufacturers' recommendations. All maintenance will be scheduled and documented electronically.

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: 0
2018: 145,000 tons per year or a capacity determined by the City for growth or merchant needs.
2023: 145,000 tons per year or a capacity determined by the City for growth or merchant needs.
2028: 145,000 tons per year or a capacity determined by the City for growth or merchant needs.

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

No

2.6 What is your available on-site storage, both prior to and post-processing:

Depending on the receipt of liquid sludge or dewatered cake sludge we propose to use the existing digester's liquid sludge storage capacity (including additional liquid sludge storage (as required)); cake storage will be approximately 2-3 hours; on site pellet storage will be 7-8 days; off-site storage provided by the buyers.

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

NEFCO proposes to design, construct and operate a biosolids management facility comprised of centrifuge dewatering and rotary drying at or adjacent to the existing wastewater treatment plant. NEFCO processes a variety of municipal sludges that are digested and undigested, dewatered cake (or we dewater in our facilty), and secondary and primary/secondary blends. After reviewing the City's information NEFCO will be able to provide a long-term, reliable solution for biosolids management.

It is possible to process the city's biosolids with a single dryer. NEFCO has extensive experience processing material very reliable with a single dryer. Further discussion with the city will be necessary to determine redundancy requirements. Single dryers of the following capacities are available from NEFCO:

NEFCO Dryer Systems	Evaporative Capacity, pph	Firing Rate, MMBTUH	Cake solids	Capacity, wet tons / day	Capacity, dry tons / day	Annual wet tons
130-44	24857	37	25%	398	99	145166
125-42	22714	34	25%	363	91	132651
110-34	15429	23	25%	247	62	90103
105-32	12000	18	25%	192	48	70080

A single NEFCO dryer system supplied with critical spare parts achieves better than 90% availability as calculated on a monthly basis. NEFCO has installed and reliably operated single dryer systems at Shakopee, Minnesota and at Cumberland Maryland over many years. An additional dryer can be constructed to provide redundant disposal capacity if desired. Sludge bypass to the existing lagoons or cake bypass to landfill disposal is can also provide redundancy, if the City's prefers.

NEFCO provides dewatering at several facilities. It is more economical for NEFCO to dewater within the dryer facility versus the City constructing and operating their own. For example, dewatering for this project consists of a pair of dewatering centrifuges feeding a single 125-42 or 130-44 dryer. This provides all of the dewatering and drying capacity needed by the City. NEFCO has provided similar dryers at The Solid Waste Authority of Palm Beach County, Florida and Detroit, Michigan, respectively.

A layout drawing of the NEFCO facility at SWA is appended. The SWA facility contains a large, fully enclosed and odor controlled tipping pit and cake bunker (storage) area. Bunkers are necessary at this site to permit weekend operation when trucks from the contributing entities are unable to deliver sludge cake.

Conceptual drawings of a facility for the City of San Jose are also attached. This facility includes centrifuge dewatering and rotary drying. ***A single dryer of this size would meet the San Jose's current needs with spare capacity.***

This combined dewatering and drying concept is ideal for San Jose. A combined facility:

- Eliminates dewatering and truck loading bays at the WWTP site;
- Eliminates tipping pits and bunkers at the dryer facility;
- Eliminates the cost of sludge cake trucking or conveyance;
- Eliminates emissions and odors associated with sludge cake movement;
- Labor costs are reduced because a single staff operates the centrifuges and the dryer system; and
- Cake may be loaded into trucks and disposed during dryer maintenance.

2.7.1 Class of Biosolids

- What class of biosolids do you accept?
  - ☐ Only Class A
  - ☐ Only Class B
  - ☒ Both Class A and Class B (not commingled)
- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?

  NEFCO will accept any type of biosolids whether primary, secondary, or tertiary; raw, or digested. We prefer solids meeting the US EPA 40 CFR Part 503 Table 3 limits, but will accept solids up to Table 1 limits. Our processing will convert any sludge to Class A biosolids. We will take ownership of all end products and will lawfully and beneficially manage distribution to end users.

- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

  _____

2.7.2 Percent Solids

NEFCO can accept biosolids in liquid form or as cake.
NEFCO currently provides economical dewatering at several of our facilities. The same staff that provides processing services provides dewatering services. If in liquid form, the solids concentration should typically exceed 2.0% for economical dewatering.
If supplied as cake, the best economy is achieved at solids concentrations over 25% (i.e. as typically achieved by centrifuges). However, NEFCO has processed sludge cake between 12% and 30%.

- Minimum percent solids of the biosolids you will accept?
  2.0% - 2.5%
- Preferred percent solids of the biosolids you will accept?
  2.5% - 6.0%

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?

  All biosolids will be dried and pelletized. The resulting dry product may be used as fertilizer or carbon-neutral fuel. Since 1991, all product from NEFCO facilities have been beneficially used as fertilizer or fuel.

- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?
  5,000 BTU/dry pound +/-
- Other characteristics required for delivered fuel product?
  N/A

2.7.4 Other (describe)

Since the City's wastewater facility is now equipped with anaerobic digesters, opportunities abound for integrating drying on-site into the WWTP process. Specific advantages of an on-site processing facility include:

- On-site dewatering and drying uses about 75% to 80% less vehicle fuel than hauling cake to off-site treatment or land application.
- Dryer equipment (unlike engines or turbines) use digester gas without pretreatment.
- The dryer's scrubber / condenser will incidentally remove sulfur oxides along with water and dust.
- Dryers are immune to fouling with silica; their emission controls (oxidizers) are tolerant of silica with regular cleaning.
- The only digester gas preparation is low-pressure compression.
- Rotary dryers are readily adaptable to use waste heat (hot exhaust) from a digester gas-fueled engine or turbine.
- Secondary effluent may be used for process cooling and emission control.
- A dryer's condenser will recover large quantities of hot water at an ideal temperature for heating digesters.

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: Pelletized Class A EQ Biosolids

Marketing / Reuse Approach: _____

NEFCO's approach to marketing biosolids pellets focuses on maintaining a diversified end-use market to ensure reliable product movement and to maximize revenue and minimize costs of beneficial reuse. A combination of fixed price contracts and sale of product via spot sales is used. In this manner, a specific volume of product shipment is guaranteed via fixed price contracts while the spot pricing on the remaining product can be adjusted to maximize revenue or to generate demand. Generally, NEFCO passes title of the biosolids onto the end-user as soon as the pelletized product is loaded into the bulk shipment trailers.

Fixed Price Contracts

NEFCO has a contract template used for higher volume fixed price contracts. Individual contracts are customized to meet the needs of the specific customer and geographical considerations. Pricing is set based on regional market demands. Volumes are mutual

commitments for supply and purchase. Trucking responsibilities are generally placed on the end-user, however NEFCO will contract for product shipment if desired.

Spot Sales Purchase Orders

NEFCO also has standard terms and conditions that it uses for spot sales via purchase orders. Pricing can be adjusted seasonally to take advantage of high demand periods or to stimulate demand during low demand periods. In order to maintain a diversified base of spot sale customers, existing customers are generally placed on allocation during high demand periods as opposed to filling orders sequentially. This leads to higher retention of customers as opposed to refusing orders.

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: Pelletized Class A EQ Biosolids

Approach: _____

NEFCO has other beneficial use outlets that could easily accommodate the entire production from the biosolids management facility. Our multi-tiered approach to product management guarantees that we will manage all biosolids products in a timely and appropriate manner. We have strategic partnerships throughout the country that have helped us maintain our track record of 100% beneficial reuse of our pelletized biosolids.

A keen understanding of product quality characteristics is critical to achieving wide acceptance and increasing demand. Particle size distribution in the range of 6 to 16 Tyler mesh is critical for fertilizer blenders. Land application customers are more forgiving, but still require some uniformity for fertilizer spreading. However, it is impractical to segregate product generated from one facility into different sizes for different customers. Biosolids pellets are inherently dusty; therefore they must be coated with a dust suppressant while loading into the transportation vehicles. A variety of dust oils can be used such as crude glycerin, complex hydrocarbon mixes, or vegetable oils.

In addition to product quality, other product marketing critical success factors include:

- Maintaining a diversified customer base, both in end use and geography.
- Viewing material as a product, not a waste.
- Using a supply chain approach – understand seasonal supply and demand.
- Knowing the customer's needs.
- Using marketing brokers as needed, but judiciously and wisely.
- Maintaining a balance between on-site product storage and distribution.
- Understanding state-to-state biosolids permitting requirements.

The most important critical success factor is to use a supply chain approach to product marketing. WWTP Facility seasonal supply of sludge is modelled. Seasonal demand is also modelled and an on-site inventory management plan is developed. This provides an early warning system; when inventories are higher than planned, alternative end use customers are developed. If supply and demand did become misaligned despite NEFCO's experience, we

would use our vast network of biosolids professionals, contact associations such as the California Association of Sanitation Agencies, and even advertise as needed.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: San Jose Biosolids Processing Facility

2.10.1 Surface Water (describe):

All NEFCO facilities are fully enclosed, including cake and dry product storage. Surface water near the San Jose treatment plant will be fully protected from spills or contamination.

Off-site, NEFCO follows all Federal and State regulations with regard to land application of Class A biosolids at all of its operating facilities, and will also do so for the San Jose project. Moreover, NEFCO's process creates fertilizer with real economic value. Because the product's value, farmers have an incentive to apply fertilizer only where its nutrients will be taken up by crops, i.e. well away from waterways.

2.10.2 Odor (describe):

A dewatering and drying facility will be a good neighbor to nearby residents and abutters.

First and foremost, the dryers will be equipped with Best Available Emission Controls ("BACT"). The emission controls will consist of Low NOx burners, separator cyclones, three stage tray scrubbers / condensers, exhaust circulation and thermal oxidizers.

Even ventilation air will be treated. The building will be tightly constructed and sealed to prevent the escape of odorous air. Alkaline hypochlorite scrubber(s) will treat all building exhaust from process areas of the plant. Alkaline hypochlorite scrubbers are used at countless treatment plants where they provide effective odor control. The scrubber fan will create a slight vacuum inside the building to ensure that no air can escape unless treated.

Loading will occur beneath a fully skirted silo to protect the product loading operation from weather and wind. A dust control agent will be applied during loading to provide lasting dust control, both at the silos and at the point of beneficial re-use.

Trucking odor impacts from filter cake will be eliminated. The mass of solids hauled and number of trucks on local streets will be reduced by a factor of four. The product will be treated for pathogens to a "Class A" standard, and will not attract disease vectors such as flies or other insects along the route.

2.10.3 Noise (describe):

Noise control is a multi-faceted task at any industrial facility such as a dewatering and drying facility. Noise from the fully enclosed facility will be well controlled. Our facilities include fans, motors and equipment that do not emit more than 85 dB(A) measured at 3

feet. This low level of noise means that workers and visitors to the plant will not need hearing protection. In addition to providing quiet equipment generally, nearly all equipment will be located indoors where the building envelope will provide sound attenuation.

Process fans are often overlooked source of noise. Large fans can generate a pure tone that can propagate great distances through ducts or stacks. NEFCO's design for scrubbers and RTOs is "forced draft", placing sound-attenuating equipment downstream of the fans thus eliminating such noise. The RTO media and scrubber packing absorb tonal noise. Tonal noise will not be a problem to the San Jose community.

2.10.4 How close is the nearest residence to this site? See 2.10.5 below

2.10.5 How close is the nearest business to this site? Describe the nature of the business?

Because our solution to this RFI includes construction of a new facility, and since no RFP has yet been issued, no facility site has yet been selected. For various technical and economic reasons, the optimum location for a dewatering and drying facility is on the site of, or adjacent to the existing treatment plant. Sites close to the treatment plant offer advantages:

- Trucking of sludge cake is avoided.
- Digester gas is frequently available for use in the dryer and oxidizer
- Cooling water (final effluent) is readily available.
- Spent (140°F) cooling water may be used on-site; for example to heat digesters
- Dilute recycle streams such as dewatering centrate and scrubber/cooling water are conveniently returned to the treatment plant.

2.11 Are there any required permits or permit limitations at the site?

Permitting Requirements

The proposed drying facility will require construction and building permits from the Department of Planning, Building and Code Enforcement (PBCE) of the City of San Jose and an air construction permit from the Air Pollution Control Officer (APCO) of the Bay Area Air Quality Management District (BAAQMD).

Construction and Building Permits

The Department of PBCE of the City of San Jose issues and enforces the building and construction codes for the City. Upon completion of the design packages, NEFCO will submit the drawings and supporting documents addressing the electrical, plumbing, and mechanical plans for the dryer facility to PBCE for review and approval. The design package will include a site plan, architectural plan, and structural drawings; as well as related support documentation.

Air Permits

The drying facility will constitute a new stationary source at the Regional Wastewater Treatment Facility (WWTF) and will require an air construction permit from the APCO of

the BAAQMD. The air construction permit can either be a minor source or a major source permit, depending upon the amount of emissions from the new installation. A stand-alone dryer facility is expected to require a minor source air construction permit.

However due to co-location of the dryer facility with the WWTP, it is possible that BAAQMD could classify the drying operation and the WWTF operations as one source. In other words, the drying facility could be considered as a modification to the existing WWTP. Under this scenario, the existing source status of the WWTP (major or minor source) will become a factor as to whether or not the dryer project will be subject to major or minor modification rules. A minor source permit review typically takes three to six months for approval after a complete application has been submitted.

The air construction permit application process will require control of emissions of regulated pollutants from the drying process. The air pollutants of concern from a rotary thermal drying system are basically the by-products of natural gas and/or digester gas combustion along with contaminants from the drying process. The "criteria" regulated pollutants emitted from the facility typically include oxides of nitrogen (NOx), carbon monoxide (CO), particulate matter (PM), PM less than 10 microns (PM_{10}) and PM less than 2.5 microns ($PM_{2.5}$), volatile organic compounds (VOCs), oxides of sulfur (SOx), and trace amounts of metals and other hazardous air pollutants (HAPs).

The potential emissions of criteria pollutants from the dryer will be based on several different sources of emissions data. These include emissions and performance guarantees provided by the dryer and emissions control equipment vendors, emission factors from USEPA's AP-42 Document, emission factors based on stack tests conducted at similar NEFCO facilities elsewhere, and/or other engineering calculations. If digester gas is used, a gas analysis needs to be performed to determine the level of sulfur and perhaps siloxanes.

The combination of low-NOx burners, a separator cyclone, wet scrubbing, condensing, exhaust recirculation, and regenerative thermal oxidation provides excellent control of odors, low emissions of regulated pollutants, and economical operation. These emission controls are considered by regulatory agencies to be Best Available Control Technology (BACT). A natural gas-fired dryer system at San Jose, of the same size and configuration as are being installed at Detroit is expected to be permitted at similar rates, which are as follows:

Pollutant	***Units***	**Emission Rate**
NOx	*Pounds per hour (pph)*	3.95
CO	*pph*	3.67
PM	*pph*	1.22
PM_{10}	*pph*	1.63
$PM_{2.5}$	*pph*	1.14
SO_2	*pph*	0.82

VOCs	*pph*	1.68

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

NEFCO is willing and able to take all or a portion of the biosolids cake. We have experience in single thermal drying facilities processing from three dry tons per day to over 400 dry tons per day. The best solution is for NEFCO to design, build, and operate dewatering equipment, preferably centrifuges, in conjunction with a thermal drying process. This is the case in half of our existing facilities. This minimizes handling of wet cake.

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☒ $60-$70 / wet ton
- ☐ Other (please indicate amount) _____per wet ton

In order to provide economies of scale, the cost of dewatering and drying should be calculated near the maximum average tonnage. Therefore, we have developed a model that estimates the total cost to the City assuming much larger tonnage and the following assumptions:

- A minimum of 120,000 tons per year (~30,000 dry tons per year)
- Two Alfa Laval G2 centrifuges plus one spare rotating assembly
- One 130-44 dryer system; >145,000 wet tons per year capacity
- One 800 ton storage silo
- One 50,000 cfm odor scrubber
- 22 - 25 therms per wet ton (90 – 100 therms per dry ton; natural gas or digester gas)
- 65 - 75 kWh per wet ton (250 – 300 kWh per dry ton)
- Potable and effluent water and wastewater services supplied by the City as needed to process

Based on these assumptions, the annual operating and maintenance costs incurred by the City can be determined for a future RFP.

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

We have one regional thermal drying facility in West Palm Beach, FL that receives wet cake from seven wastewater treatment plants. Transportation of wet cake is handled by the client, although NEFCO is amenable to providing transportation services if desired. These services would be subcontracted on a bid basis.

Final pellet transportation to end users is provided both by NEFCO and end users. NEFCO has relationships with many national transportation companies and receives competitive per-ton shipment pricing. A normal truck is usually filled with about 25 tons product. For truck transportation, a 48'L X 102"W standard flatbed trailer, powered by a double-axle truck/tractor will be used. The outside of transportation vehicles will not be exposed to biosolids as they are packaged and covered by a tarp. An appropriate trucking manifest will be provided along with an MSDS for the Class A biosolids pellets. Truck drivers will keep detailed logs of operating hours and transportation route.

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

- ☐ Service Contract (providing a direct end-use service or providing processing)
- ☒ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)
- ☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

NEFCO prefers a long term design/build/operate or design/build/finance/operate contract.

3.3 What length of contract term would you prefer? (Check one)

☐	5 years	☐	10-15 years
☐	5-10 years	☒	No preference

3.4 What is the minimum contract term you would prefer (in years)? 5 years

4 OTHER

4.1 The City is considering building a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

4.1.1 Your team's experience operating this type of facility (describe):

NEFCO provides centrifuge dewatering services at several of our facilities. As an example we have been providing dewatering services for the MWRA for 23 years. NEFCO was able to offset a $25 million capital project for the city of Detroit for $8 million by incorporating centrifuge dewatering into the drying facility. It is a much more cost effective and operational benefit to incorporate dewatering into the drying facility.

4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?

Operations and maintenance of the dewatering equipment would be integrated with the remainder of the processing facility so contract term would be included. It may require additional minimal labor to O&M the dewatering equipment.

4.1.3 Minimum term of operating contract that would accept?

Five years

4.1.4 Please identify any concerns you would have with this type of operation?

Prior to proposal development, NEFCO would request or develop more information regarding the dewatering characteristics of the City's sludge.

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

Yes. NEFCO is very interested in operating drying facilities at the city's WWTP. NEFCO would request characterization of the fuel qualities of any available digester gas.

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

The following description of NEFCO's dryer system is, for the reader's convenience, broken into four general process areas: Dewatering; Solids Handling; Air Handling and Odor controls; and Finished Product Storage and Loading. The attached process flow drawing should be consulted to assist in further understanding these systems.

Dewatering

Two new high solids centrifuges feed the dryer. The centrifuges will be fed from new sludge pumps installed within the existing digester complex. New polymer dilution systems and feed pumps will be located within the new facility. The new centrifuges collect and feed cake to the dryer via a receiving bin.

Solids Handling

The cake is metered out of the receiving bin via redundant feed screws, weighed on a belt conveyor and conveyed to a mixer. The recycle screw conveyor meters and withdraws dry solids from the recycle bin and conveys them to the mixer. At the mixer,

the dried solids are intensively mixed with the incoming cake biosolids to produce a damp, but relatively free flowing mixture. This mixture is conveyed in a screw conveyor to the dryer inlet. Almost all (95 - 98%) of the moisture is driven off inside the dryer drum. Subsequently, the dried solids are carried out of the drum in the exhaust stream to an elevated separator cyclone. The dried solids, which are now discrete granules, have become pathogen free fertilizer. The granules are collected by the separator, which discharges through an airlock into a screener.

The granules are screened into four fractions: trash; oversize; product; and fines. Trash, consisting of coarse plastic and other undesirable solids is collected in a small container for disposal. Oversize granules drop into a roll crusher, and subsequently drop into the recycle bin. Fine granules also drop into this bin. The recycle bin stores the dry material that is to be re-processed with the wet cake, as previously described. The remaining granules, which are the finished product, are cooled and transported to the storage silo either by a drag conveyor or a pneumatic conveyor.

Air Handling and Odor Controls

The heat necessary to evaporate moisture from the biosolids mix is provided by burning digester gas or natural gas. The burner creates a very hot mix of combustion products, which is "tempered" or cooled by admitting additional cool air. The mix of gasses at the dryer inlet typically varies between 700-1000 °F, depending on processing rate. The tempered, hot gas dries the sludge in the drum and provides the motive force to move the solids through the dryer. The spent, cooled gas, evaporated water and solids exit the drum, and enter the separator. Solids are collected from the gas in the separator. The gas is drawn through a scrubber/condenser to remove the small amount of remaining solids and to remove water vapor. Plant effluent is used to scrub solids and condense water vapor.

The effluent absorbs the heat that was used to evaporate water in the dryer. This heat raises the temperature of the effluent nearly to the saturation temperature of the incoming exhaust. Depending on the dryer firing rate, the hot water produced will be in the range of 120 to 140 ^{0}F. Thermal energy may be recovered by pumping this hot water to digester heat exchanger(s). Thus, digester gas energy utilized in the dryer may still be used to heat the digester.

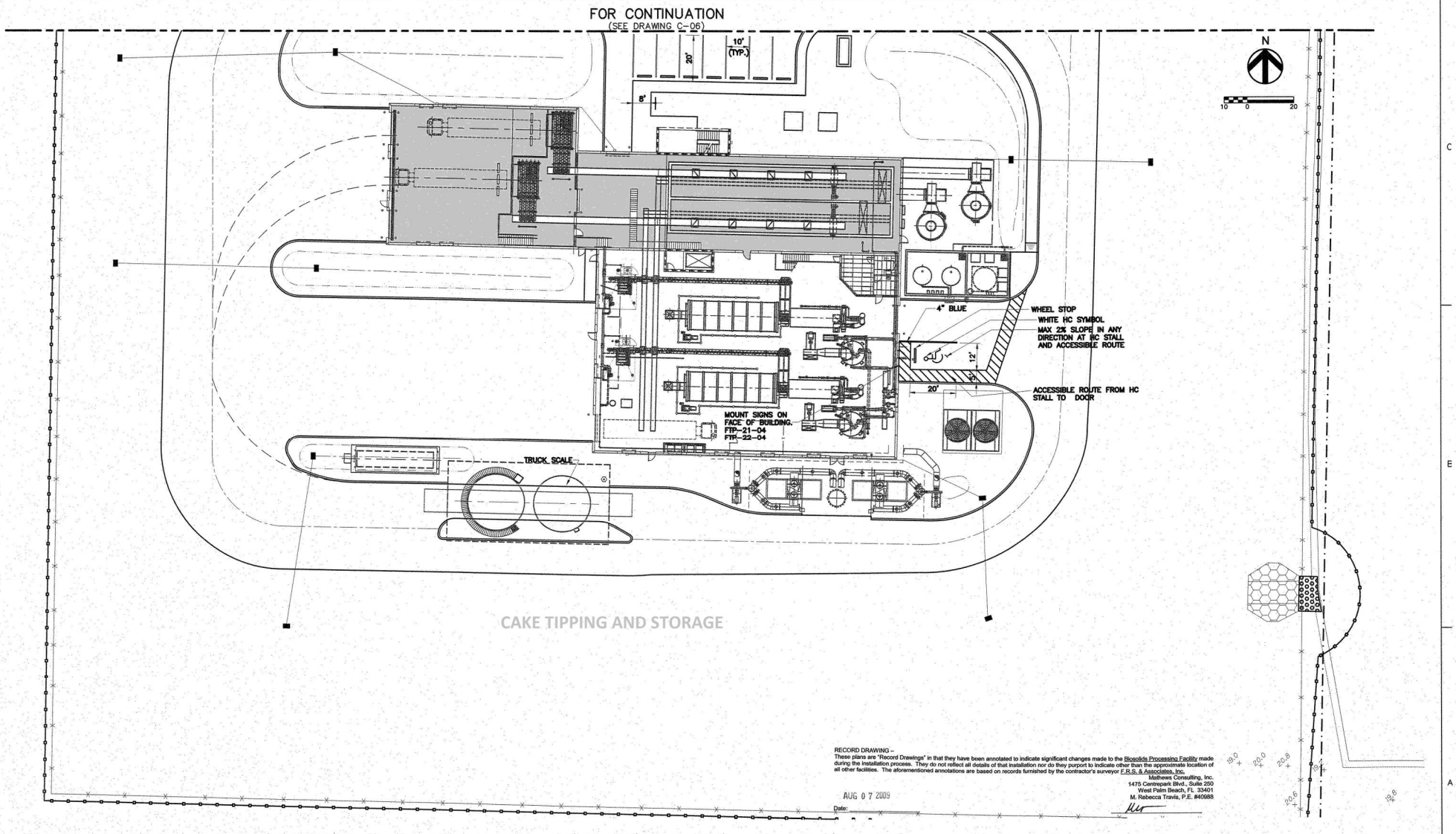
The condenser exhaust gas continues on to further treatment. The greater part of this dehumidified gas is returned to the inlet of the dryer and used as tempering gas within the dryer as described above. The gas then passes through a Regenerative Thermal Oxidizer (RTO) that destroys odor causing compounds and organic vapors by heating this gas stream to about 1500 °F. Most of the heat required in the RTO is recovered and reused via a technique called regeneration. Odorous organic compounds are oxidized to odorless CO2, and discharged to the atmosphere through a stack.

The air handling and odor control system is a key feature of the process. The combination of wet scrubbing, condensing, exhaust circulation, and thermal oxidation provides excellent control of odors, low emissions of regulated pollutants, and economical operation. These emission controls are considered by regulatory agencies to be Best Available Control Technology (“BACT”).

Finished Product Storage and Loading

The cooled, finished product is conveyed to a 38 foot diameter, 80 foot tall bolted steel silo. The silo has the capability to store approximately 800 tons of finished fertilizer.

The silo unloading system is equipped with a system to add a dust suppression agent. This system consists of a dust suppression agent storage tank, a pump, and a conveyor / mixer to distribute the agent. The system will load trucks at an approximate rate of 50 tons per hour. Storage will be enhanced with an inert gas blanketing system in both the recycle bin and the silo to provide trouble-free storage.



RECORD DRAWING –
These plans are "Record Drawings" in that they have been annotated to indicate significant changes made to the Biosolids Processing Facility made during the installation process. They do not reflect all details of that installation nor do they purport to indicate other than the approximate location of all other facilities. The aforementioned annotations are based on records furnished by the contractor's surveyor F.R.S. & Associates, Inc.

Mathews Consulting, Inc.
1475 Centrepark Blvd., Suite 250
West Palm Beach, FL. 33401
M. Rebecca Travis, P.E. #40988

AUG 07 2009
Date:

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LICENSE No. E.B.-0007929
www.mathewsconsultinginc.com

HDR
HDR ENGINEERING INC.
6190 GOLDEN HILLS DRIVE
MINNEAPOLIS, MN 55416
TEL 763-591-5400

ISSUE	DATE	DESCRIPTION
	8/11/09	RECORD DRAWING

		CHK BY:
PROJECT MANAGER	E. DeLoFOREST	
ARCHITECTURAL	S. BIRCH	
STRUCTURAL	W. KIAHON	
CIVIL	R. TRAVIS	
PROCESS	E. DeLoFOREST	
MECHANICAL	B. SPOTT	
ELECTRICAL	L. SMITH	
PROJECT NUMBER	000000000024020	

AUG 07 2009
M. REBECCA TRAVIS, P.E.
No. 40988

BIOSOLIDS PROCESSING FACILITY
SITEWORK & UTILITIES
SWA SOLID WASTE AUTHORITY
Solid Waste Authority of Palm Beach County

SIGNING AND MARKING PLAN
RECORD DRAWING

0 1" 2"

FILENAME	1280C07
SCALE	

SHEET C-07

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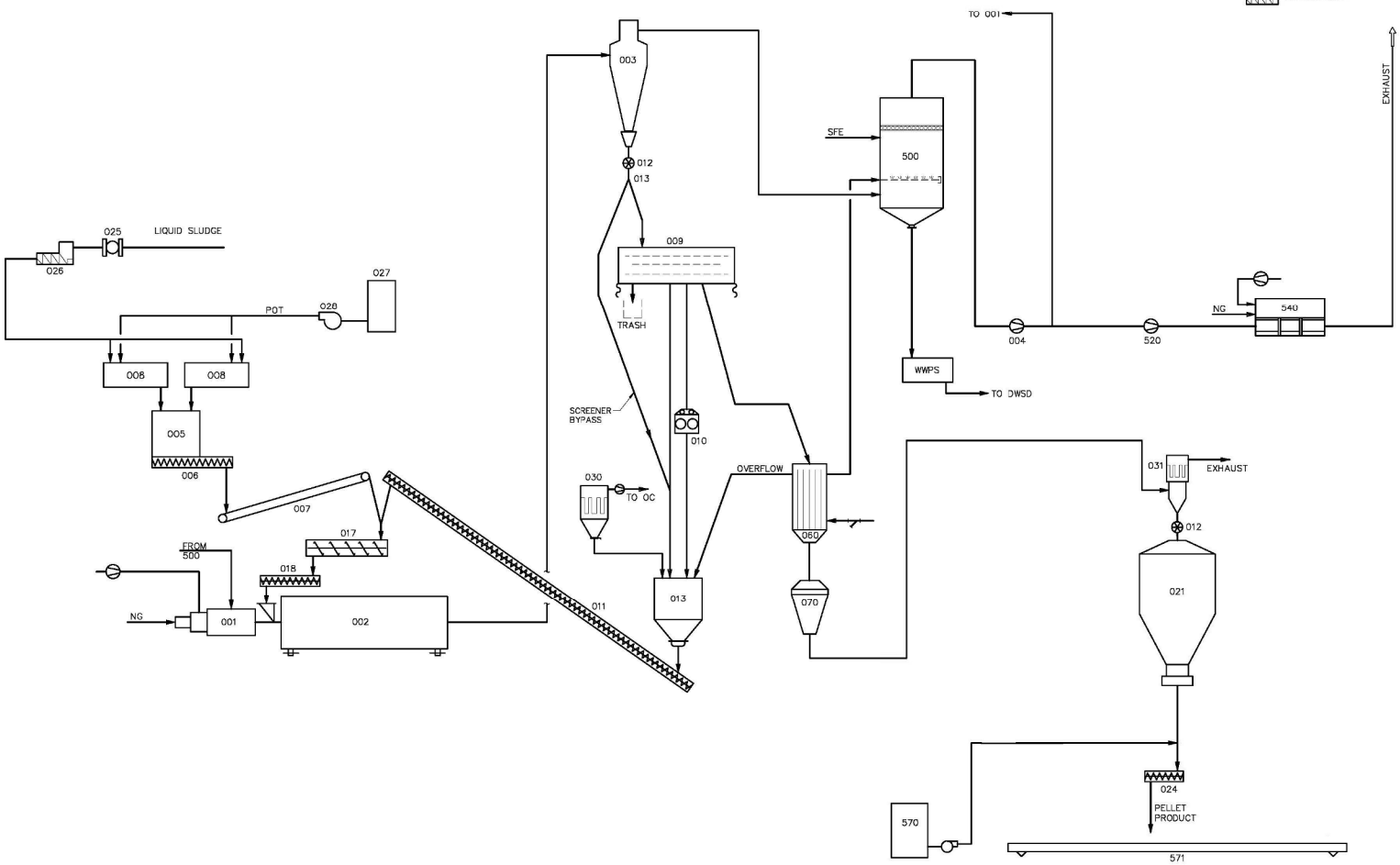
Acad Version : R17.2s (LMS Tech)
User Name : jbenning

Process Flow Diagram Without Cake Bypass

OPERATING CONDITIONS		UTILITIES	
CLIENT		NATURAL GAS (THERMS/H)	
QUANTITY		DWSD WATER (GPM) SFE	
CAKE SOLIDS		ELECTRICITY (KW)	
EVAPORATION			
FUELS			
DTPD			

001	FURNACE	009	SCREEN	021	SILO	060	PELLET COOLER
002	DRYER DRUM	010	CRUSHER	024	PELLET MIXER/CONVEYOR	070	TRANSPORTER
003	CYCLONE SEPARATOR	011	RECYCLE INCLINED SCREW CONVEYOR	025	GRINDER	500	TRAY SCRUBBER
004	MAIN ID FAN	012	ROTARY VALVE	026	SLUDGE PUMP	520	RTO FAN
005	CAKE RECEIVING BIN	013	DIVERTER	027	POLYMER TANK	540	RTO
006	CAKE RECEIVING FEED SCREWS	014	RECYCLE BIN	028	POLYMER FEED PUMP	570	PELLET OIL TANK
007	CAKE BELT CONVEYOR	017	PUGMILL MIXER	030	PROCESS DUST COLLECTOR	571	WEIGH SCALE
008	CENTRIFUGE	018	SCREW CONVEYOR	031	SILO DUST COLLECTOR		

NG – NATURAL GAS
NA – NOT APPLICABLE
OC – ODOR CONTROL
POT – POTABLE WATER
SFE – INDUSTRIAL WATER (DWSD EFFLUENT)
TBD – TO BE DETERMINED
WWPS – WASTEWATER PUMP STATION
AIR LOCK
FAN
PUMP
GRINDER
SLUDGE PUMP



NEFCO
Recycle, Renew, Restore

CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION

Biosolids Drying Facility

VERIFY SCALE
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

Mark	Date	Description

PROJECT NO.
FILE:
DRAWN BY:
CHECKED:
APPROVED BY:

PROCESS FLOW DIAGRAM

SCALE: NO SCALE

Process Flow Diagram With Cake Bypass

OPERATING CONDITIONS		UTILITIES	
CLIENT		NATURAL GAS (THERMS/H)	
QUANTITY		DWSD WATER (GPM) SFE	
CAKE SOLIDS		ELECTRICITY (KW)	
EVAPORATION			
FUELS			
DTPD			

001	FURNACE	009	SCREEN	021	SILO	060	PELLET COOLER
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NG – NATURAL GAS
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POT – POTABLE WATER
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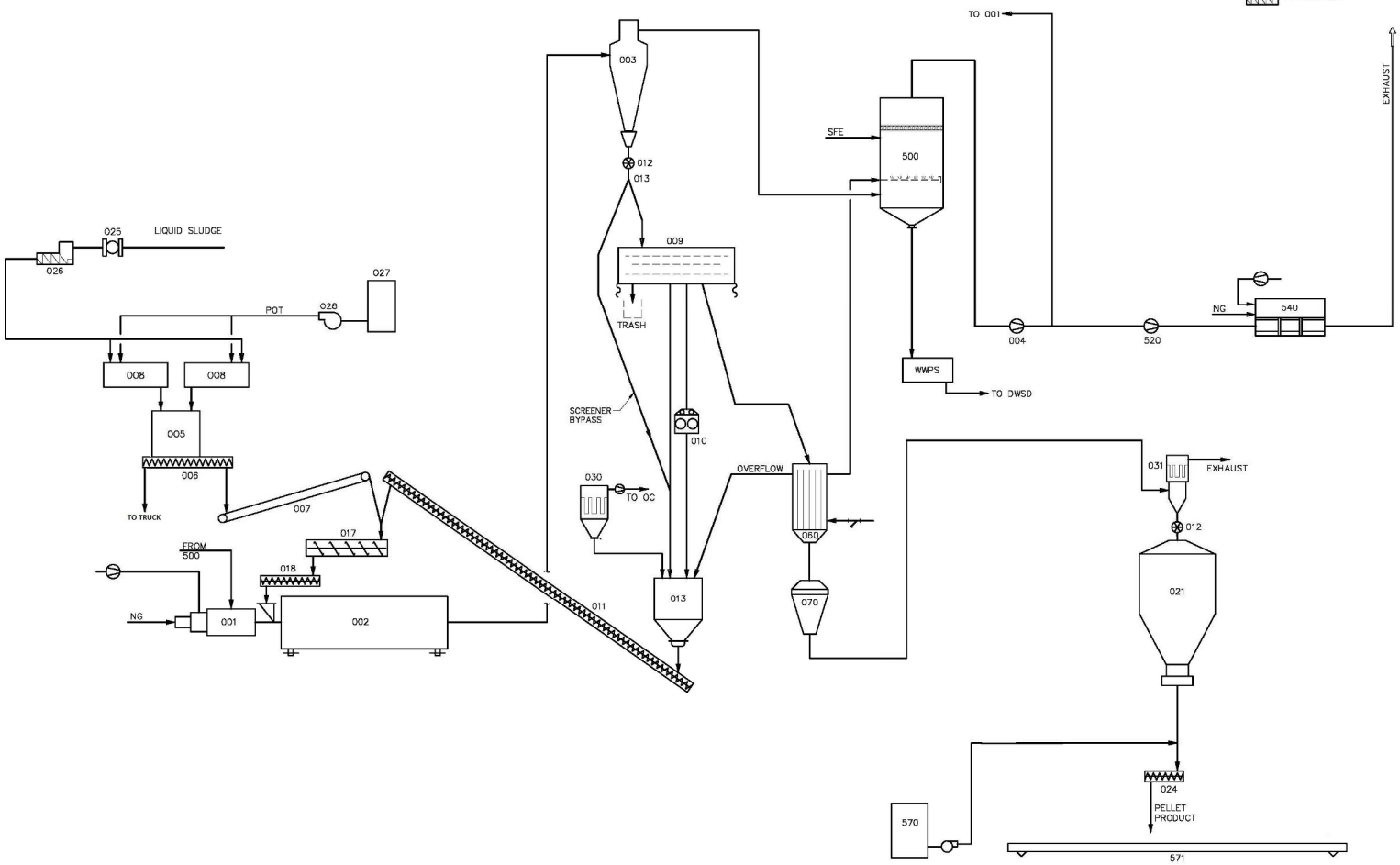
TBD – TO BE DETERMINED
WWPS – WASTEWATER PUMP STATION
AIR LOCK
FAN
PUMP
GRINDER
SLUDGE PUMP



NEFCO
Recycle, Renew, Restore

CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION

Biosolids Drying Facility

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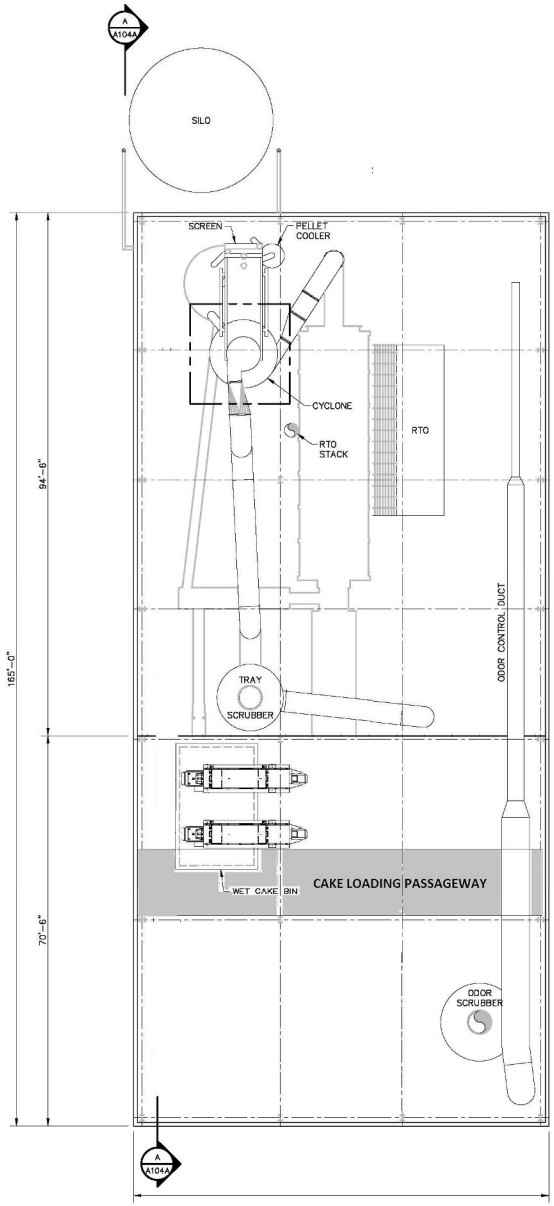
FILE:
DRAWN BY:
CHECKED:
APPROVED BY:

PROCESS FLOW DIAGRAM

SCALE: NO SCALE



NEFCO
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Mark	Date	Description

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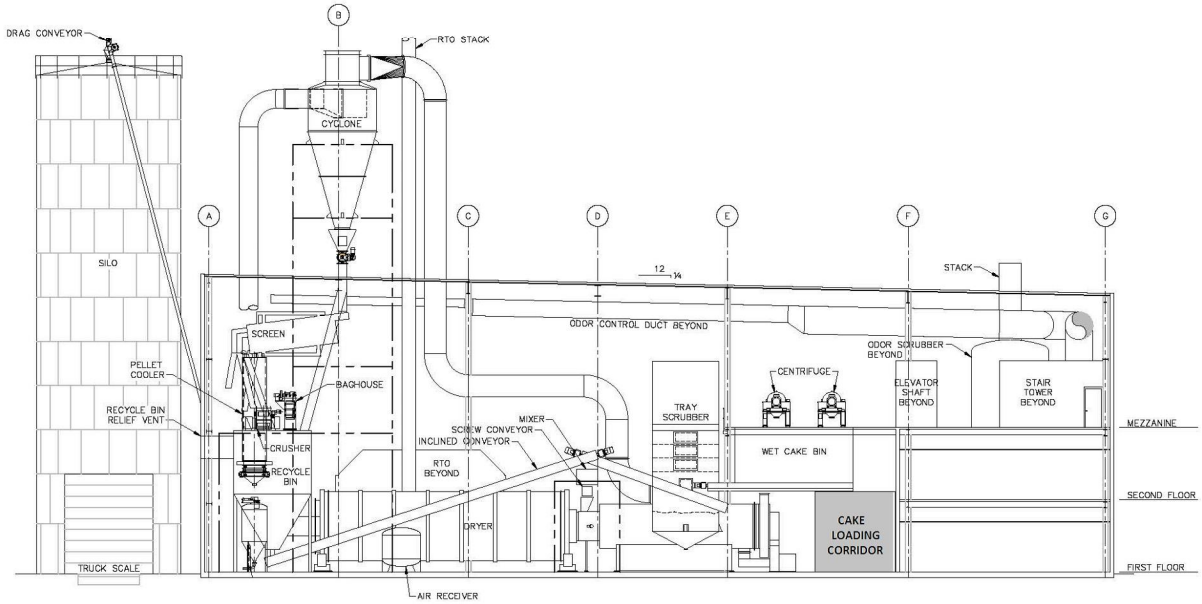
APPROVED BY:

SECOND FLOOR PLAN

SCALE: 3/32"=1'-0"



SECTION A / A201
3/32"=1'-0"

NEFCO
Recycle, Renew, Restore

CONCEPTUAL DESIGN
NOT FOR CONSTRUCTION

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Mark	Date	Description

PROJECT NO:
FILE:
DRAWN BY:
CHECKED:
APPROVED BY:

CROSS SECTION

SCALE: 3/32"=1'-0"

Synagro-WWT, Inc.

SYNAGRO

July 17, 2014

Mr. Mark Giovannetti
City of San Jose
1661 Senter Road
San Jose, CA 95112

Re: RFI 13-14-01
Biosolids Transition Program

Dear Mr. Giovannetti:

Synagro-WWT, Inc. (Synagro) is pleased to respond to the City of San Jose's Request for Information for its Biosolids Transition Program.

Having been in business for over 35 years, Synagro is the largest residuals management company in the United States with over 650 municipal and industrial customers and operations in 33 states.

Synagro has the experience and size necessary to implement a broker-type contract for biosolids reuse on behalf of the City. We propose to provide any needed processing facilities, matched with an investment in screening new technologies on the cusp of commercialization to the benefit of the City and its shareholders. This would ensure delivery of an ongoing and diverse portfolio of biosolids reuse options for the long term.

The Synagro Team is committed to providing our exemplary level of service to the City, resulting in what we are sure will be an award winning biosolids reuse project.

If you have any questions about our submittal or require any additional information, please feel free to contact me at (415) 515-3227 or mmartis@synagro.com. We look forward to hearing from you soon.

Sincerely,

Mary Martis, P.E.
Director, Project Development

MM:kw

435 Williams Court, Suite 100, Baltimore, MD 21220
Phone (443) 489-9000 • Fax: (443) 489-9042

San José-Santa Clara Regional Wastewater Facility

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

Synagro-WWT, Inc.

1.2 Contact Person, Address, Phone Number, and E-mail:

Mary Martis, P.E. – Director, Project Development; 3110 Gold Canal Drive, Suite E, Rancho Cordova, CA 95670; (415) 515-3227; mmartis@synagro.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

Yes, Synagro would be able to provide performance bonds under a service contract with the City. With regarding to restrictions on the amount/duration of such bonds, per current industry practice, the bonds would be equal to 100% of the annual contract value, and renewed on an annual basis for the term of the agreement.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

Synagro offers all commercially viable processing options and product marketing channels for biosolids and organic residuals including: heat drying and pelletization, composting, alkaline stabilization, digestion, dewatering, land application, and incineration.

This ability to offer the complete range of biosolids reuse options, along with our on-going investment in emerging technologies (e.g., biosolids-to-energy), is unique to Synagro and allows us to develop service portfolios that fit a municipality's changing needs. In addition, this breadth of experience provides Synagro with an in-depth understanding of biosolids that other companies simply do not possess. Further, as the industry leader in biosolids management, we have extensive experience in developing and managing biosolids facility design-build-own-operate (DBOO) projects and other project delivery methods to suit our clients' needs. We currently operate nine heat-drying facilities, three thermal processing facilities, four composting facilities, over a dozen alkaline stabilization facilities, and approximately 70 permanent and mobile dewatering facilities across the U.S..

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

Synagro has industry-leading biosolids drying and composting project development and operating experience, as evidenced with over 100 collective years of successful facility

operations. Synagro has more experience in operating dryer facilities than any other company in the U.S. Synagro's broad operational experience helps us to continually improve on the planning, design, construction and operation of successful biosolids drying/pelletization and composting systems.

Currently, Synagro operates municipal biosolids dryers at nine municipalities including Philadelphia, PA, Baltimore, MD (2), Sacramento, CA, Honolulu, HI, Pinellas County, FL, Stamford, CT, Hagerstown, MD, and Camden County, NJ.

Synagro operates several biosolids composting facilities that receive input materials from more than one generator or wastewater treatment plant; three of which – Central Valley Composting ("CVC"); Arizona Soils, and Charlotte County, FL -- utilize windrow composting and the South Kern Compost Manufacturing Facility utilizes aerated static pile technology.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

All of the technologies that Synagro employs are well-established and represent the best available technology or current accepted practice. Our level of experience in employing these technologies and methods are unmatched and it is this level of experience that mitigates operational and product quality risks. Further, Synagro has established business practices (e.g., providing O&M services for the technologies) that enable us to stay current on the development of emerging technologies and has committed to investing in the commercialization of these technologies to reduce risk for our clients.

2 BENEFICIAL RE-USE DESCRIPTIONS – LAND APPLICATION

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

- ☒ Land Application
- ☐ Alternative Daily Landfill Cover
- ☐ Composting of Biosolids and Marketing of Product
- ☐ Soil Amendment and Marketing of Product
- ☐ Fuel
- ☐ Other (describe)

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☒ No. Name of existing facility

Land application agricultural permitted locations at Silva Ranch in Sacramento County, CA; Solano County, CA Land Application Program; and Merced County, CA Land Application program. Please note that Synagro is currently expanding its operations in Solano County to include composting.

Location of existing facility See Counties above

☐ Yes. Name/description of planned facility _____

Anticipated operational date _____

Capacity (wet TPD) _____

How development will be funded _____

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Synagro currently manages in excess of 300,000 tons per year of biosolids in various land application programs in Northern and Central California.

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current:	150,000 – 200,000 tons
2018:	150,000 – 200,000 tons
2023:	150,000 – 200,000 tons
2028:	150,000 – 200,000 tons

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

Solano County land application program is restricted to five days per week, April 16 through October 14 of each year. Sacramento County is limited to 60 truck loads per day total per the site's Conditional Use Permit; Merced County has requirements for three hour incorporation, no limitation on time of year, truck trips per day or total volume.

2.6 What is your available on-site storage, both prior to and post-processing:

There are currently 7 days of on-site storage available at the Silva Ranch Sacramento land application site. There is no on-site storage available for either prior or post-processing at our other land application sites.

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

What class of biosolids do you accept? Class A or B

Future:

- ☐ Only Class A
- ☐ Only Class B
- ☒ Both Class A and Class B (not commingled)

If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?
No, there are no capacity restrictions that apply to the Class B portion.

If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

Not applicable

2.7.2 Percent Solids

Minimum percent solids of the biosolids you will accept?

Sacramento County – 15% solids minimum (no maximum percent solids). Solano and Merced Counties – no minimum percent solids (50% maximum percent solids).

Preferred percent solids of the biosolids you will accept?

15% or greater

2.7.3 Energy–Related Processes – *not applicable to Land Application*

Are biosolids processed (dried) to fuel at your location?

Not applicable for land application.

If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

_____

Other characteristics required for delivered fuel product?

_____

2.7.4 Other (describe)

Not applicable to land application.

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: Class A and B Biosolids

Marketing / Reuse Approach: Synagro, as the nation's leading marketer of biosolids products, has a well-established sales network that markets biosolids products direct to the agricultural community. This network is supported by our Technical Services Department, which provides permitting, regulatory oversight, and oversees the delivery of biosolids to its customers.

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: Class A and B Biosolids

Approach: Given the size of our company and number of operating sites, it is likely that we have more than one outlet for biosolids reuse to balance changes or misaligned supply and demand situations. In addition, Synagro has extensive experience developing new markets in untapped areas as well as maintaining relationships with our existing agricultural land application customers. Synagro has a sophisticated sales and operations process that allows us to balance supply and demand.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

A copy of Synagro's compliance program is attached in Appendix 1.

Site Name: Solano County Land Application

2.10.1 Surface Water (describe): Application limited to April 16 – October 14 each year
2.10.2 Odor (describe): Daily incorporation of biosolids on land application sites
2.10.3 Noise (describe): Daylight deliveries
2.10.4 How close is the nearest residence to this site? Varies by field location
2.10.5 How close is the nearest business to this site? Describe the nature of the business? Varies by field location

Site Name: Merced County Land Application

2.10.1 Surface Water (describe): Buffer zones
2.10.2 Odor (describe): Daily incorporation of biosolids on land application sites
2.10.3 Noise (describe): Daylight deliveries
2.10.4 How close is the nearest residence to this site? Varies by field location
2.10.5 How close is the nearest business to this site? Describe the nature of the business? Varies by field location

Site Name: Sacramento County Land Application

2.10.1 Surface Water (describe): Buffer zones
2.10.2 Odor (describe): Daily incorporation of biosolids on land application sites
2.10.3 Noise (describe): Daylight deliveries
2.10.4 How close is the nearest residence to this site? Varies by field location
2.10.5 How close is the nearest business to this site? Describe the nature of the business? Varies by field location

2.11 Are there any required permits or permit limitations at the site?

The Sacramento land application program has site specific WDR's and a conditional use permit already in place. The Solano County program has 4 WDR's issued under the 2004 General Order, as well as County Site Land Application Permits in accordance with the County Biosolids Ordinance. Merced County has a Biosolids Management Program. All of the permits are current and in force.

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

There are no limitations on land application at this time. We would be willing to commit to partial volumes for land application/landfill ADC and Composting. With respect to managing multiple biosolids end products and options, Synagro has the experience and size necessary to implement a broker-type contract on behalf of the City. This would ensure an on-going and diverse portfolio of biosolids reuse options for the City over the long term – enabling program flexibility as new technologies evolve.

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☒ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton

☐ Other (please indicate amount) _____per wet ton

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

Yes, we typically provide biosolids transportation services to our facilities/sites. Pricing is based on the cost of providing service at the land application site, plus the cost of transportation, which is normally dictated by the distance from the generator and the respective land application sites.

2 BENEFICIAL RE-USE DESCRIPTIONS – ALTERNATIVE DAILY LANDFILL COVER

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

Type of reuse or intermediate processing that could be provided (check one):

- ☐ Land Application
- ☒ Alternative Daily Landfill Cover
- ☐ Composting of Biosolids and Marketing of Product
- ☐ Soil Amendment and Marketing of Product
- ☐ Fuel
- ☐ Other (describe)

Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☒ No. Name of existing facility

Synagro will provide this service through our national relationships with Republic Waste, Waste Management and Waste Connections with access to five landfills in the local area. No new capacity would be required.

Location of existing facility

Newby Island Landfill, Mipitas, CA; Vasco Road Landfill, Livermore, CA; Altamont Landfill, Livermore, CA and Potrero Hills Landfill, Suisun City, CA

☐ Yes. Name/description of planned facility _____

Anticipated operational date _____

Capacity (wet TPD) _____

How development will be funded _____

Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Synagro has more than 35 years of experience in working with waste management companies in providing alternative daily cover at their sites.

What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: Current capacity of our existing facilities, net of capacity committed, is approximately 100,000 tons. This capacity is expected to remain stable or increase as long as there is no change in applicable laws.

2018: N/A
2023: N/A
2028: N/A

Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

Capacity at existing landfills for ADC may vary between 100 to 300 tons per day per landfill, however, should the ADC option not become available on any given day, Synagro offers a full complement of beneficial reuse options such as land application in Solano, Merced, Sonoma, and Sacramento Counties, as well as composting in Merced and Solano/Alameda Counties.

What is your available on-site storage, both prior to and post-processing:

On-site storage at landfills for ADC may vary by landfill, however, should the ADC storage option not become available on any given day, Synagro would have other options for beneficial reuse of the material.

Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.1.1 Class of Biosolids

What class of biosolids do you accept?

Class A, B (drying and composting, and land application)

Future:

- ☐ Only Class A
- ☐ Only Class B
- ☒ Both Class A and Class B (not commingled)

If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?

No

If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

Not applicable.

2.1.2 Percent Solids

Minimum percent solids of the biosolids you will accept?

20% for primary, 15% for secondary, must be free of standing liquid

Preferred percent solids of the biosolids you will accept?
20% or greater

2.1.3 Energy–Related Processes –

Not applicable for Alternative Daily Landfill Cover

Are biosolids processed (dried) to fuel at your location?

Not applicable.

If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

Not applicable.

Other characteristics required for delivered fuel product?

Not applicable.

2.1.4 Other (describe)

Not applicable.

For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Not applicable for Alternative Daily Landfill Cover

Material: N/A

Marketing / Reuse Approach: N/A

For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Not applicable for Alternative Daily Landfill Cover

Material: N/A

Approach: N/A

For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

All landfills have separately addressed all of the issues below in their Report of Disposal Site Information (RDSI) (i.e., surface water, odor, noise, etc.).

Site Name: _____

2.1.5 Surface Water (describe): _____
2.1.6 Odor (describe): _____
2.1.7 Noise (describe): _____
2.1.8 How close is the nearest residence to this site? _____
2.1.9 How close is the nearest business to this site? Describe the nature of the business? _____

Are there any required permits or permit limitations at the site?

Daily capacity at landfills for ADC may vary between 100 to 300 tons per day per landfill, however, should the ADC option not become available on any given day, Synagro offers a full complement of beneficial use options such as land application in Solano, Merced, Sonoma, and Sacramento counties, as well as composting in Merced and Solano/Alameda counties.

2.1.10 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

Synagro would be interested in a program in which landfill ADC is a component of an overall management strategy that would envision 10-20% of annual volume going to landfill ADC providing there is no change in regulations that would restrict its use as ADC or make it otherwise commercially infeasible. Initial limitations will be 50,000 wet ton per year and can be increased with Solano/Alameda commissioning.

2.1.11 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☒ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton
- ☐ Other (please indicate amount) _____ per wet ton

Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

Yes, transportation is typically provided as part of an all-in pricing arrangement. The basis of pricing is the cost of providing the service at the end use site plus a per ton transportation component. Transportation is normally determined by the distance from the generator to the end-use site.

2 BENEFICIAL RE-USE DESCRIPTIONS – COMPOSTING

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

- ☐ Land Application
- ☐ Alternative Daily Landfill Cover
- ☒ Composting of Biosolids and Marketing of Product
- ☐ Soil Amendment and Marketing of Product
- ☐ Fuel
- ☐ Other (describe)

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

Synagro could provide both options as noted below.

☒ No. Name of existing facility: Central Valley Compost Facility, Merced County, CA

Location of existing facility: Dos Palos, CA

☒ Yes. Name/description of planned facility: Solano/Alameda Compost Facility

Anticipated operational date: 2017

Capacity (wet TPD): 200,000 wet TPY

How development will be funded: Internally by Synagro

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Synagro owns and operates several biosolids composting facilities that receive input materials from more than one generator or wastewater treatment plant – Central Valley Composting ("CVC"), Arizona Soils Compost Facility and our newest facility, the Charlotte County Bio-Recycling Compost Facility in Florida. These facilities utilize windrow composting. Synagro's largest compost facility, the South Kern Compost Manufacturing Facility utilizes aerated static pile technology. Synagro markets the compost produced at these facilities in a number of markets and typically markets on the order of 500,000 cubic yards of compost annually. A complete list of Synagro's composting experience is attached in Appendix 2.

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: 20,000
2018: 60,000

2023: 60,000
2028: 60,000

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

Synagro's Central Valley Compost Facility accepts 355 tons per day with a total limit of 100,000 tons of combined feedstocks.

2.6 What is your available on-site storage, both prior to and post-processing:

All biosolids received at the Central Valley Compost Facility are incorporated into windrows within 24-hours of receipt. The total site capacity is 149,100 cubic yards per year with an annual loading capacity of 100,000 tons per year. The length of time compostable materials can be stored at the facility is 180 to 210 days.

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

- What class of biosolids do you accept? Merced: Class A, B (drying and composting, and land application?

Future:

☐ Only Class A

☐ Only Class B

☒ Both Class A and Class B (not commingled)

- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?
  No

- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

  Not applicable.

2.7.2 Percent Solids

- Minimum percent solids of the biosolids you will accept?
  15 percent
- Preferred percent solids of the biosolids you will accept?
  20 to 25 percent

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?
  Not applicable for composting

- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

  Not applicable.

- Other characteristics required for delivered fuel product?

  Not applicable.

2.7.4 Other (describe)

Not applicable.

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: Class A EQ Compost

Marketing / Reuse Approach: Synagro currently produces 48,000 tons per year of Class A EQ compost at our Central Valley Compost Facility. The compost produced at the Central Valley Compost Facility and the South Kern Compost Manufacturing facility is marketed under the AllGro™ brand and both facilities are sold out each year to agricultural customers, landscapers and supply yards. Synagro provides delivery of the final compost to customers under agreements or through spot sales.

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: Class A EQ Compost

Approach: Synagro has experience developing new markets in untapped areas. It's most recent market development occurred in 2014 with the opening of our new Florida compost facility. Synagro has developed two new markets where compost was not known nor utilized, as well as penetrated existing fertilizer markets. Synagro has a sophisticated Sales and Operations process which allows it to balance supply and demand.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: Central Valley Compost Facility (CVC)

2.10.1 Surface Water (describe): Non-discharge facility permitted under the RWQCB. On-site lined retention pond

2.10.2 Odor (describe): Odor control is managed through prompt mixing and windrow formation, followed by tightly controlled aeration process which promotes as rapid as possible organic matter decomposition. An oxygen meter is used to monitor windrow oxygen content on a daily basis which assists in maintaining aerobic conditions in the windrows. Additionally, Synagro/CVC implements mitigation measures under the facility's Odor Impact Minimization Plan.

2.10.3 Noise (describe): The CVC facility is located in a rural area adjacent to agricultural land. The facility has not received any complaints of noise or odor as the closes neighbor is a local farmer who's residence is located approximately 1 mile away from the facility.

2.10.4 How close is the nearest residence to this site? A single residence is approximately 1 mile away.

2.10.5 How close is the nearest business to this site? Describe the nature of the business? Menifee River Ranch is the closest business which is located immediately next door to the facility. Menifee River Ranch is a feedlot and farming operation.

2.11 Are there any required permits or permit limitations at the site?

The facility is permitted through Merced County with a Conditional Use Permit, CalRecycle with a Solid Waste Facility Permit, RWQCB with a Waste Discharge Requirements (WDR), and through the San Joaquin Valley Air Pollution Control Department with an Air Permit. The limitations of the permits are a maximum number of truck trips per day (25), maximum number of tons per day (355) and maximum number of tons per years (100,000).

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

Synagro would be interested in developing a full service program for San Jose through our offering of a full complement of beneficial reuse options such as land application in Solano, Merced, Sonoma, and Sacramento counties, as well as composting in Merced and Solano/Alameda counties and potentially drying/pelletizing at or adjacent to the City's wastewater treatment plant. Additionally, landfill ADC would be a component of an overall management strategy that would envision 10-20% of annual volume going to landfill ADC, providing there is no change in regulations that would restrict its use as ADC or make it otherwise commercially infeasible. Further, Synagro is committed to delivering a diverse portfolio of reuse options, including those associated with new or developing technologies.

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☒ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton

☐ Other (please indicate amount) _____per wet ton

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

Yes, transportation is typically provided as part of an all-in pricing arrangement. The basis of pricing is the cost of providing the service at the end use site plus a per ton transportation component. Transportation is normally determined by the distance from the generator to the end-use site.

2 BENEFICIAL RE-USE DESCRIPTIONS – DRYING/PELLETIZATION

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

☐ Land Application
☐ Alternative Daily Landfill Cover
☐ Composting of Biosolids and Marketing of Product
☐ Soil Amendment and Marketing of Product
☐ Fuel
☒ Other (describe) Biosolids Drying & Pelletization and Marketing of Product (as a fertilizer and/or as a fuel)

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility _____
Location of existing facility _____

☒ Yes. Name/description of planned facility: We would propose an on-site drying facility at or adjacent to the City's WWTP
Anticipated operational date: 2 – 3 years from Notice to Proceed
Capacity (wet TPD): Per agreed upon design (up to full capacity needed by San Jose)
How development will be funded: Synagro

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Synagro has over 70 years of cumulative operating experience using six different drying technologies. We are the most experienced heat drying & pelletizing company in the U.S. In addition, we market more heat dried product than any firm in the Nation. A reference list of our current facilities is attached in Appendix 3.

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Not applicable as this facility would be developed specifically for San Jose. (Note: our closest dryer operation is in Sacramento.)

Current: _____
2018: _____
2023: _____
2028: _____

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

No.

2.6 What is your available on-site storage, both prior to and post-processing:

We recommend designing 8 – 24 hours of pre-processing storage into the facility and 7 – 14 days of product storage.

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

What class of biosolids do you accept?

We would prefer to accept digested biosolids, but can accept undigested primary and secondary solids if necessary.

Future:

- ☐ Only Class A
- ☐ Only Class B
- ☒ Both Class A and Class B (not commingled)

We can also accept sub-Class B material.

If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?

No

If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

No, not for a drying/pelletization facility.

2.7.2 Percent Solids

Minimum percent solids of the biosolids you will accept?

15 percent is minimum (unless we are operating dewatering then we can accept liquid as low as 1 – 1.5 percent)

Preferred percent solids of the biosolids you will accept?

20 to 25 percent cake if available

Our highest preference would be to operate dewatering as well as drying/pelletizing.

2.7.3 Energy–Related Processes

Are biosolids processed (dried) to fuel at your location?

Synagro typically produces dried pellets that have a BTU value of 5000 – 7000 BTU.

If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

N/A

Other characteristics required for delivered fuel product?

In order to have value in the fuel market, the dried product needs to have a minimum BTU value of 5000. In addition, it is important to have a bulk density of 35 or above to flow well in a typical pneumatic transport system.

2.7.4 Other (describe)

_____

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: Dried pellets

Marketing / Reuse Approach: See attached Marketing Plan in Appendix 4.

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: Dried pellets

Approach: See attached Marketing Plan in Appendix 4.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: Onsite drying/pelletizing facility

2.10.1 Surface Water (describe): Typically, all operations are within a building. We have used cisterns within our design at our Philadelphia, PA drying facility to collect roof drainage and reused in the process, which can be done here.

2.10.2 Odor (describe): All material handling is in enclosed equipment, which is controlled via dust collection equipment and/or odor control systems.

2.10.3 Noise (describe): Designed to minimize noise impacts via good engineering practices to below any nuisance or operate discomfort conditions.

2.10.4 How close is the nearest residence to this site? TBD

2.10.5 How close is the nearest business to this site? Describe the nature of the business? TBD

2.11 Are there any required permits or permit limitations at the site?

Air Permit from BAAQMD; CEP from local county; JTD/RCSI from Waste Board & Water Board; CEQA Compliance; and other local permits/licenses required for design and construction.

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

Synagro understands the City's desire to maintain a diverse portfolio of biosolids reuse options. The greater the volume of biosolids the City can commit to a dryer/pelletization operation, the more cost-effective the operation will be. Based on our experience, the minimum volume to justify installation and operations of a new drying/pelletization facility is on the order of 20 dry tons per day. It should be noted that a dry product is necessary for many emerging biosolids technologies (e.g., gasification; pyrolysis) and therefore a diverse portfolio can still be guaranteed with drying as an intermediate process.

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☒ $50-$60 / wet ton*
- ☒ $60-$70 / wet ton*
- ☐ Other (please indicate amount) _____ per wet ton

* Drying projects can range from $50.00 - $75.00 per wet ton depending on site characteristics, biosolids quality, product end markets and utility costs.

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

Yes, transportation is typically provided as part of an all-in pricing arrangement. The basis of pricing is the cost of providing the service at the end use site plus a per ton transportation component. Transportation is normally determined by the distance from the generator to the end-use site.

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

- ☒ Service Contract (providing a direct end-use service or providing processing)
- ☒ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)
- ☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

Design/Build/Own/Operate or Design/Build/Operate – for any facilities

3.3 What length of contract term would you prefer? (Check one)

☐	5 years	☒	10-15 years
☐	5-10 years	☐	No preference

3.4 What is the minimum contract term you would prefer (in years)?

It depends on the technology and if there is capital funding. For projects where Synagro is funding the capital, we typically prefer 20 years. If no capital is required, five years is the minimum.

4 OTHER

4.1 The City is considering building a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

4.1.1 Your team's experience operating this type of facility (describe):

Synagro currently operates over 20 permanent dewatering facilities and up to 50 mobile dewatering units at any given time. We have over 35 years' experience operating these types of facilities. A reference list with a sampling of our dewatering projects is attached as Appendix 5.

4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?

Synagro would prefer an operating contract of 10 – 20 years; typically, a longer term operating contract will result in a lower base rate (e.g., lower service pricing).

4.1.3 Minimum term of operating contract that would accept?

The minimum term of operating contract that Synagro would accept is 5 years.

4.1.4 Please identify any concerns you would have with this type of operation?

We do not have any express concerns with this type of operation, however we do want to stress that balanced contract terms for operating these types of facilities are critical to a successful partnership. Based on Synagro's experience we recommend that the contract terms be performance based.

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

Yes, Synagro would be interested in operating these types of facilities. We do not have any express concerns with operating these types of facilities as we are well experienced in drying/thermal process operations. Once again, as described above, it is important to have balanced performance-based specifications in any type of operating contract.

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

Synagro is interested and has the experience and size necessary to implement a broker-type contract on behalf of the City. This would ensure an on-going and diverse portfolio of biosolids reuse options for the City over the long term – enabling program flexibility as new technologies evolve.

Appendix 1

Synagro Compliance Program

A Framework For Compliance:
Synagro's PACT Compliance Assurance Program
For Land Application

Biosolids/residuals management programs are subject to a myriad of different environmental, health, safety and transportation (EHS&T) regulatory requirements at the federal, state, and local levels. Regulatory requirements associated with biosolids/residuals management have increased and become more complex over time. A strong compliance program is essential to ensure that regulatory requirements are adhered to and to build and maintain public confidence and acceptance of these programs.

To achieve compliance with regulatory requirements, Synagro has implemented a compliance assurance program referred to as PACT. The PACT program has four key elements - Prevention, Assessment, Corrective Action, and Training. Each of these elements is described below along with the programs Synagro has established under each of the elements.

PREVENTION

The goal of a compliance assurance system is to prevent compliance issues from occurring. Prevention involves:

- Ensuring personnel know and understand their role in assuring compliance;
- Identifying compliance requirements at the federal, state and local levels;
- Implementing a system where compliance tasks are scheduled, assigned and tracked to completion;
- Developing standard operating procedures where appropriate; and
- Reviewing the compliance task list and standard operating procedures on an ongoing basis and modifying them as appropriate to account for changes in regulations/requirements and operating methods, and to address compliance deficiencies.

<u>Employee's Compliance Role</u>
Synagro ensures employees know and understand their role in assuring compliance through new employee orientation programs and on the job training.

<u>Compliance Requirements Tracking</u>
Synagro identifies and keeps current with compliance requirements at the federal, state and local levels through the use of:

- Membership and participation in trade associations such as the National Association of Clean Water Agencies (NACWA), the Water Environment Federation (WEF) and its member associations, and the National Biosolids Partnership
- Membership and participation in Regional Biosolids Associations such as the Mid-Atlantic Biosolids Association (MABA), New England Biosolids and Residuals Association (NEBRA) and the Northwest Biosolids Management Association (NBMA)

- Monitoring regulatory and legislative web sites
- Serving on state and local technical advisory committees
- Ongoing communication with state and local regulatory officials
- Weekly BLR Regulatory Updates

Standard Operating Procedures (SOPs)

Synagro develops and implements SOPs to ensure compliance tasks are completed consistently across the company. For example, after the 40 CFR Part 503 Regulation was published, Synagro developed an implementation SOP to ensure the notification requirements, management practices, site restrictions, and monitoring, record keeping and reporting requirements were met. The SOP provides standard forms to use, approved biosolids analytical methods, frequency of monitoring information, etc.

Another key SOP relative to preventing compliance issues from occurring is the use of a "Pre-Operating Checklist" and a "Buffer Zones & Spreader Operator Instruction Sheet". Synagro develops these documents for each State where land application operations are conducted.

The Pre-Operating Checklist ensures federal, state and local regulations and permit requirements are met prior to initiating biosolids applications at field sites. Compliance items on the Pre-Operating Checklist include:

- The field is permitted and suitable for the biosolids/residuals type being applied;
- Pre-application requirements are met;
- Farmer and landowner agreements are current and the crop to be grown has been verified;
- The field is flagged to prevent applications in buffer zones and restricted areas;
- The appropriate application rate and field capacity is calculated; and
- Any special permit or local requirements are met.

The Buffer Zones & Spreader Operator Instruction Sheet provides the field operations staff:

- A listing of the buffer zones and restricted areas where biosolids/residuals cannot be applied
- A listing of operating requirements including notification requirements, application method requirements, and inclement weather operating requirements

A third key SOP is Synagro's Land Application Lab Results Review and NANI Receipt and Review Procedures. This SOP provides instructions on how to review biosolids lab results and Notice and Necessary Information (NANI) Forms from biosolids generators to ensure the biosolids are suitable for land application.

As regulations and permits conditions change the SOPs are updated as appropriate to ensure compliance with the new requirements. For example, the lab review forms, Pre-Operating Checklists and Buffer Zones & Operator Instruction Sheets are updated as appropriate to capture the most current requirements.

ASSESSMENT

To help ensure compliance requirements are being met and the compliance assurance system is implemented and working, periodic, consistent, objective and documented assessments of a project/facility's compliance status need to be conducted. Personnel must have clearly-defined compliance assessment responsibilities and time to conduct such assessments.

Synagro conducts informal site inspections and formal audits on an ongoing basis. Facility and land application audits are conducted by personnel from the corporate Environmental, Health, Safety and Transportation staff.

Internal and outside vendor audit checklists are used which cover federal requirements, state requirements and Company requirements. State, local and client requirements are researched prior to the audit and a list of the requirements is recorded prior to the audit or the audit is conducted directly from highlighted sections of the regulations, permits and contract documents.

Informal inspections and assessments are also done periodically by Synagro's EHS&T and Technical Services staff as they visit land application operations to provide compliance assistance and training.

CORRECTIVE ACTION

Once compliance issues have been identified during the course of day to day business and through internal and external audits and inspections a system must be in place which ensures that appropriate and timely corrective action is taken, the cause of the compliance issue is identified and actions are taken to prevent recurrence of the issue.

Synagro's goal is to have no instances of non-compliance. However, issues and incidents occur and when this happens employees work to correct the incident in a timely and thorough manner. When compliance issues are identified, the situation is examined to determine the root cause of the problem and the corrective and preventive action that must be taken. The preventive action must address the root cause with the ultimate goal of preventing the incident from occurring again.

Depending on the nature of the compliance issue, it is assigned to one or more responsible parties to ensure the corrective and preventive actions are completed/implemented. A deadline for completion of the task is assigned and the issue is tracked to completion by regional and corporate compliance personnel.

TRAINING

An effective compliance training program involves:

- Identifying training needs and requirements;
- Assigning personnel to provide training and providing them the resources they need

to conduct training;
- Documenting and tracking that mandatory training has occurred; and
- Assessing the effectiveness of the training that is provided.

An employee's training needs and requirements as well as their training responsibilities are based on his/her position within the company.

Each new employee receives Synagro's New Employee Safety Orientation during their first week of employment. Synagro partners with an outside vendor to provide on-line safety training. Mandatory courses are assigned out quarterly based on an employee's job responsibilities. The employee is required to complete their courses by the end of the quarter in which it was assigned. A course consists of training lessons and there are quizzes at the end of each lesson to assess the employee's comprehension of the lesson. The employee must pass all the lesson quizzes to successfully complete a course.

The on-line safety training is supplemented by on-site safety meetings which occur at least monthly and include a monthly safety topic and a review of safety alerts and near misses as applicable.

Most states do not have mandatory training requirements relative to biosolids/residuals land application operations. However, there appears to be an increasing trend to establish such programs.

Synagro's Technical Services Staff receive comprehensive training relative to biosolids and residuals regulatory requirements and they in turn provide training to the field operations staff. For example, Synagro's Technical Services Specialists are responsible for completing and reviewing the Pre-Operating Checklists (which include land application requirements) with the project/field manager or equipment operator prior to beginning field operations.

Ongoing training and updates on new requirements are also provided for all Technical Services staff through regularly scheduled training sessions at the corporate and regional offices or through web-ex sessions. For example, Synagro held several training sessions for Technical Services and Operations personnel after the 40 CFR Part 503 Rule was published and developed a 40 CFR Part 503 Compliance Manual and Standard Operating Procedure which are available to all employees.

Synagro employees also receive training through State biosolids and nutrient management planning training and certification programs. Several employees have served as instructors for such programs.

CONCLUSION

Maintaining compliance with all the federal, state, local and client requirements associated with biosolids/residuals management programs is a challenging and never ending task. PACT is a way of dividing this major task into manageable components. Achieving and maintaining compliance with regulations is an important element in gaining public confidence and acceptance of beneficial use programs.

Appendix 2

Synagro Composting Experience

State/Project	Processing Capacity	Type of Facility	Years of Service
Arizona			
Arizona Soils Composting Facility Highway 60 & McVay Road Vicksburg, AZ 85348	500 wet tons/day of biosolids and 1,000 tons/day of green waste and or wood waste	Open Windrow Biosolids Composting	1992 - present
California			
Synagro Regional Composting Facility 10490 Dawson Canyon Corona, CA 91719	500 tons/day of biosolids combined with green waste, wood waste and/or straw/stable bedding	Open Windrow Biosolids Composting	1989 - 2008
Inland Empire Utilities Agency Co-Composting Facility 2450 E. Philadelphia Avenue Ontario, CA 91761	150 wet tons/day of biosolids and up to 1,100 wet tons/day of manure	Open Windrow Biosolids & Cow Manure Composting	2001 - 2004
South Kern Compost Manufacturing Facility 2653 Santiago Road Taft, CA 93268	400,000 tons/year of biosolids with 270,000 tons/year of wood waste	Aerated Static Pile	2006 - present
Central Valley Composting 13757 S. Harmon Road Los Banos, CA 93635	360 tons/day of biosolids combined with green waste	Open Windrow Biosolids Composting	2006 - present
Florida			
Charlotte County Bio-Recycling Center 29751 Zemel Road Punta Gorda, FL 33955	50,000 Wets Tons of biosolids annually, 100,000 yards of Class AA compost	Open Windrow Biosolids Composting	2014 - present
New Jersey			
Burlington County Co-Composting Facility 800 Co-Co Lane Columbus, NJ 08022	225 tons/day of biosolids combined with green waste, wood waste and/or food waste	In-Vessel Biosolids Composting w/enclosed receiving/mixing, active composting and curing	1998 - 2008
New York			
Rockland County Co-Composting Facility 400 Thorne Valley Road Hilburn, NY 10931	108.1 tons/day of biosolids combined with green waste and/or wood waste	In-Vessel Biosolids Composting w/enclosed receiving/mixing, active composting and curing	1999 - 2004

Appendix 3

Synagro Drying/Pelletization Experience

Synagro Technologies, Inc. and Subsidiaries
Heat Drying and Pelletization Projects

Location	Quantity and Type of Material Processed	Process Used	Facility Start Date	Client Contact
Baltimore, MD Patapsco WWTP	20,000 dry tons/year Municipal Biosolids	Swiss Combi direct drying with indirect heating of drying air	1994	Mr. Gary Wagner Plant Manager City of Baltimore 3501 Asiatic Avenue Baltimore, MD 21226 (410) 396-2800 Gary.wagner@baltimorecity.gov
Baltimore, MD Back River WWTP	20,000 dry tons/year Municipal Biosolids	Synagro-Seghers Pelletech™ indirect drying system	1997	Mr. Nick Frankos Plant Manager City of Baltimore 8201 Eastern Blvd. Baltimore, MD 21224 (410) 396-9814 Nick.frankos@baltimorecity.gov
Hagerstown, MD	10,950,000 gallons/year Municipal Biosolids	ESP process	1990	Mr. Mike Spiker City of Hagerstown Water Pollution Control 1 Clean Water Circle Hagerstown, MD 21740 (301) 791-0435 mspiker@hagerstownmd.org
New York, NY (NYOFCO)	186,150 wet tons/year Municipal Biosolids	ESP process with afterburners	1993	Mr. Mike Quinn New York Department of Environmental Protection Bureau of Clean Water 9605 Horace Harding Expy. Corona, NY 11368 (718) 595-5043
Pinellas County, FL	8,000 dry tons/year, Municipal Biosolids	Andritz Drum Drying System	2003	Mr. Jim Dulaney WWTP Manager Pinellas County Utilities 1620 Ridge Road, Building A Largo, FL 33778 (727) 582-7015 jdulaney@pinellascounty.org
Sacramento Regional County Water Reclamation District, CA	20 dry tons/day, Municipal Biosolids	Andritz Drum Drying System	2004	Mr. Ruben Robles SRCWRD 10545 Armstrong Ave., #101 Mather, CA 95655 (916) 876-6119 roblesr@sacsewer.com

Synagro Technologies, Inc. and Subsidiaries
Heat Drying and Pelletization Projects

Location	Quantity and Type of Material Processed	Process Used	Facility Start Date	Client Contact
City and County of Honolulu, HI	8,200 dry tons/year, Municipal Biosolids	Andritz Drum Drying System	2006	Mr. Ross Tanimoto City and County of Honolulu 1350 Sand Island Parkway Honolulu, HI 96819 (808) 768-3482 rtanimoto@honolulu.gov
City of Stamford, CT	Up to 6,000 dry tons/year, Municipal Biosolids	Andritz Drum Drying System	2008	Mr. William Brink Executive Director Stamford Water Pollution Control Authority 111 Harbor View Avenue Stamford, CT 06902 (203) 977-5809
Philadelphia Water Department	65,000 dry tons/year municipal biosolids	Andritz Drum Drying System	2011	Ms. Debra McCarty Deputy Water Commissioner Philadelphia Water Department 1101 Market Street Aramark Tower, 25th Floor Philadelphia, PA 19107 (215) 685-6102 Debra.McCarty@phila.gov
CCMUA Camden, NJ	16,000 dry tons/year	Komline Sanderson Drying System	2011	Mr. Andy Kricun Executive Director 1645 Ferry Avenue Camden, NJ 08104 (856) 541-3700, ext. 1223 andy@ccmua.org

Updated 10/2013

Appendix 4

Synagro Pellet Marketing Approach

The Synagro Product Marketing Advantage

Synagro is unique in its product marketing approach in that we have a full-time product marketing staff dedicated to managing product sales. Individuals on this team are specifically trained and are uniquely qualified in their experience selling biosolids products. As such, they are familiar with the unique features which biosolids products offer and can successfully identify and develop the most appropriate markets specific for each product to best match needs in market place. Synagro Product Marketing has achieved a successful track record of over 20 years of specialized experience in marketing of processed biosolids products. No outside marketer, broker or subcontractor can match this level of diversity and experience.

Unequalled Experience

Synagro has a proven track record of developing markets for heat dried products from a variety of facilities. Since our first heat drying and pelletization facility for the City of Hagerstown, MD went on line in 1990, Synagro has been in the business of marketing dried biosolids products. We understand that biosolids-derived products, especially heat dried products, are not "commodity" market driven. On the contrary, heat dried products are distinctly different from one facility to the next.

By employing the unique and comprehensive experience of Synagro's Product Marketing Team, our customers can be confident that reliable and sustainable outlets for long-term beneficial use and marketing of their biosolids products will be created.

Synagro Product Marketing has achieved a long history of success in creating marketing programs for many municipalities. As our business has grown, Product Marketing has expanded from being a product marketing arm for our initial facility to a full service Division providing tailor-made heat dried and compost product marketing services to many biosolids management facilities across the country. These facilities include; Biosolids Pelletizing Plants in Philadelphia, PA; Camden Co, NJ; Baltimore, MD; Hagerstown, MD; UOSA, Sacramento, CA; Honolulu, HI; Pinellas County, FL; Stamford, CT and support to Ocean County, NJ. In addition Synagro manages multiple compost marketing projects. Synagro's extensive experience in all aspects of product marketing uniquely qualifies us to develop the most effective marketing program possible for product produced. Synagro maintains product marketing offices and staff from coast to coast and has one of the most extensive network of biosolids marketing professionals within the industry.

The heat dried products currently marketed by Synagro are produced by a variety of different wastewater treatment facilities and processed by a number of different drying technologies. The biosolids feeds to these drying facilities range from extremely well anaerobically digested to completely undigested biosolids. The heat dried products are also produced and marketed from several different geographic locations. The diversity of heat dried product types and points of production have given Synagro a very thorough understanding of the market for biosolids

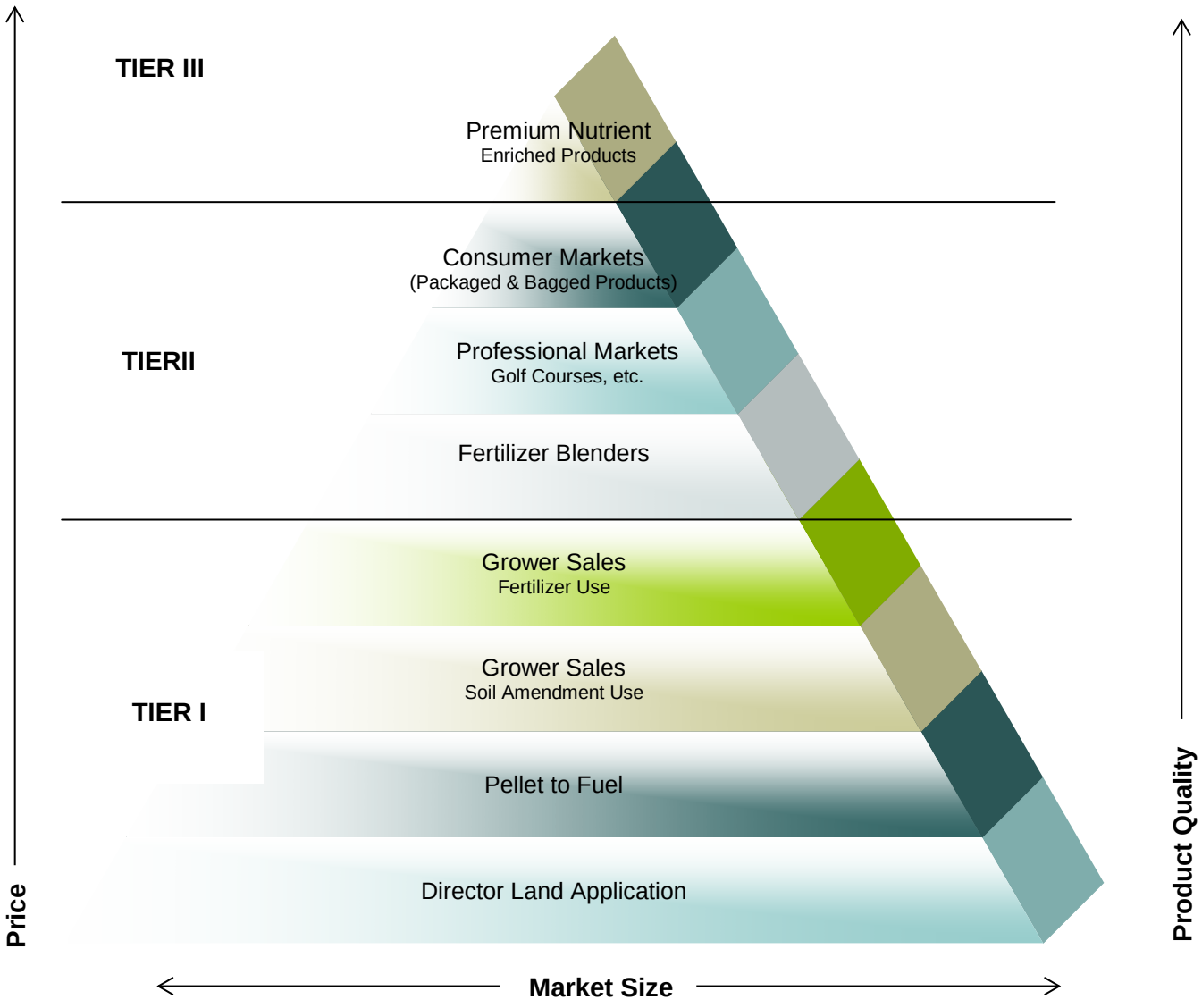
based fertilizer products in the United States. This experience has also fostered the development of highly diverse sales outlets for products that take into account seasonal fluctuations in demand, state-by-state variations in the rules and regulations concerning biosolids product marketing/distribution, and the wide-ranging needs and concerns of the end users of the products. This wide ranging marketing activity – moving a variety of pelletized biosolids products to a diverse group of end-users - is the core of Synagro's product marketing services program.

Product & Market Evaluation

Synagro believes in implementing a multi-level approach to market development for distribution of all heat dried, pelletized products which it markets. Establishing multiple distribution channels will ensure that product will be consistently moved to end markets in spite of potential obstacles, such as; seasonality of crops, renewable energy plant shut downs, transportation problems/weather, varying marketing and distribution regulations, and competition from alternative products. The first step in doing this is to conduct a Product and Market evaluation.

In considering which beneficial use outlets or alternative markets may be developed product quality will be a key consideration. Upon reaching a determination of the physical and chemical quality characteristics of products produced the most suitable outlets for development will be targeted. In general the pellet pyramid below illustrates the type of markets that will be targeted specific to the quality features offered. The base of the graph or pyramid illustrates outlets for low quality product with each higher tier representing a step up to the highest value markets for top quality product at the upper tip of the pyramid.

Pyramid of Potential Pellet Markets



Regardless of the ultimate quality of product produced, Synagro is strongly positioned to provide the complete package of necessary services in establishing reliable and consistent outlets for disposal, beneficial use and sales of all product produced.

Role of Product Quality

In order for heat dried - pelletized products to be marketed successfully into the highest value markets, product quality is of key importance. In referencing the pyramid of potential markets above successfully achieving market development of higher value markets goes hand in hand with producing higher quality product. As is the case with all products, consumers are constantly

seeking the highest value options for dollars spent. While consumer needs for product quality do vary from market to market a few typical examples of features important in defining high quality pelletized biosolids are as follows:

- High Bulk Density
- Uniform Particle Sizing Meeting SGN Standards of Market
- Low Moisture
- Dust Free
- High Nutrient Analysis – Nitrogen
- Low Odor
- Contaminant Free
- Meet all Exceptional Quality criteria as defined by the USEPA 40 CFR Part 503 Regulations.
- Meets State Requirements for Distribution

As part of our typical service package to our drying/pelletizing customers, Synagro Product Marketing will complete a product quality assessment. Upon completion of the assessment Synagro will work in developing the highest value market outlets possible for use of the product. In the event that product does not meet the quality standards necessary for marketing into higher end markets, Synagro will fully develop alternate outlets for product shipment. Heat dried pellet-to-fuel, land application and soil blending are all examples of alternative outlets which could be targeted for development.

Ideally, while the desire is always to ship all production to high value markets from day one practical experience suggests that a combination of many outlets will be necessary in achieving a successful program. As an organization Synagro has much experience in identifying, evaluating and developing all outlets as may be applicable to pelletized biosolids. Synagro's marketing plan will include much focus on developing as many outlets and markets as may be necessary in achieving reliable, steady shipment of material from the plant. A few examples specific outlets which Synagro will work to first create include:

- Renewable Fuel
- Agricultural Land Application
- Direct Sales to Growers
- Soil Blending and Reclamation
- Blended Fertilizer Market

Maximizing shipments to the above outlets will help ensure that back-up landfilling of product is minimized. Landfilling will be provided as a backstop to these markets. In addition, it may be necessary to landfill some heat dried product initially while regulatory approvals for distribution are secured. A description of these markets follows:

Renewable Fuel

Synagro has a long history of successfully providing dried biosolids to the renewable fuels industry. While the dried biosolids markets have traditionally focused on the fertilizer industry, during the past several years Synagro has been on the cutting edge of expanding into renewable fuels markets such as the cement manufacturing industry. Dried biosolids has a significantly high heating value and ash components such as silica, calcium, and iron that are integral to cement, making it an ideal renewable fuel for the cement making process.

Cement is not the only end market for the material when used as a fuel. The power industry, institutional, and other solid-fuel markets are all viable users of dried biosolids.

Agricultural Land Application
One of the most commonly used outlets for beneficial use of biosolids is land application. Dried biosolids which are land applied generally require that Synagro permit, transport and spread the material. Land application represents a large potential outlet which Synagro is strongly positioned to serve. Synagro's existing land application programs have provided us with a thorough understanding of and immediate access to this market. The agricultural consumer is currently the largest user of dried biosolids products.

Direct Sales to Growers
Synagro is clearly the industry leader in sales and marketing of pelletized biosolids products sold to the Agricultural Industry. Synagro maintains an extensive list of contacts within the agricultural industry and has existing relationships with many key growers and distributors throughout the United States. Synagro will build upon these relationships in working to insure that the needs of our customers' product marketing and inventory management programs are met.

Soil Blending & Reclamation
Increasingly, heat dried pelletized biosolids are gaining attention for use as a supplement in enhancing soil blends. Pelletized biosolids incorporated into manufactured soils provide supplemental organic matter and slow-release nutrients. As part of the marketing plan Synagro will identify local soil blenders, explore and fully develop opportunities as may be identified to compliment the marketing plan.

Blended Fertilizer Market
Fertilizer blenders are companies that purchase raw fertilizer materials in bulk and custom blend the materials to provide a mix of necessary plant nutrients for growing crops. These prescription mixes typically contain as much as 10% - 30% by weight dried biosolids. Fertilizer blending firms have long recognized the value of pelletized biosolids to provide a source of primary, secondary and micronutrients. Synagro will conduct a thorough analysis of all 14 nutrients essential to plant growth contained in our customer's pellets and create a technical product specification sheet for use in summarizing and communicating same to prospective product customers.

Synagro's Product Marketing Plan – Outlets Targeted

Synagro's product marketing plan typically includes a comprehensive approach with multiple options for end use and/or disposal. Our proposal is based on the best available information gathered regarding characteristics of our customers' sludge. Our experience with drying blends of raw primary and secondary biosolids shows us that undigested solids tend to produce dried pellets with lower than average bulk density. Also, higher than average associated fiber content can reduce the structural integrity of pelletized material allowing the product to more easily fracture during handling and transportation. Results of this may lead to increased dust, fines and reduced uniformity of particle sizing. In addition, undigested biosolids tend to be odorous often making them not conducive for use in the fertilizer blender or specialty markets.

Typically, Synagro will supplement direct dales to growers and renewable fuel use by using land application and soil blending/reclamation as back-up options. As a failsafe to these options, Synagro will establish landfill disposal to be utilized during times at which shipment to higher value markets are not achievable. This will include the initial time window during which necessary approvals are secured for distribution and use. Such approvals include:

- Filing for and receiving necessary distribution and marketing or D&M permits for each state to which product is desired to be shipped.
- Sampling and testing of finished product as required in order to certify compliance with Federal "EQ" as well as state standards for Class A requirements.
- Registering the product with state agricultural departments as necessary in order that tonnages shipped can be tracked. This is necessary so that appropriate payment can be calculated of fertilizer tonnage tax.
- Establishing necessary permits and approvals by burners for use of pellets as a fuel in their plants.
- Obtaining permits as necessary for land application of material.

Closing Summary

Synagro is the nationwide leader in the marketing, sale and beneficial use of pelletized biosolids products. Synagro maintains excellent working relationships with hundreds of customers across the country in management of biosolids products. Few other companies compare to Synagro in terms of overall service to the biosolids industry.

Appendix 5

Synagro Dewatering Experience

Synagro Dewatering Installation Projects

Examples of dewatering facilities designed, built and/or operated by Synagro are provided below.

City of Rock Hill, SC

- Start-up in 1997
- Dewatering, lime-stabilization and land application
- 14,000 WT annually
- Dewater using 2 City-owned BFP's
- Synagro replaced 1 BFP in 2003 w/contract extension
- Storage pad management and land application
- Design, build, own, operate contract

Contact: Mr. David Hancock
Superintendent
(803) 329-8706

Knoxville Utilities Board, TN

- Awarded 10-year contract for land application in 1991
- Contract awarded in 2002 for expanded scope
- Synagro replaced plate & frames with 2 centrifuges
- Start-up in January 2006
- 10,000 DT annually
- Storage and land application of dewatered cake
- Design, build, operate contract

Contact: Mr. Wayne Loveday
Director – Plants & Collection
(865) 594-7602

Before

After

Anne Arundel County, MD

- Start-up in 1984
- 12,000 DT annually at 6 WWTP's
- Synagro DBO at 3 of the WWTP's
- Synagro operations at all 6 of the WWTP's
- Dewater using 8 BFP's
- Stabilization, storage and land application
- Design, build, own, operate contract

Contact: Mr. Michael Bonk
(410) 224-1332

City of Grand Rapids, MI

- Start-up in 1998
- 16,500 DT annually
- Dewatered using 3 BFP's
- Synagro installed 2 centrifuges and related equipment in 2001
- Landfilling
- Design, build, own, operate contract

Contact: Mr. Randall Fisher
(616) 456-3625

City of Dayton & Montgomery County, OH

- Start-up in 1986
- 15,000 DT annually
- Dewatered using 7 BFPs installed by Synagro – 4 at Dayton; 3 at County WWTP's
- Synagro installed 2 centrifuges at Dayton in 2001 with contract extension
- Storage pad management and land application
- Design, build, own, operate contract

Contact: Mr. Thomas Schommer
(937) 333-1501

City of Waverly, OH

- Start-up in 2000
- Conversion of liquid land application program to dewatering and stabilization
- Facilities provided by Synagro include belt press, alkaline stabilization, building & ancillaries
- Storage pad management and land application
- Design, build, own contract

Contact: Mr. John Vorhees
Superintendent
(740) 947-4403

City of Wilmington, NC

- Synagro operates City-installed dewatering equipment
- Start-up in 1996
- 3,500 DT annually from 2 WWTP's and 1 WTP
- Synagro dewaters using 4 BFP's and 3 GBT's
- Storage pad management and land application
- Operations contract

Contact: Mr. Ken Vogt, Superintendent
(919) 341-7891

Sacramento Regional County Sanitation District, CA

- Start-up in 1995
- Dewatering and land application
- 37,000 DT annually
- Dewater using 5 BFPs – facility construction by Synagro
- Signed dryer/pelletizer contract in 2002
- Dryer operational in December, 2004
- Design, build, own, operate contract

Contact: Mr. Ruben Robles
916-876-6119

City of Coshocton, OH

- Start-up in 1999
- Dewatering and land application
- 250 DT annually
- Dewatering using 1 belt filter press
- Design, build, own, operate contract

Contact: Mr. Dave McVay
Superintendent
(740) 622-1864

City of Lancaster, OH

- Start-up in 1989
- Dewatering and land application
- 1,500 DT annually
- Dewater using 1 belt filter press
- Design, build, own, operate contract

Contact: Mr. Mike Nixon
Superintendent
(740) 687-6664

City of Pickerington, OH

- Start-up in 1997
- Dewatering and land application
- 250 DT annually
- Dewater using 1 belt filter press
- Design, build, own, operate contract

Contact: Mr. Ed Drobina
Director of Utilities
(614) 833-2292

City of Troy, OH

- Start-up in 1995
- Dewatering and landfilling
- 750 DT annually
- Dewater using 1 belt filter press
- Design, build, own, operate contract

Contact: Mr. Mark Livengood
Utilities Director
(937) 339-1410

Terra Renewal West, LLC (dba Denali Water Solutions)

Request for Information (RFI 13-14-01)

Biosolids Transition Program

June 27, 2014

1 BACKGROUND

1.1 OVERVIEW

Over the next several years, the San José-Santa Clara Regional Wastewater Facility will be transitioning to a new biosolids program and is seeking input from potential beneficial re-use service providers.

The San José-Santa Clara Regional Wastewater Facility (Facility) currently manages its post-digestion biosolids through extended-stabilization lagoons and open-air drying beds prior to shipping 100% of the stabilized biosolids product to the nearby Newby Island Landfill for use as alternative daily cover.

The Facility treats 110 MGD from six tributary agencies. The current biosolids process includes Mesophilic Digestion, after which the sludge is stabilized in the lagoons for approximately three years and dried in the beds for an additional six months. The City of San José (City) has decided to implement advanced digestion at the Facility; depending on the extent of other biosolids improvements implemented at the Facility, approximately 130,000 wet TPY of dewatered biosolids (25% solids) will be generated requiring off-site disposition and possibly off-site processing.

1.2 BIOSOLIDS PROGRAM OBJECTIVES

1.2.1 Provide a reliable, diversified and flexible biosolids program that can adapt to future regulatory and market changes;

1.2.2 Provide a cost effective program;

1.2.3 Reduce environmental and community impacts;

1.2.4 Maximize beneficial re-use of biosolids; and

1.2.5 Explore emerging technologies which have been successfully tested at full scale.

1.3 KEY BIOSOLIDS TRANSITION ACTIVITIES

1.3.1 The City is currently upgrading the existing Mesophilic Digestion Process to Temperature Phased Anaerobic Digestion Process;

1.3.2 Decommissioning the existing lagoons and drying beds;

1.3.3 Developing new infrastructure (with the exception of composting facilities which the City will <u>not</u> be building on-site) at the existing wastewater treatment plant site for treating biosolids and potentially contract for their operation; and

1.3.4 Contracting for transportation, additional off-site processing where applicable, and beneficial re-use of the treated biosolids.

1.3.5 The City intends to begin operating the new biosolids infrastructure by the end of 2018. Transportation of biosolids to beneficial re-use sites (including possibly intermediate processing sites) is also planned to start at the same time.

1.3.6 As part of the City's intent to provide a reliable, flexible program, the City plans to arrange for several end uses for its biosolids. This would be through a "broker-type" contract that includes a variety of end uses, or through contracts with several end-use service providers. These end-use contracts may involve intermediate processing (i.e. composting). The City may enter into service contracts for a variety of disposition options and products, including but not limited to:

- Land Application
- Compost
- Alternative Daily Landfill Cover
- Dried Pellets

2 DOCUMENT PURPOSE

2.1 Obtain information on the range of private sector firms interested in utilizing anaerobically digested biosolids cake for a variety of purposes and / or interested in providing processing/ beneficial re-use services for the City's biosolids;

2.2 Obtain information on the range of potential biosolids processing technologies that exist in the marketplace;

2.3 Obtain information on the potential types of contract structures that would be of interest to potential service providers;

2.4 Obtain information that might affect our decisions regarding the type and size of biosolids treatment processes to develop at our wastewater treatment plant;

2.5 Determine if processing and re-use service providers also have the capability and interest in operating biosolids treatment processes at the City's Facility location; and

2.6 Obtain information regarding the feasibility of outsourcing the final disposition of biosolids produced at the Facility.

3 TIMELINE

RFI Released	June 27, 2014
Deadline for Questions (please post all questions directly on the BidSync System at any time prior to the deadline)	July 10, 2014
Deadline to Respond per Sections 6 and 7	July 17, 2014, Close of Business

4 CONTACT/QUESTIONS

Please direct all inquiries and post all questions to the Bidsync system on or before July 7, 2014. The City shall respond to questions on Bidsync. City responses to all such questions shall be considered formal addenda to this RFI.

5 RESPONSE

5.1 Respondents should complete the attached Exhibit 1 and attach additional supplemental information as appropriate.

5.2 Responses will be retained by City, subject to City records retention policies. Any data submitted to City hereunder may be utilized by the City. All submittals received from Respondents will become the property of the City and will not be returned. By making submittals in response to this RFI, respondents expressly acknowledge and agree that the City will not be responsible or liable in any way for any losses that Respondent may suffer from disclosure of information or materials to third parties.

5.3 All information must be legible. The contents of the response submitted may be relied upon to create requirements for related projects, either procured or otherwise accomplished by City.

6 HOW TO SUBMIT YOUR RESPONSE

Please submit the reference information requested above by uploading your response and posting to the "RFI response line item" on the BidSync System. **Wherever possible, please consolidate your response into one file in order to facilitate distribution and review by the City.**

7 NEXT STEPS

7.1 The City is soliciting feedback from companies with recent, successful experience and present capability to provide outsourced biosolids beneficial use and resource recovery. The information received in response to this RFI will be used by the City to decide how to maximize market opportunities available. By participating in this RFI process, the Respondent expressly agrees that no contract of any kind is formed under, or arises from this RFI and that no legal obligations will arise. The City will have no obligation to enter into negotiations or a Contract with Respondent, even though one or all of the Respondents are determined to be responsive. In the future, the City may engage in formal procurement(s) including Requests for Qualification and Requests for Proposals.

7.2 The City reserves the right to contact any respondents to seek clarification or request follow-up information on their response.

8 PUBLIC NATURE OF PROPOSAL MATERIAL

All correspondence with the City including responses to this RFI will become the exclusive property of the City and will become public records under the California Public Records Act (Cal. Government Code section 6250 et seq.) All documents that you send to the City will be subject to disclosure if requested by a member of the public.

EXHIBIT A
RESPONSE INFORMATION

Note: Please be as complete yet concise as possible when responding to these questions and submitting any additional information.

1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

Terra Renewal West, LLC dba Denali Water Solutions

1.2 Contact Person, Address, Phone Number, and E-mail:

Jeff Thurber

12812 Valley View St, #9, Garden Grove, CA 92845

Phone: (949) 678-3153, Jeff.Thurber@denaliwater.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

We are able to provide performance bonds up to $5-$10 million per year.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

Terra Renewal West is a full service biosolids management company. We currently manage biosolids at permitted land application sites and can offer the City drying technology and composting. We can offer immediate biosolids land application services at our permitted biosolids sites for both class A and class B biosolids. Our land application program has been in operation since 2003. We also offer composting, alternative daily cover and drying technology as additional options to the City.

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

Terra Renewal West provides biosolids management services to some of California's largest municipalities including the City of Los Angeles, East Bay Municipal Utility District, Los Angeles County Sanitation District, City of San Diego and City of Riverside providing land application, composting and alternative daily cover reuse options. Our land application operations reach full scale implementation upon execution of our contract with the municipalities we contract with. We have been able to provide service to our customers with as little as 48 hours notice. We have teamed with indirect dryer technology company have build installations throughout the world and has been in the industry for decades.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

Terra Renewal West's primary biosolids management option for the City is off-site and application and alternative daily cover (ADC), with minimum risk to the City. Both of these options have been viable options for the over 50 facilities we have serviced in California over the last 15 years. We have mitigated the risks with land application and ADC by offering multiple sites to provide redundancy in our operations and limit the impacts of an issue arising from one site.

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

- ☒ Land Application
- ☒ Alternative Daily Landfill Cover
- ☒ Composting of Biosolids and Marketing of Product
- ☒ Soil Amendment and Marketing of Product
- ☒ Fuel
- ☐ Other (describe)

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☒ No. Name of existing facility Merced County Land application sites
Location of existing facility Merced County, CA

☐ Yes. Name/description of planned facility _____
Anticipated operational date _____
Capacity (wet TPD) _____
How development will be funded _____

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Our company has been providing biosolids land application services to Northern California since 2003 and throughout the country since 1995. We have land applied biosolids for over 15 Northern California biosolids generators and over 50 facilities throughout California and Arizona. Our operations have been audited and approved by the National Biosolids Partnership's Environmental Management System (EMS) through four different municipality participating in the EMS program. We managed over 650,000 tons of residuals in 2013 in California and Arizona alone.

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: 80,000 (available)
2018: 120,000
2023: 150,000
2028: 150,000

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

Each operation can manage up to 500 tons of biosolids per day. If additional tonnage is added, an additional operation can be added to double the daily capacity

2.6 What is your available on-site storage, both prior to and post-processing:

Our land application operation does not have storage capacity. Our composting option will have on-site storage capacity.

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

- What class of biosolids do you accept?
  - ☐ Only Class A
  - ☐ Only Class B
  - ☒ Both Class A and Class B (not commingled)
- If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?
  The capacity we have listed above applies to class B biosolids, and is 25-50% higher for class A biosolids. Our land application program also has the potential for expanded capacity if we can secure more biosolids
- If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

2.7.2 Percent Solids

- Minimum percent solids of the biosolids you will accept?
  12-100 percent solids
- Preferred percent solids of the biosolids you will accept?
  12-100 percent solids

2.7.3 Energy–Related Processes

- Are biosolids processed (dried) to fuel at your location?
  The drying technology we are offering needs to be built, most ideally, at the City's facility. We can design, build, own and operate the dryer if the City is interested in drying technology.
- If not, what is the range of net energy value you would require in a delivered biosolids fuel product?
  The final product that is produced from our dryer technology provides approximately 6,000-10,000 BTUs. The net energy derived depends on the operation of the facility and sources of fuel used to operates the facility.
- Other characteristics required for delivered fuel product?

2.7.4 Other (describe)

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: Class A and B biosolids

Marketing / Reuse Approach: No marketing is required to land apply or beneficially reuse these materials as alternative daily cover. Our services could start immediately and require no additional capital or lengthy permitting to begin.

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: Class A and B biosolids

Approach: As one of the largest biosolids management companies in California, we understand generators need for uninterrupted service. To assure our generators have an outlet for their biosolids, we use multiple farms in several different locations. This provides us the ability to move our operations to another site if an unforeseen situation arises like inclement weather, road closures, etc. If supply and demand as misaligned, we can either fertilize fewer fields or add additional equipment to handle the increased capacity. We maintain excess capacity to assure we can manage surges in material. We also maintain approvals at back-up facilities like landfills that can beneficially reuse the material as ADC. This provides numerous options for our generators.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: Merced County Land Application Program

2.10.1 Surface Water (describe): We maintain buffer zones from surface water as part of our EMS approved Biosolids Management Plan that meet or exceed County and State requirements.
2.10.2 Odor (describe): We maintain buffer zones from sensitive receptors like homes and public road ways, and incorporate the biosolids in the ground as part of our EMS approved Biosolids Management Plan that meet or exceed County and State requirements.
2.10.3 Noise (describe): We maintain buffer zones from sensitive receptors like homes as part of our EMS approved Biosolids Management Plan that meet or exceed County and State requirements.
2.10.4 How close is the nearest residence to this site? Our land application sites are located in rural areas with few residents within 1-5 miles
2.10.5 How close is the nearest business to this site? Describe the nature of the business? Our land application sites are surrounded by agricultural land.

2.11 Are there any required permits or permit limitations at the site?

Our land application operations in Merced County are approved by the Merced County Department of Environmental Health. We are limited to operating only on fields that meet the County, State and Federal regulation for biosolids land application.

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

We work with a number of large biosolids generators who use multiple companies to manage their biosolids. We would be willing to manage a portion of the City's biosolids. We prefer to haul at least 100 tons per day.

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☒ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton
- ☐ Other (please indicate amount) _____per wet ton

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

We primarily provide the biosolids transportation services to our sites. We have a fleet of trailers and equipment designed to haul biosolids. Transportation costs are based on the cost of diesel and either the time it takes or the driving miles to the site.

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

- ☐ Service Contract (providing a direct end-use service or providing processing)
- ☒ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)
- ☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

We would like to provide the City with the transportation and beneficial reuse of their biosolids. If the City is interested in our drying technology, we would offer the city a design, build, own and operate arraignment.

3.3 What length of contract term would you prefer? (Check one)

☐	5 years	☐	10-15 years
☒	5-10 years	☐	No preference

3.4 What is the minimum contract term you would prefer (in years)? We prefer a 3 year minimum

4 OTHER

4.1 The City is considering building a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

4.1.1 Your team's experience operating this type of facility (describe):
We are not interested in operating a loadout facility at this time
4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?

4.1.3 Minimum term of operating contract that would accept?

4.1.4 Please identify any concerns you would have with this type of operation?

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

If the City selects our drying technology, we would be interested in operating that facility.

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

_____

Utility Service Co., Inc. (USG)

Request for Information (RFI 13-14-01)

Biosolids Transition Program

June 27, 2014

Utility Service Group
Bringing Innovation and Trust to the Water Industry
www.UtilityService.com

Response to RFI 13-14-01
Submission date: July 17, 2014

1230 Peachtree St, NE, Suite 1100, Promenade Building II, Atlanta, GA 30309

1 BACKGROUND

1.1 OVERVIEW

Over the next several years, the San José-Santa Clara Regional Wastewater Facility will be transitioning to a new biosolids program and is seeking input from potential beneficial re-use service providers.

The San José-Santa Clara Regional Wastewater Facility (Facility) currently manages its post-digestion biosolids through extended-stabilization lagoons and open-air drying beds prior to shipping 100% of the stabilized biosolids product to the nearby Newby Island Landfill for use as alternative daily cover.

The Facility treats 110 MGD from six tributary agencies. The current biosolids process includes Mesophilic Digestion, after which the sludge is stabilized in the lagoons for approximately three years and dried in the beds for an additional six months. The City of San José (City) has decided to implement advanced digestion at the Facility; depending on the extent of other biosolids improvements implemented at the Facility, approximately 130,000 wet TPY of dewatered biosolids (25% solids) will be generated requiring off-site disposition and possibly off-site processing.

1.2 BIOSOLIDS PROGRAM OBJECTIVES

1.2.1 Provide a reliable, diversified and flexible biosolids program that can adapt to future regulatory and market changes;

1.2.2 Provide a cost effective program;

1.2.3 Reduce environmental and community impacts;

1.2.4 Maximize beneficial re-use of biosolids; and

1.2.5 Explore emerging technologies which have been successfully tested at full scale.

1.3 KEY BIOSOLIDS TRANSITION ACTIVITIES

1.3.1 The City is currently upgrading the existing Mesophilic Digestion Process to Temperature Phased Anaerobic Digestion Process;

1.3.2 Decommissioning the existing lagoons and drying beds;

1.3.3 Developing new infrastructure (with the exception of composting facilities which the City will <u>not</u> be building on-site) at the existing wastewater treatment plant site for treating biosolids and potentially contract for their operation; and

1.3.4 Contracting for transportation, additional off-site processing where applicable, and beneficial re-use of the treated biosolids.

1.3.5 The City intends to begin operating the new biosolids infrastructure by the end of 2018. Transportation of biosolids to beneficial re-use sites (including possibly intermediate processing sites) is also planned to start at the same time.

1.3.6 As part of the City's intent to provide a reliable, flexible program, the City plans to arrange for several end uses for its biosolids. This would be through a "broker-type" contract that includes a variety of end uses, or through contracts with several end-use service providers. These end-use contracts may involve intermediate processing (i.e. composting). The City may enter into service contracts for a variety of disposition options and products, including but not limited to:

Land Application

Compost

Alternative Daily Landfill Cover

Dried Pellets

2 DOCUMENT PURPOSE

2.1 Obtain information on the range of private sector firms interested in utilizing anaerobically digested biosolids cake for a variety of purposes and / or interested in providing processing/ beneficial re-use services for the City's biosolids;

2.2 Obtain information on the range of potential biosolids processing technologies that exist in the marketplace;

2.3 Obtain information on the potential types of contract structures that would be of interest to potential service providers;

2.4 Obtain information that might affect our decisions regarding the type and size of biosolids treatment processes to develop at our wastewater treatment plant;

2.5 Determine if processing and re-use service providers also have the capability and interest in operating biosolids treatment processes at the City's Facility location; and

2.6 Obtain information regarding the feasibility of outsourcing the final disposition of biosolids produced at the Facility.

3 TIMELINE

RFI Released	June 27, 2014
Deadline for Questions (please post all questions directly on the BidSync System at any time prior to the deadline)	July 10, 2014
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7 NEXT STEPS

7.1 The City is soliciting feedback from companies with recent, successful experience and present capability to provide outsourced biosolids beneficial use and resource recovery. The information received in response to this RFI will be used by the City to decide how to maximize market opportunities available. By participating in this RFI process, the Respondent expressly agrees that no contract of any kind is formed under, or arises from this RFI and that no legal obligations will arise. The City will have no obligation to enter into negotiations or a Contract with Respondent, even though one or all of the Respondents are determined to be responsive. In the future, the City may engage in formal procurement(s) including Requests for Qualification and Requests for Proposals.

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1 Corporate and Contact Information

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

Utility Service Co. Inc. (USG),
Technology provided by our affiliate AQUALOGY

1.2 Contact Person, Address, Phone Number, and E-mail:

Miguel MOLINA – mmolina@utilityservice.com
Office: 678-235-0285
Cellphone: 404-313-5573
1230 Peachtree St, NE Suite 1100 – Promenade Building II
Atlanta, GA 30309

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount / duration of such bonds?

Performance bonds are usual in our projects. Typical limitations are 20-30% of contract value during construction phase and 10% during the guarantee period. The duration can't be longer than the duration of the contract and guarantee period.

1.4 A description of the technology, service and/or bioslids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

Our STC low temperature drying system is a belt dryer using hot air convection at 176-185ºF (80-85ºC). It's fed with mechanically dewatered biosolids.
The end product is a high quality biosolids (Class A, 90%DS) with demonstrated physical characteristics (density, porosity) to maximize efficiency of energy recovery processes and absorption in agriculture or land application.
This technology provides flexibility to maximize beneficial reuse for agriculture, biofuel or energy production.
Some other advantages aligned with your goals are described hereafter:

- *Working between 65-80C, it's the heat drying technology most reliable and easiest to operate.*
- *No risk of explosion or fires, no operational hazards and very easy to start and stop.*
- *Environmental friendly with no dust, low odor emissions and minimized water consumption.*
- *Maximizes waste energy recovery providing sustainability.*
- *It's cost effective and expandable to increase capacity or add other energy sources for drying.*

Full description attached.

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

We have 14 references of full scale implementations plus another 2 currently under construction. The following table indicates location, size and year of start-up:

Location	*Capacity (wet tons per year)*	*Commissioning date*
Huddersfield (UK)	*8,000*	*In execution*
Limeira - São Paulo (Brazil)	*15,000*	*In execution*
St Marcellin (France)	*6,000*	*2013*
Melilla (Spain)	*6,600*	*2012*
Shanganagh – Dublin (Ireland)	*18,000*	*2012*
Lugo (Spain)	*20,000*	*2011*
Cémex – Alicante (Spain)	*60,000*	*2011*
Besos – Barcelona (Spain)	*160,000*	*2009*
Guadalhorce – Málaga (Spain)	*70,000*	*2007*
Guillarei – Pontevedra (Spain)	*10,000*	*2009*
Motril – Granada (Spain)	*15,0000*	*2006*
Reguerona – Asturias (Spain)	*15,000*	*2005*
Louis Fargue - Bordeaux (France)	*15,000*	*2003*
Lorca – Murcia (Spain)	*40,000*	*2002-2003*
Ibi – Alicante (Spain)	*6,000*	*2000*
Baiña – Asturias (Spain)	*5,000*	*1998*

Full description attached.

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

Our technology operates at low temperature and is therefore intrinsically safe regarding explosion of fire risks. It has been assessed by an independent party (INERIS) which proved it is out of any ATEX zoning (European explosive atmosphere regulation).

2 BENEFICIAL RE-USE DESCRIPTIONS

Note: For each type of processing or beneficial re-use that you could provide, please duplicate this Section and provide a response to the following questions:

2.1 Type of reuse or intermediate processing that could be provided (check one):

- ☒ Land Application
- ☒ Alternative Daily Landfill Cover
- ☒ Composting of Biosolids and Marketing of Product
- ☒ Soil Amendment and Marketing of Product
- ☒ Fuel
- ☒ Other (describe)

Our technology is fed with mechanically dewatered biosolids and produces a dried biosolid product (90%dried solids) which can be used both for land application or for energy recovery (as alternative fuel), for example in cement factories or using gasification / pyrolysis technologies. We can provide references for all of these applications.

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

☐ No. Name of existing facility _____
Location of existing facility _____

☒ Yes. Name/description of planned facility *STC drying unit*
Anticipated operational date *To be planned*
Capacity (wet TPD) *To be constructed, designed to needs*

How development will be funded *We can provide financing if needed*

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

Our business activities include wastewater treatment plants which includes the managements of biosolids and other by-products. Aqualogy operates over 500 wastewater treatments plants located in 15 countries. Some of these installations includes thermal drying. We are also in charge of a significant 15-year DBO contract on our installation of Alicante for 60,000ton/yr.

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current: 0
2018: *designed to suit needs*
2023: *designed to suit needs*
2028: *designed to suit needs*

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

Not applicable to our case as we would design and build an installation to suit the needs, based on the customer's requirements. Our largest installation to date has a capacity of 160,000 ton/yr of dewatered biosolids. We have strong experience and many references of installations which accumulated capacity accounts for 470,000 ton/yr of dewatered biosolids processed.

2.6 What is your available on-site storage, both prior to and post-processing:

Not applicable (designed to suit needs)

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

What class of biosolids do you accept?

- ☐ Only Class A
- ☐ Only Class B
- ☒ Both Class A and Class B (not commingled)

If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?
None

If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?

None

2.7.2 Percent Solids

Minimum percent solids of the biosolids you will accept?
20% solids for digested biosolids and 22% solids for non-digested biosolids

Preferred percent solids of the biosolids you will accept?
22-30% solids

2.7.3 Energy–Related Processes

Are biosolids processed (dried) to fuel at your location?

Our technology produces dried biosolids over 90%dried solids content which can then be used as alternative fuel. Beyond dryness, our dried product has proved to offer many other key characteristics which enable a wide variety of energy recovery routes. Some of these key features are: no dust, high porosity and low density which are key to controlling the behaviour in any energy recovery unit.

If not, what is the range of net energy value you would require in a delivered biosolids fuel product?

To produce a biosolid fuel product, an average of 1MWh heat (hot water) and 0.1MWh power are required per ton of water removed.

Other characteristics required for delivered fuel product?

It is worth noting that our drying process operates at very low temperature, allowing for much heat recovery from any source of waste heat available, greatly reducing the demand of heat externally sourced.

2.7.4 Other (describe)

_____

2.8 For each process / beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

Material: _____

Marketing / Reuse Approach: _____

As described, many options are available, needing to be studied and agreed with City of San Jose (direct reuse, marketing, etc.)

2.9 For each process / beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability to develop and service new markets).

Material: _____

Approach: _____

We are able to develop and service new markets directly or in collaboration with other partners.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

Site Name: *None to date. Our process operates at low temperature and is therefore intrinsically safe and has low environmental impact.*

2.10.1 Surface Water (describe): _____
2.10.2 Odor (describe): _____
2.10.3 Noise (describe): _____
2.10.4 How close is the nearest residence to this site? _____
2.10.5 How close is the nearest business to this site? Describe the nature of the business?
_____

2.11 Are there any required permits or permit limitations at the site?

Our low-temperature drying technology allows to greatly reduce any emissions and impact to the environment, compared to other high temperature alternatives. The flow of process air collected to be discharge is kept to a minimum. The flow of air for buildings ventilation is defined by building ventilation renewal standards and health and safety standards.

The air pollution is low. The main compound accounting for odors is ammonia which is straightforward to treat prior to emission. The emission of VOCs and other odorous organic compounds is very low. There are no other gas emissions, except that for heat generation: boiler, engine or other.

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicated your willingness / ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

Our low-temperature dryer allows for the production of Class A biosolids. This therefore constitutes and intermediate processing of biosolids allowing to widen the range of options for disposition, including: agriculture, land reclamation, alternative fuel for heat production (eg. Cement kiln), emerging options of alternative fuel producing heat and power (eg. Gasification).

We apply a wide range of disposition routes in our existing installations. One of our largest sites is also located on the premises of a cement factory, allowing for allowing for a perfect integration of both facilities: the dried product is used as alternative fuel on the cement plant and the heat required for drying is fully supplied by waste heat from the cement plant.

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products: (Check one)

- ☐ $10-$20 / wet ton
- ☐ $20-$30 / wet ton
- ☐ $30-$40 / wet ton
- ☐ $40-$50 / wet ton
- ☐ $50-$60 / wet ton
- ☐ $60-$70 / wet ton
- ☒ Other (please indicate amount): *Operation costs are estimated at 30-50 $/ton for drying, and investment is estimated at $ 20-25 millions.*

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

When transportation is needed, we used to do it through other partners.

3 POTENTIAL CONTRACT STRUCTURES

3.1 Please indicate your preference with respect to contracting options (check all that apply):

- ☒ Service Contract (providing a direct end-use service or providing processing)
- ☐ Service and Disposition Contract (providing a processing service and responsibility for marketing / sales of the end product)
- ☐ Disposition Contract (providing marketing / sales of end product)

3.2 What type of commercial agreement / business model would most interest you?

DB (Design & Build) or DBO (Design & Build & Operate)

3.3 What length of contract term would you prefer? (Check one)

☐	5 years	☐	10-15 years
☐	5-10 years	☒	No preference

3.4 What is the minimum contract term you would prefer (in years)? *5 years for the Operation*

4 OTHER

4.1 The City is considering buidling a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for that facility? If yes, please respond to the following questions:

4.1.1 Your team's experience operating this type of facility (describe):
Our business activities include wastewater treatment plants which includes the managements of biosolids and other by-products. Aqualogy operates over 300 wastewater treatments plants located in 15 countries.
4.1.2 Term of operating contract that you would prefer and potential impact on service pricing?
To be studied
4.1.3 Minimum term of operating contract that would accept?
2 years for operating contract or 5 years in case of DBO
4.1.4 Please identify any concerns you would have with this type of operation?
A review of the designs and state of the installations would have to be carried out before definite pricing, for servicing contracts on any facility pre-existing or not designed by ourselves.

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

We do not have any particular concern to state at this point. As stated in 2.3 and 4.1.1, wastewater treatment facilities operation is part of our core business and this involves operation and maintenance of the effluent treatment as well as biosolids and other by-product management. We would therefore be keen to be considered for this opportunity.

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

We strongly believe our low-temperature drying solution meets your goals in terms of flexibility and opportunities for biosolids management. It produces a Class A pellet at 90%dried solids with a high agronomic value as well as energy content. It would allow for a wide range of disposition options, both current and future, as depicted in the document attached.

Submission Date:

JULY 17, 2014

Response to:

CITY OF SAN JOSE

SAN JOSE-SANTA CLARA REGIONAL WASTEWATER FACILITY

REQUEST FOR INFORMATION (RFI 13-14-01)

BIOSOLIDS TRANSITION PROGRAM

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July 16, 2014

CITY OF SAN JOSE
SAN JOSE-SANTA CLARA REGIONAL WASTEWATER FACILITY
700 Los Esteros Road, San Jose, CA 95134

RE: Request for Information (RFI 13-14-01), Biosolids Transition Program

To Linda Steward /Mark Giovannetti/ John Cannon:

Utility Service Co., Inc. is pleased to submit this response in accordance with the RFI 13-14-01. Utility Service Co., Inc. understands the requirements of the Biosolids transition Program and the necessary steps required to perform at the highest standards in the industry providing the services needed to meet your goals. Further, we have the experience, people, technology, equipment, standard operation procedures, human and capital resources and know-how to exceed the expectations of City of San Jose.

Our proposed solutions have been successfully deployed in many countries, and we are very excited to be introducing it to City of San Jose. Aqualogy is part of our corporate group and is continuously researching, developing, and redefining innovative solutions to support a sustainable future of the community in terms of the environment and the economy. Utility Service Co., Inc. has exclusive access to these unique Aqualogy technologies that can solve problems in a sustainable, cost-effective manner.

Regarding the documentation provided, the objectives of the Biosolids program are:

- Provide a reliable, diversified and flexible biosolids program that can adapt to future regulatory and market changes;
- Provide a cost effective program;
- Reduce environmental and community impacts;
- Maximize beneficial re-use of biosolids; and
- Explore emerging technologies which have been successfully tested at full scale.

We understand that the intention of City of San Jose with this RFI is also to collect information to align the different projects around the program

Regarding your objectives, intention of this RFI and our experience regarding the actual status of novel technologies (especially around Biosolids-to-Energy schemes), we recommend the best strategy to the City of San Jose, based on a step by step approach starting by a heat drying process to solve the major problem of the actual biosolids use. During the implementation of this first stage, the City of San Jose would give time to new promising technologies to become more mature and reliable.

Our exclusive and really low temperature drying technology would help City of San Jose to produce high quality dried product (Class A biosolids) with demonstrated physical characteristics (density, porosity) to maximize efficiency of energy recovery processes and absorption in agriculture or land application.

Therefore, our technology would provide flexibility to maximize beneficial reuse for agriculture, biofuel or energy production according to the evolution of other available complementary technologies, as described in section 3. Some other advantages aligned with your goals are described hereafter:

- Working between 65-80C, it's the heat drying technology most reliable and easiest to operate.
- No risk of explosion or fires, no operational hazards and very easy to start and stop.
- Environmental friendly with no dust, low odor emissions and minimized water consumption.
- Maximizes waste energy recovery providing sustainability to the program.
- It’s cost effective and expandable to increase capacity or add other energy sources for drying.

We would be glad to develop a business case for the solutions described on this document if needed.

In addition to that, we are able to tailor our solutions to meet the needs of City of San Jose. We are flexible to find the model required that may include services, financing and performance guarantee. Once said that, our technology can be operated by the same operators of your dewatering system, unlike medium and high temperature heat dryers, so City of San Jose would have more flexibility in your decisions.

As you read further in our proposal, you will discover that our team is very experienced in all aspects of wastewater and water utilities. We have a highly skilled professional team, who has the very highest standards in performance. We take pride in our services, and we offer you our best.

We look forward to serving City of San Jose. Do not hesitate to call me with any question or concerns.

Sincerely,

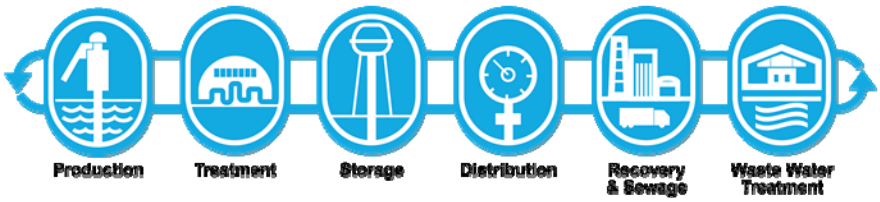
Dominique Demessence
CEO, Utility Service Co., Inc.

PART 1. INTRODUCTION

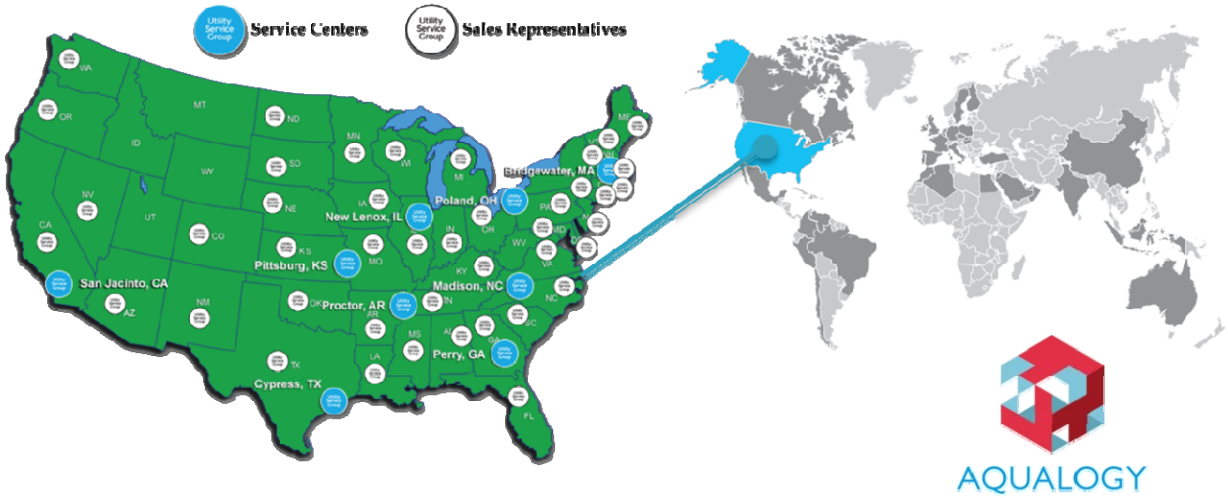
1.1 ABOUT USG

Utility Service Company, Inc. (Aqualogy USA) has proudly served the municipal and industrial water industries for over 50 years. Since its founding in Madison, NC in 1963, USG has provided comprehensive solutions and services for water utilities throughout the whole water cycle – source to tap.

Our comprehensive portfolio of innovative sustainable technologies and custom designed professional services allow for a holistic approach to optimize water and waste water systems.



With a staff of over 400 water professionals, USCI serves approximately 2,500 water utilities in the US with approximately 5,000 long term asset management programs. USCI has national coverage with local presence in almost 50 states. Proximity to our customers allows us to deliver excellent quality of service.



AQUALOGY is a global company providing solutions and technologies for the whole water cycle in North America, South America, Europe, Africa, Asia and Oceania.

Aqualogy is also specialist in design, manufacture, installation and maintenance of biosolids equipment of a wide variety of products based on low temperature air convection processes, with more than **20 years of experience**. Our solutions provide high quality drying with simple, reliable and safe processes, minimum global energy consumption and the best quality of materials.

1.2 Utility Service Co., Inc.'s Understanding of the Feasibility Study

San José-Santa Clara Regional Wastewater Facility, treating actually 110 MGD from six tributary agencies, will be transitioning to a new biosolids program over the next several years. At the beginning of this process, it's submitting this Request for information in order to collect data of potential solutions for beneficial re-use of biosolids.

Actual biosolids are stabilized in the lagoons for approximately three years and dried in the beds for an additional six months being shipped further to the nearby Newby Island Landfill for use as alternative daily cover.

The City of San José has decided to implement advanced digestion at the Facility; depending on the extent of other biosolids improvements implemented at the Facility, approximately 130,000 wet TPY of dewatered biosolids (25% solids) will be generated requiring possibly additional processing and disposition.

The City of Jose is currently reviewing options for biosolids management in order to face actual and future economic, environmental and social challenges, overcoming actual drawbacks like biosolids monetary value, limited restrictions of use, volume reduction and flexibility.

The main objectives of the biosolids program are:

- Provide a reliable, diversified and flexible biosolids program that can adapt to future regulatory and market changes;
- Provide a cost effective program;
- Reduce environmental and community impacts;
- Maximize beneficial re-use of biosolids; and
- Explore emerging technologies which have been successfully tested at full scale.

The City may enter into service contracts for a variety of disposition options and products, including but not limited to:

- Land Application
- Compost
- Alternative Daily Landfill Cover
- Dried Pellets

Utility Service Co., Inc. states that it is capable of providing the state of the art solutions and services outlined in this preliminary design. By using the latest technology, Utility Service is offering City of Sna Jose the best solutions possible. Our talented team of experienced and specialized professionals has high standards that go beyond the minimum requirements. Utility Service Co., Inc. has the requisite personnel and staff and the right partners to meet the requirements of this RFP and will apply all necessary resources to ensure that the goals of Black & Veatch are met.

Aqualogy is part of Utility Service Co., Inc.'s corporate group. As a reputable global firm, it crosses continental boundaries with its services. Its team is focused on innovative solutions for the holistic water system. Hundreds of water utilities are using Aqualogy's solutions, which are being continuously improved with the feedback from the operators.

PART 2. SOLUTIONS DESCRIPTION

2.1 BIOSOLIDS MANAGEMENT EXPERTISE

Aqualogy (together with sister companies such as AquaE) currently manages about **500 wastewater treatment plants**, including the biosolids management of all plants. This has allowed developing experience in a wide range of biosolids management options, for example:

- Biosolids anaerobic digestion
- Biosolids cake composting
- Biosolids cake drying (thermal and solar)
- Biosolids land application
- Other: Rhizo-composting

In particular, Aqualogy has developed strong experience on anaerobic digestion and advanced anaerobic digestion processes, as well as the use of the biogas produced. At present, Aqualogy and sister companies operate **40 plants which include anaerobic digestion**, of sizes ranging from 150,000 to 3,000,000 population equivalent and treating a wide variety of sewage biosolids, usually mixed (primary and waste activated sludge).

Anaerobic digestion is now considered a mature technology, both in terms of engineering and in terms of operation and control. The typical operating conditions for domestic sewage biosolids anaerobic digestion on our plants are: 15-30 days biosolids retention time, mesophilic temperature (95-99°F) (35-37°C) or thermophilic temperature (122-131°F) (50-55°C), organic matter removal 45-65% depending on the type of biosolids, biogas production of approximately 1,000$Nm^3/kgVS_{removed}$ at 65%CH_4. Depending on the wastewater characteristics, the effluent treatment process and the biosolids management process, the anaerobic digestion can cover approximately 40-70% of the plant's power requirements.

In order to improve anaerobic digestion performance, focusing both on biosolids quality and on energy production, Aqualogy has invested greatly in research and development in this field over the past years, and has developed products and services aimed at design and operation improvements in order to: optimize the use of existing assets, push further the limits of biosolids degradation and biogas production (advanced processes), make the best use of the biogas produced.

The following sections give some examples and references of such products and services.

2.2 STC LOW TEMPERATURE DRYING TECHNOLOGY

The STC thermal drying system is a **low temperature** (149/176ºF) (65/80ºC) in a **belt dryer** using hot air convection. This system has been designed to dry biosolids that has already been mechanically dewatered, so that the residual water it contains can be removed to attain the required final dryness (90%).

The biosolids feeding system does not require the biosolids to have passed plastic state, although minimum consistency is needed for shaping and belt feeding process. If a uniform dryness of minimum 20% cannot be guaranteed, further dewatering or a dry product recirculation system may be required.

The biosolids, stored in the receiving pit or silo must be taken to the dryer head and through the **extruder**. The purpose of this special system is to distribute the biosolids evenly onto the upper belt, facilitating air circulation through the product mass, which is basically for efficient and reliable drying.

The system has **two belts** for conveying the biosolids inside of the drying tunnel, each one moving in the opposite direction to one another. As they progress through the dryer, hot air circulates at a temperature of maximum 176-185ºF (80-85ºC) perpendicular to the belts. This air, which is propelled by the ventilation system, passes through the product extracting water through hygroscopic equilibrium. As there is no movement or friction in the drying process, **very little dust** is generated during this stage.

Once the drying process is completed, the granulated biosolids is a low-density dry product, easy to handle, transport and with excellent properties for end uses (agriculture, energy, etc). The dry and granulated biosolids are collected and taken to one side of the dryer, from where it has to be distributed to the dried biosolids storage system selected by the client.

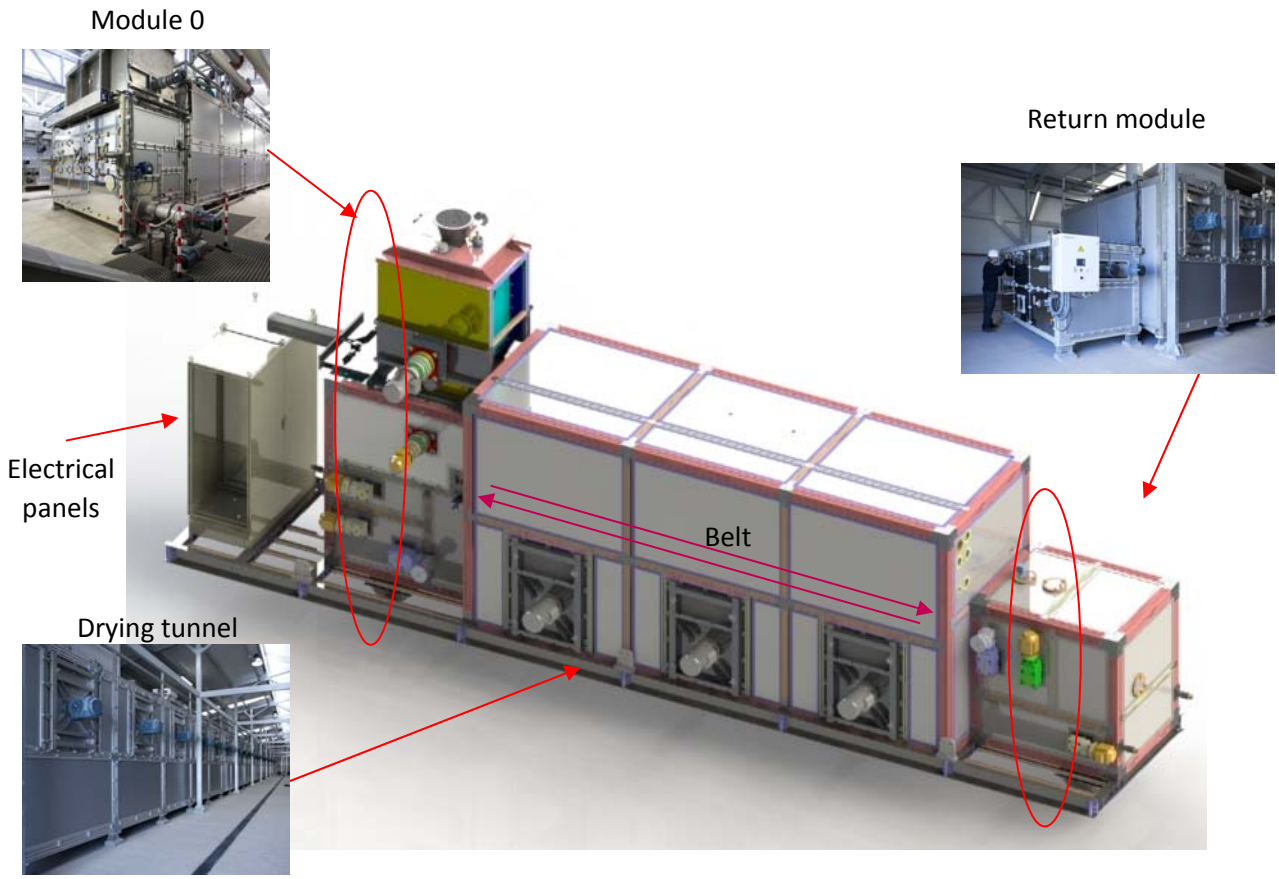
The dryer uses a **modular design concept**, therefore future extensions based on the equipment already installed are possible. High quality materials are used for construction to meet all the technical specifications required for these uses. As it is a modular system, each module is **manufactured and fully tested** in the Aqualogy-STC factory before being delivered to the plant. On-site assembly is therefore easier and faster, and only requires fixing the modules to the sole base plate with special anchors and connecting the pipes, electrical cables between the modules and other peripheral connections to the plant.

The STC dryers are divided into **three working areas**, each one with different functions:

- **Module 0**
- **Drying modules**
- **Return module**

The loading of the dewatered biosolids and discharge of the dried biosolids take place in module 0. The HMI is located in this area for the control of the whole dryer. This module includes the receiving hopper, the extruder, the dried product collection system and the traction system of the lower belt. The upper belt is loaded with the dewatered biosolids and the lower belt comes back to the module 0 loaded with the fully dried product. Once here, the dried product falls from the lower belt into a small hopper, from where it is extracted from the dryer by means of a discharging screw. There are some brushes at this point for cleaning the belts.

The **drying modules** are the units that constitute the drying tunnel, where the drying process takes place. They work as independent units and include both belts, which convey the product through the whole drying tunnel, the water/air heat exchangers of the process, both for heating the product and condensing the evaporated water and the fans for circulating the hot air loop through the product and the heat exchangers. All the elements forming the equipment are accessible from the outside, with easy maintenance by detachable panels. The dryer has its own electrical panels for power distribution, power and control, the PLC and HMI.



The **return module** is located at the opposite end of the module 0. The traction system of the upper belt is located in this area. In this module, the product falls from the upper belt to the lower belt and is returned to the front of the drying tunnel. There is a longitudinal brush system at this point to assist biosolids loading and uniform distribution on the lower belt.

The low drying temperature significantly increases the number of possibilities to provide thermal power to the dryer. The STC dryers can work with a **wide range of heat sources**. They can be adapted to make the best use of hot water circuits, which can come from different origins: CHP engines, hot water boilers, exhaust gases, waste vapor or hot water. Any source of energy that can produce a **hot water circuit** of approximately 194/167ºF (90/75ºC) can be used in the dryer.

If there is no heat source available, Aqualogy offers the possibility to equip the STC dryer with a heat pump technology, which only requires the use of an electrical connection. The various alternatives of thermal energy sources can lead to the following dryer configurations:

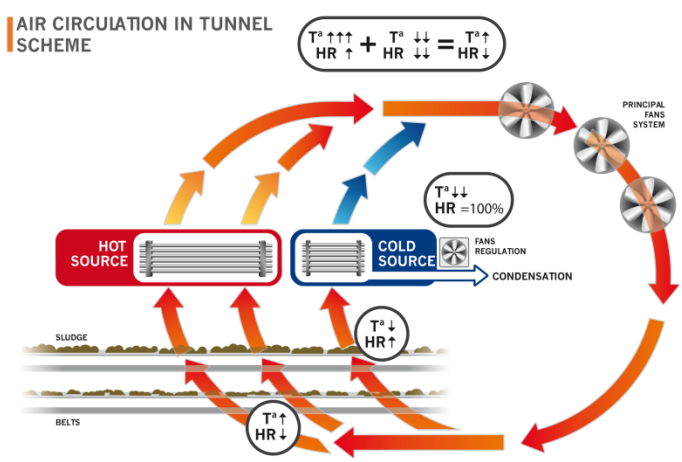
- **Dryer equipped with the hot water exploitation technology (HW)**: the dryer uses a hot water circuit 194/167ºF (90/75ºC) provided by CHP engines, hot water boilers, exhaust gases, waste vapor, waste heat, etc.

- **Dryer equipped with the heat pump technology (HP):** the dryer is equipped with the heat pump system developed by Aqualogy, which uses electricity for generating the energy both the evaporation and the condensation processes that take place inside of the dryer.

- **Dryer equipped with the mixed system (MX)**: the dryer combines the Hot Water Exploitation Technology and the Heat Pump Technology for giving more flexibility to the operation and optimize the energy costs.

Inside the dryer there are a number of air/water heat exchangers for producing both the evaporation and condensation capacity. All the required heat for the hot water heat exchangers for supplying the evaporation capacity is obtained from the hot water circuit fed by the selected heating system. The drying air passes through these exchangers, increases its temperature and thanks to its hygrometric conditions it extracts the humidity removed from the biosolids. On the other hand, a part of the humid air passes through the cold-water heat exchangers located inside of the dryer, which condenses the vapor from the humid air into water. The cold water for those exchangers can be obtained by means of cooling towers, cold water streams (eg. Treated waste water), heat pump or other methods.

The evaporation and condensation processes take place inside of the dryer, operating **in a closed air loop**, maintaining the independence of external climatic conditions and obtaining the maximum heat efficiency. It is only required to extract a small fraction of the air to maintain the system in a small under pressure. It is recommended that this extraction is piped and treated by a deodorization system before discharge to the atmosphere.



The condensate is collected by a drainage network and taken to one side of the dryer, where the flow is continuously measured and data logged. The low temperature drying process prevents from carry-over of other pollutants, retained in the biosolids, so that they do not return to the condensate and also

reduce odor emissions. Therefore only **high quality condensate** is obtained, with very low entrainments, depending on the kind of the biosolids treated.

Odor emissions can vary greatly because as they are mainly linked to the sludge content itself and its history (eg. storage time and temperature before drying), and also drying temperature (low temperature dryers such as STC produce much lower emissions, all the more so as the drying air is continuously condensed as well). Some orders of magnitude based on our experience are: NH3<200ppm; H2S<10ppm; VOC<40mg/Nm3; dust<3mg/Nm3. As mentioned above, emissions are highly linked to the sludge itself, so these values are orders of magnitude and not guarantees. Moreover, if required, Aqualogy also comprises a gas treatment unit and we are able to assess, design and build any suitable gas treatment system if required.

Proper air hygrometric conditions can be established at every stage in the dryer, which optimizes the drying curve and therefore **the product is dried uniformly**. Due to the low drying temperature, the end product maintains its organic and chemical properties and only the water content is modified.

The final solids content is achieved in two ways: varying the height of the product layer placed on the belt, which means varying the amount of water to be eliminated per unit of time; or varying the belt speed, which means varying how long the biosolids is in the dryer. The final product is obtained by combining both methods automatically. This regulation is essential to ensure proper drying of the product even when the initial properties of the biosolids vary.

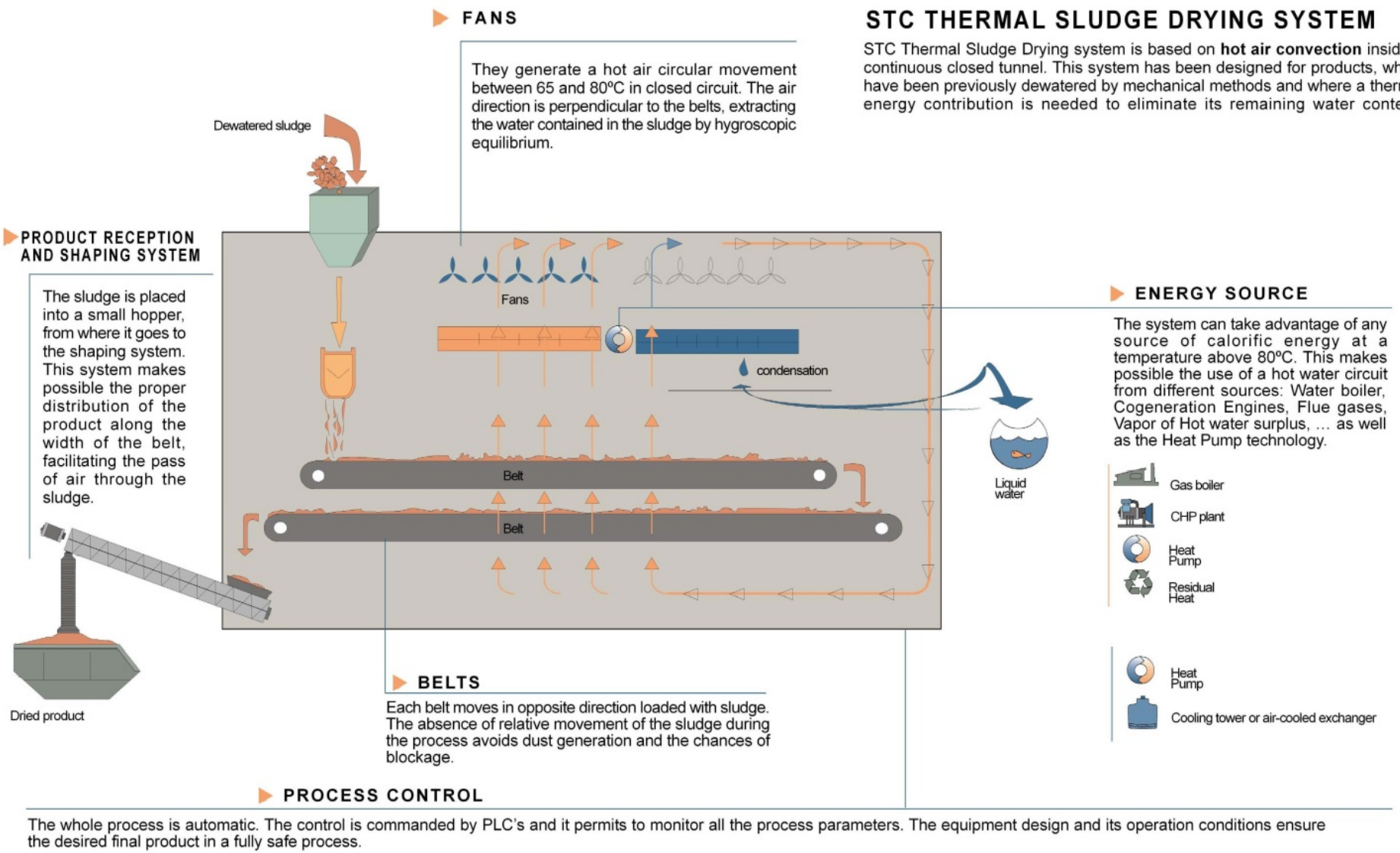
The **system is automatic**, controlled by a PLC. All the process parameters can be tracked and monitored to obtain the required end product, depending on specific requirements or final uses at all times. The control of air temperature and humidity in the drying chamber together with the water temperature in the hot and cold water circuits allow the system to regulate automatically, within the set points in order to produce the desired final product according to the requirements.

The dryer is sized to operate **24 hours per day** with an effective availability of over 8,000 h/year.

No cleaning and discharge operations are necessary during stopping and starting procedures. **Start-up is immediate** after the operating temperature has been reached in about 15 minutes. The operator can therefore select the equipment operating mode without being limited to the continuous operation of other systems.

Due to the low temperature drying (air at T ≤ 176ºF (80ºC)) in an indirect system (heat exchange hot water/air), the **STC drying system is intrinsically safe**: there is no risk of self-ignition or explosion inside of the dryer. No explosive atmosphere zoning has been identified and therefore it is not in the field of application of the ATEX regulation (equivalent to HAZLOC standard in USA) and does not require any implementation of corrective measures in order to guarantee the safety of the process. It can be tested by a Nationally Recognized Testing Laboratory like UL. For detailed information please refer to ***Appendix 2: The ATEX evaluation report of the STC system*.**

Transitional operations like start-up and shut-down do not imply special situations or danger and therefore do not need any presence of staff or safety procedures both under normal or abnormal operations, even in case of stop due to blockage or power cut.



Simplified process diagram. The direction of the circulating air may vary according to the biosolids characteristics.

Beyond safety, there are a number of other advantages of using STC low temperature dryer versus other high temperature alternatives as described in the table below:

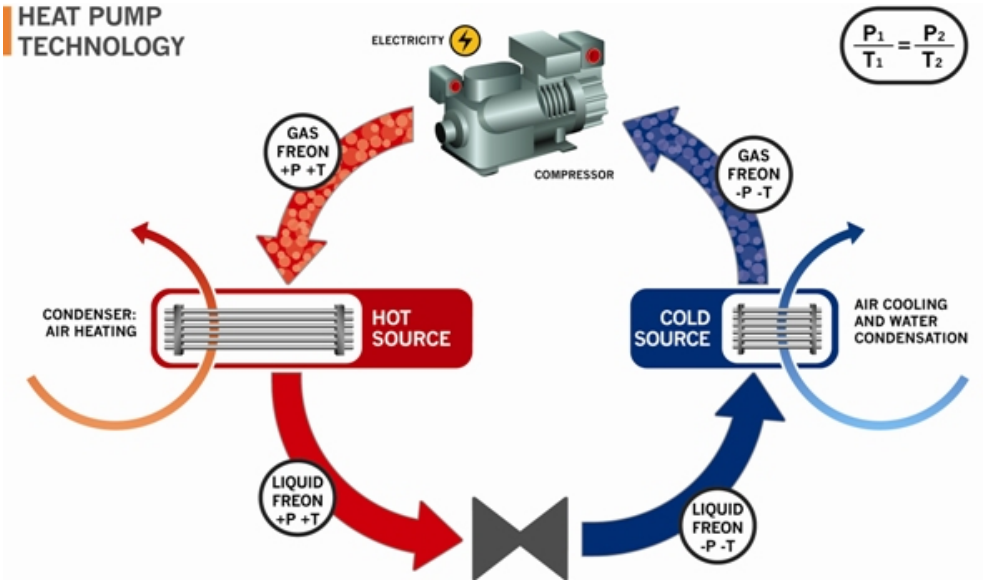
TOPIC	STC LOW TEMPERATURE DRYER	HIGH TEMPERATURE DRYERS
TEMPERATURE	Drying by evaporation at low temperature (T < 176ºF)(80ºC). Working fluid: water	Drying by vaporization (T > 212ºF)(100ºC). Fluid: Thermal oil (pressure equipment regulation and increase of fire risk).
SUPERVISION	Automatic system. Not personnel presence for a long time	Require continuous direct supervision
RECIRCULATION	It does not require dried sludge recirculation	Dried sludge recirculation in most cases
CONDENSATION	Internal water condensation	Water and particles emission out of the dryer to the cooling system and filter
DUST	There is no dust and minimum wears by product movement	High quantity of dust in suspension and high wears by friction and product movement
PERIPHERALS	Less necessity of peripheral equipment	More condensers, filters, dust separation devices, sludge mixers, etc
ATEX	ATEX certification without the need to apply corrective measures. No risk of explosion	Produce ATEX situations, and need to apply corrective measures to avoid fire and explosion. Specialized operators required.
HUMIDITY CONTROL	Easy humidity control due to the hygrometric equilibrium	Difficult humidity regulation
ENERGY RECOVERY	Maximum waste energy recovery: 100% exhaust gases + 100% engine cooling water. Comply with cogeneration requirement (REe > 65%)	They take advantage only of partially the exhaust gases. They do not comply with the cogeneration requirement (REe < 55 %)
DURABILITY	Higher (stainless steel and alloyed aluminum).	Fewer (steel carbon and more wears because of friction)
VOLATILES	Less emission due to both low temp and inner condensation processes	Higher due to the high temperature of the process
OPERATIONS	Start up, stop and sludge type change easy operations, fast and with no risk	Start up, stop and sludge type change sensitive operations. Special control needed.

2.2.1 Heat pump technology

Aqualogy owns a high efficiency Heat Pump technology to dry different type of products. The energy needed to heat up the product and evaporate the water in the equipment is recovered from the saturated, hot air in the chambers themselves, at the same time as condensation takes place due to the water removed.

The Heat Pump technology allows heat transfer from a cold tank to a hot one in order to recover residual energy and use it beneficially. As shown in the figure, the Heat Pump is designed to obtain

energy from another source with a low residual level of energy. Auxiliary energy, always less than the transferred energy, is used to raise these thermal levels.



There are two possible Heat Pump applications:

- As an energy restorer: Due to the Heat Pump's ability to transfer energy from a low temperature tank (Cold tank) to a high temperature one (Hot tank).
- As a de-humidifier: Through the dehumidification properties that it gives to the cold tank, when it partially cools the saturated air returned by the process.

This technology also enables to control the heat dryer in a closed circuit without taking air from outside, producing high energy savings and avoiding gas emissions.

2.2.2 Dried product

Low temperature drying allows for **environmentally-friendly reduction of volume of sewage biosolids**. Beyond this, the dried biosolids product is easy to store and handle, and is also a **renewable solid fuel**. STC dried biosolids has been tested with several gasification and pyrolysis technologies, showing that the product has an ideal density and porosity for reliable control in such reactors and for high biosolids to gas ratios (energy conversion). The low operating temperature of the STC dryer also allows for optimized energy integration of the overall system: excess high and low grade temperature from the engine and reactor are used for drying, and the dried biosolids is used as a fuel for the gasifier/pyrolyser. Such "**biosolids to energy**" schemes allow for almost 0-waste solutions while producing renewable heat and electricity.

Concerning land application, it is also worthwhile noting that, despite the low temperature of the drying process, the retention time of the biosolids in contact with the hot air, allows for the dried biosolids to **comply with the vector attraction and pathogens reduction to obtain Class A biosolids**.

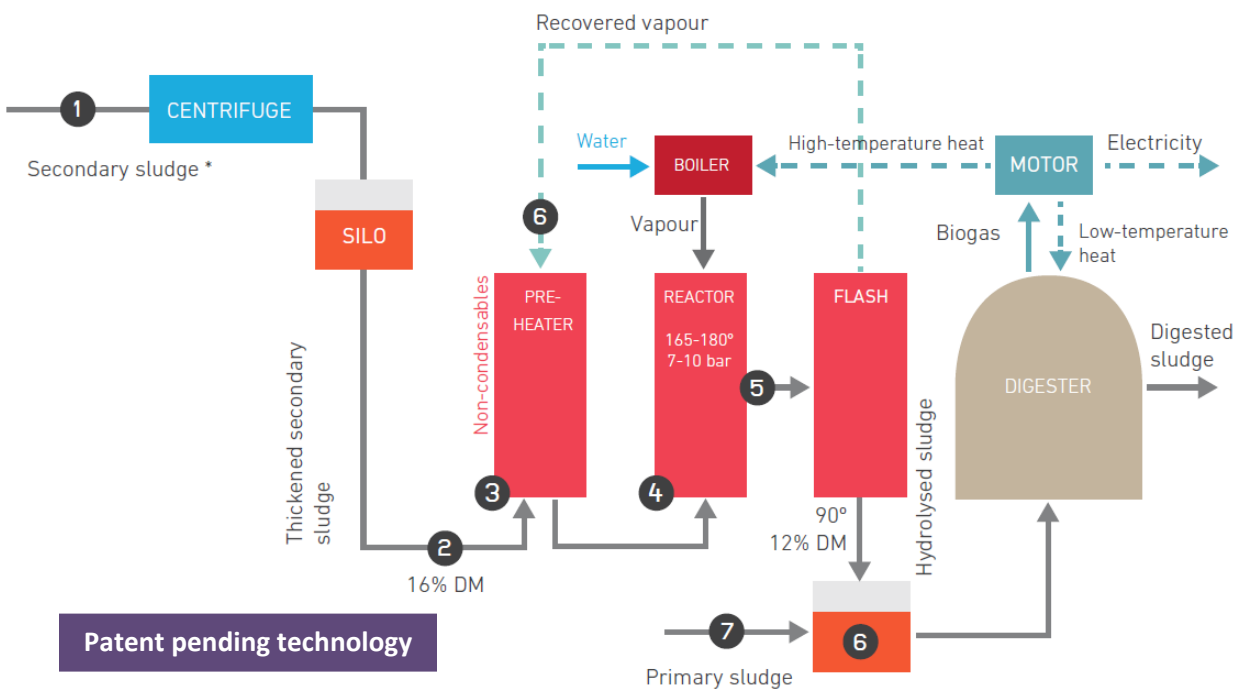
Aqualogy-STC have developed and improved the dryer over 15 years, especially for biosolids applications. A full list of references is described in section 4.3: References. These installations vary widely in size, source of heat and end-use of the biosolids.

2.3 CONTINUOUS THERMAL HYDROLYSIS

Thermal hydrolysis is a process usually implemented prior to anaerobic digestion, throughout which high temperature (329-356°F) (165-180°C) and high pressure (101-145psi) (7-10bar) maintained for 15-30 minutes allows to break the cells of the biosolids. This allows for particulate organic matter to be turned into readily biodegradable matter, thus **enhancing and accelerating anaerobic digestion**. This process also improves the quality of biosolids in terms of **pathogen reduction**, allows to greatly reduce retention time in digesters (thus **reducing the volume and cost of digester units**) and improves **dewatering performance** (thus reducing total quantity of biosolids cake produced).

Aqualogy's thermal hydrolysis consists in 3 steps (illustrated in figure below):

1. *Pre-heating*: using waste steam. This allows for the unit to recover heat and increase the overall energy efficiency
2. *Hydrolysis reactor*: pressure and temperature supplied by steam, produced by a boiler using the waste heat from the biogas CHP itself (completely integrated). This is where the bulk of the reaction takes place
3. *Flash*: sudden decrease in pressure to release the hydrolyzed biosolids, which also allows for further cell disruption



The key features of Aqualogy's thermal hydrolysis technology are:

- ✓ operates in **continuous mode**, allowing for significant reduction of size and cost of the unit, as well as simplifying the control and operation
- ✓ **reduced retention time in the reactor**, allowing for significant reduction of size and cost of the unit

- ✓ **enhanced energy and process integration**: Aqualogy is a wastewater and biosolids process expert. We ensure any process equipment is designed for the specific features of each situation. This includes
  - ➢ energy efficiency: beyond energy recovery within the thermal hydrolysis unit itself, the energy integration also includes the anaerobic digester, engine. For example the heat needed for the thermal hydrolysis is produced by the biogas itself
  - ➢ process efficiency: the thermal hydrolysis is not considered as a sole equipment, but part of an overall advanced digestion process. This allows to ensure its performance both in terms of process efficiency and holistic control of the integrated process
- ✓ The preferred feed into the process is biosolids dewatered to 16% dried solids, this allows for the best balance between biosolids handling and energy efficiency.

Aqualogy has a full-scale plant installed on the wastewater works of Valladolid (Spain). The capacity of the unit is 8gpm (1.8m3/h) biosolids feed at 14%dried solids. The system was designed focusing on energy efficiency. For this reason only the waste activated biosolids is hydrolyzed, and then mixed with the primary biosolids before anaerobic digestion. Overall the system has reached an average of 30% increase in biogas production and 30% reduction in biosolids cake production since the unit was started-up.

Full-scale thermal hydrolysis unit in Valladolid.

2.4 Co-Digestion

Driven by increasing energy costs, high power consumption of wastewater treatment, and sustainability of waste management, recently co-digestion of different types of waste and/or effluents has gained increasing interest. This development has been led both by evolution of regulation in certain countries aiming at supporting emerging sustainable waste management schemes, as well as industrial interest for better use and profit of existing assets.

Aqualogy has taken advantage of its position as an operator of a number of domestic biosolids anaerobic digestion plants to develop key partnerships to implement such schemes on several plants. Aqualogy currently successfully operates 6 plants using co-digestion, and 5 plants are currently in the phase of feasibility study. Aqualogy's typical scope of service includes:

- Feasibility study: available capacity of anaerobic digester system, availability of adequate local organic substrates, planning and permitting
- Equipment installation: usually only silos, dosing pumps and piping work
- Software installation: includes substrate dosing together with anaerobic digester and gas holder management in order to optimize the use of assets at all times
- Operation & Maintenance : management of substrate supply (quantity and type adapted to each plant needs), maintenance of equipment and software

Aqualogy have developed strong expertise in particular on :

- Technical expertise on substrate selection and biosolids/substrate interaction and behavior in c-co-digestion
- Management of the value chain: from the status of liquid waste to the status of valuable organic substrate
- Control software to allow for a simple and automated management for the operator

2.4.1 Co-digestion case study

One of the wastewater treatment plants started operating co-digestion in 2011. Is it located in Spain, near Barcelona. The plant's capacity is 200,000 people equivalent, with a nominal capacity of 34,560m3/d.

It includes 2 anaerobic digesters of 4,200m3 each, with biogas lances mixing system. 2 MAN CHP units (2*250kW installed capacity). The substrate added is an industrial effluent, containing mainly alcohols and with an average COD content beyond 600,000mg/L.

The substrate dosing represents 4-5% in volume of the feed to the anaerobic digester, and is added in the pipe of mixed biosolids feed.

The control system uses gas holder level to control optimized substrate dosing. The biogas production of the plant increased from an average of 1,600Nm3/d up to 3,100Nm3/d after starting co-digestion. This represents an additional +100% of energy production on average with negligible investment.

It has therefore allowed to significantly increase profits using mainly existing assets (digester and engines).

The start-up of co-digestion has not shown any impact on biogas quality (CH4 64% on average and H2S <15ppm in biogas) nor on return liquors and digestate.

The implementation and operation have been very smooth and almost transparent for the operator as the dosing system is fully automated and the substrate supply is fully managed by Aqualogy and its partner Sisltech.

Co-digestion installation. Top left: substrate reception area. Top right: substrate holding tank. Bottom left: substrate dosing pump. Bottom right: substrate injection point in pipe.

2.5 BIOGAS USE

The most common use of biogas on the plants operated by Aqualogy and sister companies is cogeneration using CHP engines (current total installed power 21MW, with CHP units sizes ranging from 130kWe to 2,700kWe and from the main manufacturers: Caterpillar, Guascor, Deutz, Jenbacher, MAN). Aqualogy also operates plants using innovative technologies such as micro-turbines (Capestone), some plants providing heat for district heating, also clean gas used as alternative gas for domestic consumption and Aqualogy and Suez Environment are currently installing several large biomethane production plants for injection in the natural gas grid using different biogas upgrading technologies to produce a biomethane with quality equivalent to natural gas.

Aqualogy has even carried out high profile research and development projects on emerging technologies such as fuel cells. For example, within the the BIOCELL project (www.life-biocell.eu) both low-temperature (PEMFC) and high-temperature fuel cells (SOFC) were successfully tested at pilot scale on wastewater treatment plants. They were fuelled directly with sewage biogas and the results allowed benchmarking these technologies against alternatives such as CHP engines and biomethane production and also identifying bottlenecks for these technologies to be competitive on the biogas market.

The wide variety of biogas quality (which depends on the wastewater characteristics and process parameters) as well as variety of biogas end-uses on Aqualogy plants, has also led to a wide variety of biogas cleaning technologies to be installed and operated on our sites. These include for example: caustic scrubbers, advanced caustic scrubbers (bioscrubber), biotrickling filters, refrigeration, a number of types of activated carbon filters, iron sponge. Moreover, some challenges and needs from the sites led to study and gain expertise on specialist fields such as siloxanes measurement and removal.

Altogether, seeing the variety of situations, economic & regulatory contexts, technologies, customer requirements and interests, Aqualogy also took a holistic view of biogas management and developed an in-house software tool (BiogApp Tool) for feasibility assessments of biogas plants. This tool has allowed Aqualogy to gather all the expertise on feasibility and preliminary design within one software tool, which is now used for internal purposes as well as a basis for consultancy to third parties.

Examples of biogas treatment units on Aqualogy plants. Left: biotrickling filter. Middle: bioscrubber. Right: Activated carbon.

Examples of biogas fuelled CHP engine units on Aqualogy plants.

PART 3. SOLUTION PROPOSAL

3.1 APPROACH

From our understanding of the Biosolids Transition program, we believe that several of our solutions would allow for improving the quality of the biosolids produced as well as recover their energy content. For example we would be keen to introduce advanced anaerobic digestion including our thermal hydrolysis technology and discuss alternatives for the use of the biogas produced. Our understanding is that this option may be more of a medium- or long-term scheme for San José-Santa Clara Regional Wastewater Facility so we will not detail this in this document, however we are keen to discuss if this is considered interesting.

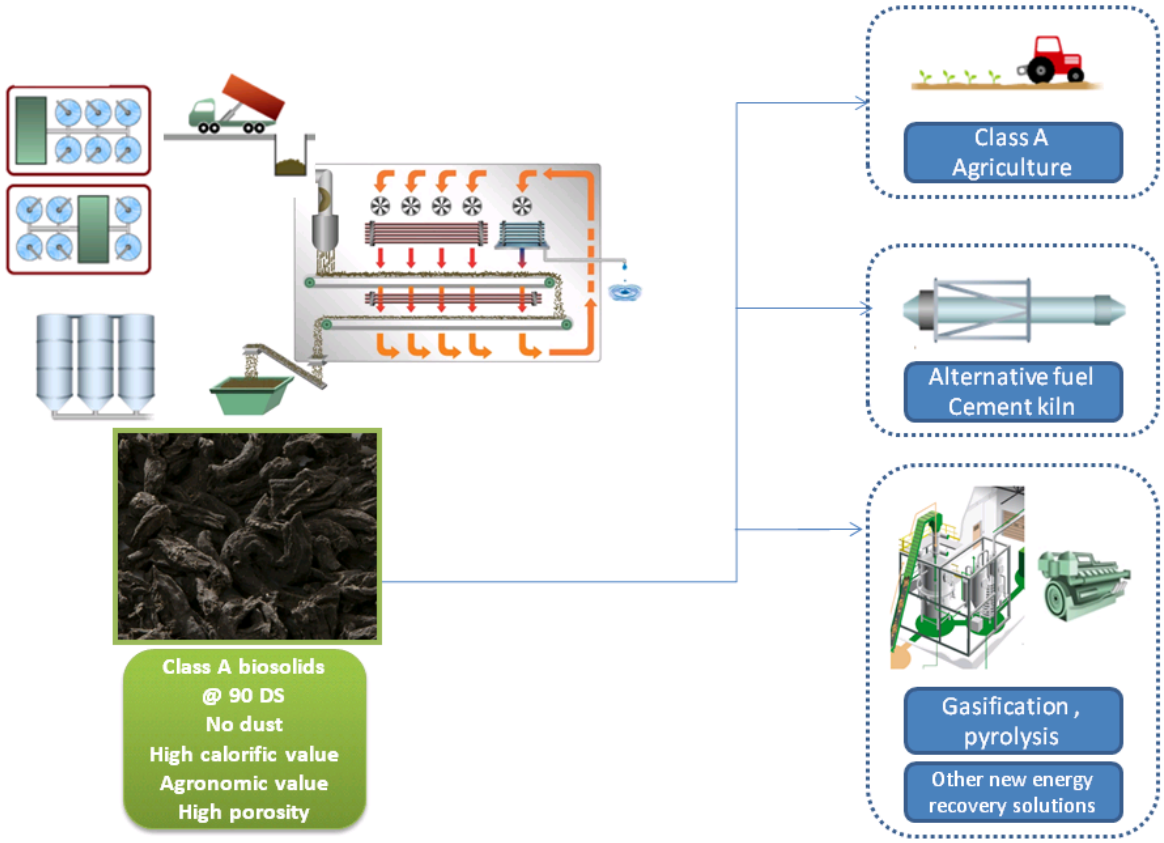
We recommend the best strategy to the City of San Jose, based on a step by step approach starting by a heat drying process to solve the major problem of the actual biosolids use. During the implementation of this first stage City of San Jose would give time to new promising technologies around the scheme "Biosolids-to Energy" to become more mature and reliable. In terms of short term "quick win" solution, we consider that our **STC low temperature drying solution is well suited as a key technology for producing Class A biosolids for San José-Santa Clara Regional Wastewater Facility**. The Class A biosolids produced are then suitable for a number of uses and would therefore offer a range of opportunities for biosolids management. Some of these options are:

- **Land application and reclamation**: our product is stable, easy to store and manipulate and therefore allows for low-term storage to adjust to agriculture land requirements and spreading operations. The product also shows high quality features in terms of pathogen removal (Class A) ensuring the safety in this application and supplying essential nutrients and organic matter to the soil. These properties also allow the product to be well-suited for land reclamation application.

- **Energy recovery – heat production**: our product can be used as alternative fuel, for example in cement kilns or other types of boilers and furnaces. One of our largest installations is located on the premises of a cement plant allowing for a perfect integration of both facilities: the dried product is used as alternative fuel on the cement plant and the heat required for drying is fully supplied by waste heat from the cement plant. We are also keen to install applications using different furnaces, in particular boilers and are currently exploring new options and making key contacts with technology suppliers.

- **Energy recovery – power and heat production**: our product has been tested as a fuel with several pyrolysis and gasification technologies, producing fuel gas to supply an engine and producing power and heat. The product has proved to suit these processes in particular in terms of physical characteristics (density, porosity) which is key to control their behavior in the delicate pyrolysis/gasification reactors. It has allowed for high energy conversion rates and therefore high energy efficiency of the energy recovery. Beyond this, our low-temperature dryer is perfectly suited for being integrated together with such technologies on a same site, allowing for heat recovery and therefore further improving the overall energy efficiency and costs.

USG would be glad to develop a business case for any of these options or a combination of them if needed.



Our full list of references (section 4) gives further detail of the range of applications currently implemented on our installations. Moreover, we are confident that our low temperature drying technology contributes perfectly to reaching the goals set out by City of San José, as described below:

KEY FEATURE	GOAL
Intermediate process producing Class A biosolids Working between 65-80C, it's the heat drying technology most reliable, no operational hazards and very easy to start and stop. Modular design expandable to increase capacity or add other energy sources for drying	Provide a reliable, diversified and flexible biosolids program that can adapt to future regulatory and market changes
Maximum waste heat recovery from actual processes Simple operation and maintenance	Provide a cost effective program
Reduced odor emissions, no dust and minimized exhaust gases. Minimized water consumption No explosive atmosphere zoning, no fire risks	Reduce environmental and community impacts
High quality product (Class A biosolids) with physical characteristics (density, porosity) to maximize efficiency of the energy recovery and absorption in agricultural or land application uses.	Maximize beneficial re-use of biosolids
Many successful references working for more than 10 years	Explore emerging technologies which have been successfully tested at full scale

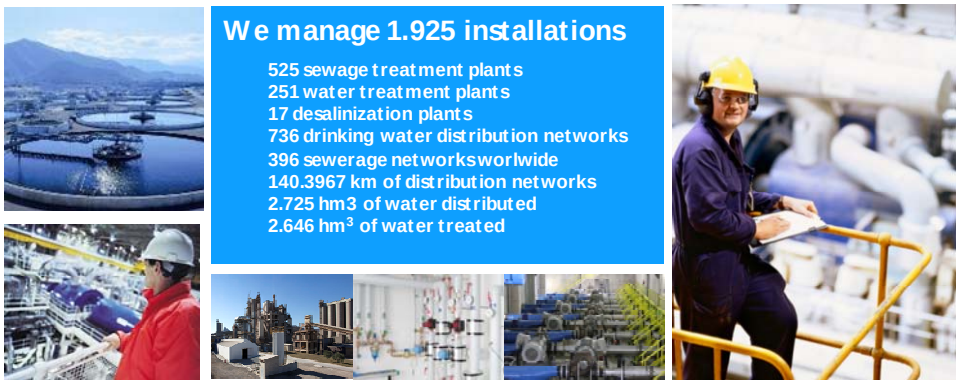
PART 4. QUALIFICATIONS AND EXPERIENCE

4.1 AQUALOGY

Tank in Barcelona,1905

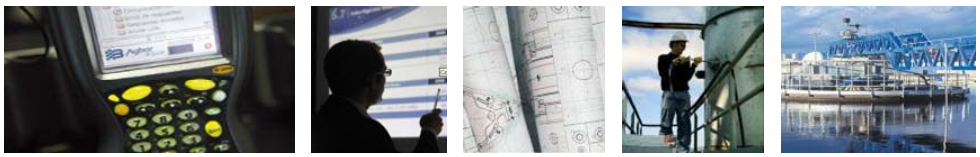
Since 1867, the companies which make up Aqualogy have brought the future to the management of water and the environment, continuously applying new developments, technological advances and knowledge. After over 145 years, Aqualogy is an international benchmark, with a presence many countries like USA (Utility Service Co. Inc.), United Kingdom, Spain, Chile, Brazil, Mexico, Peru, Colombia, Caribbean Islands, Algeria and Turkey. Aqualogy adapts to the needs of the societies in which it participates in order to offer the best services to 25.6 million people every day. Aqualogy shareholders include Suez Environnement, the second largest water company in the world.

At present, Aqualogy manages 1,925 facilities; 525 of these are purification plants, 251 drinking water plants, 17 desalination plants, 736 supply networks and 396 sewage networks.



With a portfolio of 3,500 industrial clients and a presence in more than 15 countries, Aqualogy demonstrates its capacity of adaptation to the environment, and it boasts a knowledge network made up of 16,383 professionals.

Integral solutions provider



Technology | Consulting | Project/ Design | Construction | Operations

Aqualogy positions itself as:

- A supplier and integrator of technologies for the complete water cycle
- A supplier of consulting services for improving the performance of water companies and for industry sectors with intensive consumption of water
- A leading consultant in knowledge management and training of professionals in the complete water cycle
- A partner in project development and infrastructure design in treatment plants, supply and distribution networks, and much more
- An integrator and constructor of infrastructure needed to cover the complete water cycle
- A leading manager and/or operator for the operation of services in the water industry with a sharp focus on the final client

Aqualogy is structured into 4 differentiated lines of business:

Environment

- Management of water resources and water infrastructure
- Control environmental quality (water, air, soil)
- Industrial Water Treatment
- Recovery of biosolids

Solutions

- Transformation Plans
- Integration & Systems
- Revenue Management Services
  - NRW consulting services (Customer DB review, metering and fraud)
  - Business Strategy and Process Reengineering
  - Technology (AquaSuite and Smart Metering)
  - BPO (metering – SICAM+; commercial – COC)
  - Retail: Seguragua

Knowledge

- HR Consulting
- Professional Training program development
- Implementation of solutions to identify, share, generate and transfer knowledge

Infrastructures

- Design and implementation of hydraulic installations and exploitation
- Works related to water treatment facilities turtles (ITAM) wastewater treatment plant (WWTP), drinking water (DWTP) and its ducts and accessories

4.2 Utility Service Co., Inc.'s Parent Company, SUEZ ENVIRONNEMENT

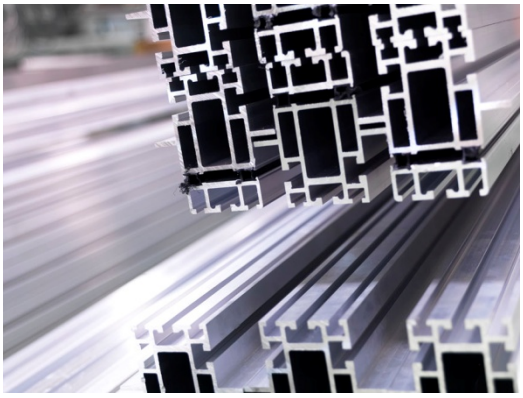
SUEZ Environnement is a global technology and environmental services provider specializing exclusively in water and waste management. It pursues an international growth policy that connects sustainable development with economic value. The SUEZ Environnement Group vision is based on a simple value proposition: enabling its customers to achieve their environmental and operational performance goals. By maximizing the potential of its water and waste management businesses, the Group addresses environmental issues facing local authorities, manufacturers, and utilities while promoting green growth. A core competency of the Group is to make innovation a driver for excellence.

4.3 References

SUMMARY			
WWTP	**Capacity (wet tons per year)**	**Technology**	**Commissioning date**
Limeira - São Paulo (Brazil)	15,000 tpy	Heat pump	In execution
Huddersfield – Bradford (UK)	8,000 tpy	Hot water exploitation	In execution
St Marcellin – Rhône-Alpes (France)	6,000 tpy	Hot water from biomass (wood) and biogas boilers	2013
Shanganagh – Dublin (Ireland)	18,000 tpy	Hot water from cogeneration engines (exhaust gases)+ biogas boiler	2012
Melilla (Spain)	6,600 tpy	Heat pump	2012
Cemex Factory – Alicante (Spain)	57,000 tpy	Hot water from waste energy from cement industry	2011
Lugo (Spain)	20,000 tpy	Hot water (natural gas boiler)	2011
Besos – Barcelona (Spain)	160,000 tpy	Hot water from cogeneration engines (exhaust gases + engine cooling water)	2009
Guillarei – Pontevedra (Spain)	10,000 tpy	Hot water from a natural gas boiler	2009
Guadalhorce – Málaga (Spain)	70,000 tpy	Hot water from cogeneration engines (exhaust gases + engine cooling water)	2007
Motril – Granada (Spain)	15,000 tpy	Hot water from natural gas boiler	2006
Reguerona – Asturias (Spain)	15,000 tpy	Hot water from natural gas boiler	2005
Louis Fargue - Bordeaux (France)	15,000 tpy	Heat pump + 33% hot water recovery from site biogas	2003

SUMMARY			
WWTP	**Capacity (wet tons per year)**	**Technology**	**Commissioning date**
Lorca – Murcia (Spain)	40,000 tpy	Hot water from cogeneration engine (only cooling water exploitation)	2002
Ibi – Alicante (Spain)	6,000 tpy	Heat pump + cogeneration engine	2000
Baiña – Asturias (Spain)	5,000 tpy	Heat pump	1998

Limeira WWTP (São Paulo - BRAZIL)



Final customer	FOZ DO BRASIL
Bid winner (Client)	FOZ DO BRASIL – AQUALOGY
Biosolids type	Urban digested sludge
Biosolids capacity	15,000 wet tons per year
Initial solids content	25%
Final solids content	>80%
Water evaporation capacity	1 line x 1.575 l/h
Technology	Hot water recovery
Use of biosolids	All options
Commissioning date	Under construction (2013)
Additional information	Aqualogy will supply, install and operate in guarantee one of the most cutting-edge solutions in the thermal drying domain, the low temperature STC system, which has been in this occasion specially designed to foresee future enlargement. This operation will permit to treat the whole sludge volume from the Brazilian city of Limeira (280,000 people), located at the state of São Paulo.

Huddersfield WWTP (Bradford - UK)

Final customer	YORKSHIRE WATER
Bid winner (Client)	AQUALOGY ENVIRONMENT LTD.
Biosolids type	Municipal mixed sludge
Biosolids capacity	8,000 wet tons per year
Initial solids content	20 - 30%
Final solids content	≥ 90%
Water evaporation capacity	1 line x 1,590 pph (H2O)
Technology	Hot water exploitation
Use of biosolids	Energy valorization
Commissioning date	In execution (2014)
Additional information	Aqualogy UK has been awarded with the design, delivery and installation of a thermal sludge dryer for the WWTP Huddersfield (Bradford) for Yorkshire Water. The solution, for the treatment of 1 t/h of municipal sludge is based on the STC thermal drying system at low temperature, technology owned by Aqualogy. The Project is based on a monoblock dryer, container sized, with cover integrated on the dryer, which allows the simplification of the mounting and commissioning processes and gives fast response to short delivery times. In this occasion the on-site assembly has been completed in 2 weeks. Yorkshire Water is one of the main actors in the water treatment sector in the UK, serving to around 5 million of equivalent inhabitants. The dryer is a part of an ambitious Project for thermal sludge valorization.

St Marcellin WWTP (Rhône-Alpes - FRANCE)

Final customer	SIVOM St Marcellin
Bid winner (Client)	Degremont France Assainissement
Biosolids type	Digested Sludge
Biosolids capacity	6,000 wet tons per year
Initial solids content	22%
Final solids content	90%
Water evaporation capacity	1,245 pph (H2O)
Technology	Use of hot water coming from a biomass boiler (wood)
Use of biosolids	All options
Commissioning date	2013
Additional information	The company Degremont Services has given us the opportunity to design in this project a Monoblock installation in France, project that incorporates as a new option the use of a biomass boiler (wood chips) as calorific source for the sludge thermal drying treatment. The Monoblock equipment has been specially designed to be a simple and competitive solution when there is a need of treating both industrial and small WWTP sludge. The main advantage of this equipment is the possibility of a PLU&PLY type of delivery, minimizing commissioning time.

Shanganagh WWTP
(Bahie Dublin - IRELAND)

Final customer	DLRCC – DUN Laoghaire Rathdown Country Council
Bid winner (Client)	SDD Construction Joint Venture (Sisk + Dragados + Drace Medio Ambiente)
Biosolids type	Digested sludge
Biosolids capacity	18,000 wet tons per year
Initial solids content	22 %
Final solids content	>90%
Water evaporation capacity	2 dryers of 1.1,100 pph (H2O)/dryer
Technology	Use of hot water coming from cogeneration engines (exhaust gases+ engine cooling water) + biogas boiler
Use of biosolids	All options
Commissioning date	2012
Further information	The SDD construction Joint Venture, formed by Drace Medio Ambiente, Dragados S.A. and the irish construction company John Sisk and Son Ltd., has given us the opportunity to participate in the Shanganagh WWTP project based on a 25 years BOT, which serves the southeast of Dublin. This challenge has been possible thanks to the continuous improvement effort in our technology.

Melilla WWTP (Melilla - SPAIN)

Final customer	City of Melilla
Bid winner (Client)	Cadagua / Acciona Infraestructuras
Biosolids type	Digested sludge
Biosolids capacity	6,600 wet tons per year
Initial solids content	25%
Final solids content	> 70%
Water evaporation capacity	1,245 pph (H2O)
Technology	Heat pump
Use of biosolids	All options
Commissioning date	2012
Additional information	The Monoblock equipment represents STC's commitment to innovate, providing a simple and competitive solution for industrial sludge treatment and small urban treatment plants. In this case, it was developed an installation without lateral closure but with roof. Due to the fact that there is no natural gas supply in the area where the equipment is installed, heat pump technology has been chosen as system's energetic source. With a capacity of up to 5,000 t/year of sludge, this equipment is based on the PLUG&PLAY concept. It is transported fully complete and tested from the factory, which minimizes on-site installation time.

CEMEX FACTORY (Alicante - SPAIN)

Final customer	EMARASA (City of Alicante joint venture with AGBAR)
Bid winner (Client)	Private investment
Biosolids type	Municipal sludge
Biosolids capacity	57,000 wet tons per year
Initial solids content	20-30%
Final solids content	80-90%
Water evaporation capacity	2 dryers of 6,610 pph (H2O) each dryer
Technology	Hot water exploitation from cement processes residual energy
Use of biosolids	Biofuel in cement factory and agricultural use
Commissioning date	2011
Additional information	This facility is located inside the facilities of CEMEX's cement factory in San Vicente del Raspeig and is designed as an external treatment plan (multi-management) for sludge from different treatment plants in the city of Alicante and surrounding areas. This installation's main innovative feature is that the heat used for the drying process is a result of recovering the extra heat from the cement factory. This allows a considerable CO_2 quota saving since primary energy is not used for the drying process. The dry sludge can be used in agriculture or sent for energy recovery at the cement factory.

LUGO WWTP (Lugo - SPAIN)

Final customer	CONFEDERACIÓN HIDROGRÁFICA DEL NORTE
Bid winner (Client)	ACCIONA AGUA
Biosolids type	Digested sludge
Biosolids capacity	20,000 wet tons per year
Initial solids content	22 %
Final solids content	>90%
Water evaporation capacity	1 dryer x 4,410 pph each dryer
Technology	Hot water exploitation
Use of biosolids	Energy recovery
Commissioning date	2011
Additional information	This facility has been installed in a new WWTP, following the main quality standards of implementation of WWTP A pneumatic transport of sludge from the dryer to the containers has also been installed, and taking special care of safety aspects in the operation.

METROFANG WWTP (Barcelona - SPAIN)

Final customer	METROFANG
Bid winner (Client)	METROFANG
Biosolids type	Primary + activated sludge
Biosolids capacity	180,000 wet tons per year
Initial solids content	30-35%
Final solids content	>90%
Water evaporation capacity	4 dryers of 8,820 pph (H2O) each dryer
Technology	Use of hot water from Cogeneration engines (exhaust gases + cooling water)
Use of biosolids	Energy recovery
Commissioning date	2009
Additional information	This facility treats 30% of the sludge generated in the entire Catalonia region. Set in the heart of the tourist centre of Barcelona, next to the FORUM facilities and Barcelona beach, it represents STC's consolidation in terms of large facilities (35.280 pph H2O). During the engineering design process, particular attention was paid to safety and environmental aspects (mainly during the deodorization stage). At this facility, STC also carried out adaptation of existing sludge conveyor systems and use of heat energy from cogeneration. A 15-year warranty agreement was signed for this facility.

GUILLAREI WWTP (Pontevedra-SPAIN)

Final customer	CONFEDERACIÓN HIDROGRÁFICA DEL NORTE
Bid winner (Client)	EDAR GUILLAREI UTE (Ferrovial- Cadagua)
Biosolids type	Municipal sludge
Biosolids capacity	10,000 wet tons per year
Initial solids content	25%
Final solids content	80-90%
Water evaporation capacity	1 dryer of 2,200 pph (H2O)
Technology	Hot water from natural gas boiler
Use of biosolids	All options
Commissioning date	2009
Additional information	The facility built at the GUILLAREI WWTP for CADAGUA and CONFEDERACIÓN HIDROGRÁFICA DEL NORTE consolidated STC in the north of Spain.

GUADALHORCE
WWTP (Málaga - SPAIN)

Final customer	EMASA – City of Malaga
Bid winner (Client)	Infilco
Biosolids type	Municipal sludge
Biosolids capacity	70,000 wet tons per year
Initial solids content	27-30%
Final solids content	80-90%
Water evaporation capacity	2 dryers of 8,000 pph (H2O) each dryer
Technology	Use of hot water from Cogeneration engines (exhaust gases + cooling water)
Use of biosolids	All options
Commissioning date	2007
Additional information	The company ACCIONA AGUA and EMASA have given us the chance to build a facility with maximum treatment capacity per line (8,000 pph H2O/line). The special location of the treatment plant, which is near a shopping center, required the construction of a confinement building for the facilities. The parties signed a 5-year global warranty agreement.

MOTRIL WWTP (Granada - SPAIN)

Final customer	MANCOMUNIDAD DE MUNICIPIOS DE LA COSTA TROPICAL DE GRANADA
Bid winner (Client)	AGUAS Y SERVICIOS (PRIDESA- FCC)
Biosolids type	Municipal sludge
Biosolids capacity	15,000 wet tons per year
Initial solids content	22-25%
Final solids content	80-90%
Water evaporation capacity	1 dryer of 1.1,100 pph (H2O)
Technology	Hot water from natural gas boiler
Use of biosolids	Agricultural direct use and/or compost
Commissioning date	2006
Additional information	At this facility, AGUAS y SERVICIOS and the Mancomunidad de la Costa Tropical de Granada entrusted a “turn-key project” to us. STC completed all of the engineering process and built all the facility, including a sludge collection hopper, wet sludge conveyor system and dry sludge conveyor system. For this facility, STC developed a pneumatic conveyer system for dry sludge, which allows greater flexibility during the sludge transport and cooling phase prior to storage, without any dust being created. The facility is designed to treat sludge from the Motril WWTP and up to 15% of external sludge from other facilities.

REGUERONA WWTP (Asturias-SPAIN)

Final customer	CONFEDERACIÓN HIDROGRÁFICA DEL NORTE
Bid winner (Client)	UTE CADAGUA – FERROVIAL AGROMAN
Biosolids type	Primary municipal sludge with industrial load
Biosolids capacity	15,000 wet tons per year
Initial solids content	22-25%
Final solids content	80-90%
Water evaporation capacity	1 dryer of 1.1,100 pph (H2O)
Technology	Hot water exploitation coming from a natural gas boiler
Use of biosolids	All options
Commissioning date	2005
Further information	The facility built at the REGUERONA WWTP for CADAGUA and CONFEDERACIÓN HIDROGRÁFICA DEL NORTE recovers the heat produced in a natural gas boiler and the water condensation takes place through an exchange with the water eliminated from the treatment plant, once this has passed through a filter.

LOUIS FARGUE WWTP - (Bordeaux - FRANCE)

Final customer	LYONNAISE DES EAUX (Private Investment)
Bid winner (Client)	LYONNAISE DES EAUX (Private Investment)
Biosolids type	Municipal sludge with industrial load
Biosolids capacity	15,000 wet tons per year
Initial solids content	28-30%
Final solids content	80-90%
Water evaporation capacity	1 dryer of 3,090 pph (H2O)
Technology	Heat pump + 33% hot water (biogas boiler)
Use of biosolids	Biofuel for a cement Plant
Commissioning date	2003
Additional information	This facility involved a huge effort to adapt to the treatment plant's special safety and operation conditions (17 hours of continual operation without staff present) Despite the difficulties of this project, STC technology was improved and adapted to the strictest European standards. This facility incorporates a mixed operation concept: all of the available heat from the biogas is used, which is burned in a hot water boiler and the heat requirements are completed using heat pump technology, with both technologies working simultaneously.

Lorca WWTP (Murcia - SPAIN)

Final customer	AQUAGEST LEVANTE (Private investment)
Bid winner (Client)	AQUAGEST LEVANTE (Private investment)
Biosolids type	Industrial sludge (tanning sector)
Biosolids capacity	40,000 wet tons per year
Initial solids content	22-25%
Final solids content	80-85%
Water evaporation capacity	2 dryers of 4,410 pph (H2O) each dryer
Technology	90 to 80ºC hot water exploitation (cogeneration engine cooling water heat exploitation)
Use of biosolids	Landfill
Commissioning date	2002
Additional information	With this facility, the AGBAR group gave us the chance to significantly increase installed drying capacity. Since the water comes from tanned leather treatment, sulphur levels in the sludge are high and the facility has performed as required. At this facility, only cooling heat from the installed cogeneration motors is used.

Ibi WWTP (Alicante - SPAIN)

Final customer	SANEJAMENT D'AIGÜES DE LA COMUNITAT VALENCIANA (EPSAR)
Bid winner (Client)	SEARSA
Biosolids type	45% municipal sludge+ 55% industrial sludge. Primary and biological sludge from belt filters
Biosolids capacity	6,000 wet tons per year
Initial solids content	25%
Final solids content	85%
Water evaporation capacity	1,320 pph (H2O)
Technology	Heat pump + exploitation of cogeneration heat
Use of biosolids	THW waste manager
Commissioning date	2000
Additional information	The main innovative feature of this facility was the introduction of a cogeneration system in the heat pump system. This uses both heat from the motor exhaust gases and cooling heat, resulting in maximum use of energy. This facility can alternate between both heat sources in accordance with the prices of different fuels. We are proud to state that since the facility was started up, 100% of the sludge generated in the WWTP has been dried thermally.

Baiña WWTP (Asturias - SPAIN)

Final customer	CONSEJERIA DE FOMENTO DEL PRINCIPADO DE ASTURIAS
Bid winner (Client)	PRIDESA
Biosolids type	Sewage sludge, lime stabilization, filter press
Biosolids capacity	5,000 wet tons per year
Initial solids content	40%
Final solids content	88%
Water evaporation capacity	1,100 pph (H2O)
Technology	Heat Pump
Use of biosolids	Landfill
Commissioning date	1998
Additional information	STC had opportunity to build the first industrial facility in Baiña WWTP thanks to the confidence given by the Regional Ministry for Public Works of the Asturias Principality. For this installation, apart from the sludge management system, a heat pump facility with a variable adjustment option depending on each processing area was also developed

APPENDIX 1: ATEX EVALUATION REPORT

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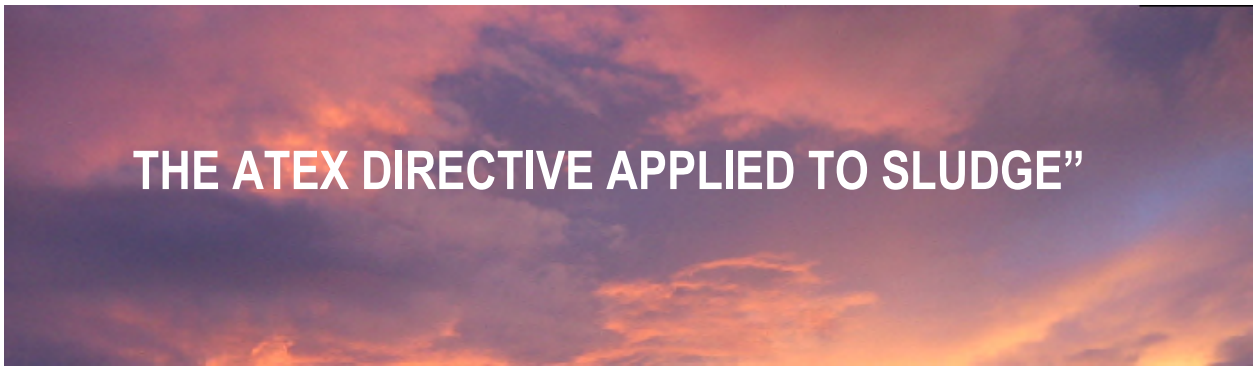

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HISTORY

The activity of thermal sludge drying is one which falls within the scope of application of the Directives on protection against explosive atmospheres (ATEX), leading AQUALOGY STC to carry out an analysis of the implications and requirements of the said legislation, to be taken into account in:

- Basic and detailed engineering for the installation of equipment in a WWTP
- The operation of AQUALOGY STC equipment by the final client

To this end, we have requested the cooperation of "Institut National de l'Environnement Industriel et des Risques" (INERIS - National Institute of the Industrial Environment and Risk), associated with the French Ministry for the Environment, in light of its reputation, certification, extensive experience and resources for the preparation of risk assessment reports.

The assessment carried out includes not only the thermal drying equipment, but also the usual peripheral equipment that is needed for the operation of a dryer, such as those used for the storage and transportation of dry and wet sludge.

This report has been drawn up in such a way as to present and summarise the information supplied by INERIS, from the following documentation:

- Risk assessment report no. 81818/02
- Presentation DRA 2004
- STC PRESENTATION: CREATION OF AWARENESS OF EXPLOSIVE ENVIRONMENT RISKS

For full information, please refer to the original documents.

This report presents a SUMMARY of data on the application of the ATEX Directive in the field of thermal sludge drying.

The aim of said data is to document the difference that exists between equipment that is INTRINSICALLY SAFE and one in which there exists an Explosive Atmosphere, including the safety and corrective measures that need to be taken into account in equipment that is subject to the said legislation.

AQUALOGY STC's equipment is the only equipment on the market that can be defined as "intrinsically safe", since no ATEX zones have been identified in relation to it, either in normal or abnormal operation, hence it does not require any protective measure to be adopted.

In all other cases, since there is a possibility of an explosive atmosphere occurring, safety is thus compromised by the reliability of the protective measures.

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1. REGULATORY ASPECTS

1.1 Applicable Legislation

The following legislation applies to protection against explosive atmospheres (AT EX = Explosive Atmosphere):

- Directive 83/391: Framework directive
- ATEX Directive 94/9/EC: Applicable to protective equipment and systems used in potentially explosive and equivalent atmospheres
- **ATEX Directive 1999/92/EC:** Defines the minimum provisions for the health protection and the safety of employees exposed to the risks associated with explosive atmospheres. **This is the regulation that indicates the obligations of operators of equipment**

The objective of the said directives is to protect employees and the environment.

1.2 The ATEX Directive - 199/92/EC. Objective and associated obligations

The objective of the said directive is to ensure the prevention of explosions and protection against them, adopting measures to:

- prevent the formation of ATEX
- prevent the ignition of ATEX
- attenuate the harmful effects of explosions

in the said order of priority.

The obligations established by the ATEX Directive 1999/92/EC, for the **manager of an establishment**, are:

1 – **Assessment** of the risks of explosion

2 – **Classification** of explosive atmosphere sites that may occur

3 – Particular provisions applying to **equipment and materials**

4 – Measures to **prevent** explosions and **protect** against the effects thereof

5 – **Organisational** measures

6 – **Documentation** relating to protection against explosions, which states all of the abovementioned obligations

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2. DEVELOPMENTS AS REGARDS THE OBLIGATIONS ESTABLISHED BY THE ATEX DIRECTIVE

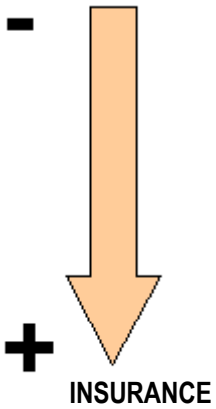
2.1 ASSESSMENT OF EXPLOSION RISK

To evaluate the risk of explosion, the following should be taken into consideration:

- The probability of the formation of an ATEX
- The probability of ignition of the ATEX, according to the nature of the processes, the equipment and the properties of the products involved
- The foreseeable consequences

2.2 THE CLASSIFICATION OF ATEX ZONES

The different ATEX zones are defined according to the frequency and duration of the presence of ATEX, however the intensity of the foreseeable effects in the event of an explosion should also be considered. The following ATEX zones have been established:



GASSES	DUST	DEFINITION
Zone 0	**Zone 20**	An ATEX is present **continuously and during long periods of time**
Zone 1	**Zone 21**	An ATEX is likely to occur **occasionally in NORMAL operation**
Zone 2	**Zone 22**	An ATEX could occur in **ABNORMAL functioning**
not classified		An ATEX **cannot be formed**, in **NORMAL** or **ABNORMAL** operation

When designing and characterising equipment, the aim is to obtain the **least restrictive classification** possible, as this implies a **lesser possibility of the formation of an explosive atmosphere**. For this reason, measures or provisions that reduce the possibility of the formation of an explosive atmosphere should be prioritised - therefore implying a less restrictive classification – over and above measures that prevent its ignition.

2.3 PARTICULAR PROVISIONS IN RELATION TO EQUIPMENT AND MATERIALS

Installed material should be adapted in accordance with the ATEX defined. Material is classified into 3 categories, according to the level of protection it affords against explosions.

Classified zones should be properly identified (yellow triangle with the text EX.).

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2.4 MEASURES TO PREVENT EXPLOSIONS AND PROTECT AGAINST THE EFFECTS THEREOF

Where necessary, measures of prevention and protection are as follows, in order of their effectiveness:

1 **Prevention of the formation of an ATEX**

- Reduction in the concentration of dust, through cleaning, aspiration, etc., and/or control of the atmosphere of premises
- Eliminating useless deposits, through adequate design and/or regular cleaning of equipment
- Preventing the formation of clouds, for example, through the elimination of compressed air, etc.

2 **Prevention of the formation of ATEX by inertisation, which requires:**

- Oxygen concentration 2% lower than the oxygen concentration limit (OLC)
- Closed equipment with effective control of the concentration of oxygen
- Inerting gases: N_2, CO_2, water vapour, air, etc.
- Attention to risk of anoxia

3 **Prevention of the ignition of ATEX**, through the elimination of all active sources of ignition (including those of electrostatic origin). The 13 possible sources of ignition are:

1. hot surfaces
2. flames or hot gasses, including hot particles
3. sparks of mechanical origin
4. electrical devices
5. static electricity
6. lightning
7. parasitic electrical currents
8. high frequency radiation
9. optical radiation
10. ionising radiation
11. ultrasound
12. adiabatic compression
13. exothermic reactions, including fermentation and self-ignition

2.5 ORGANISATIONAL MEASURES

Organisational measures, where necessary, may include:

- The hiring of specialised personnel, as specific training is required for employees exposed to risks of explosion
- Written instructions and authorisation for the execution of certain types of work, such as procedures, fire licenses, etc.

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- Instructions: for cleaning, preventative maintenance, regular controls, coordination of work, etc.
- Planning of procedures, insurance, RESPONSIBILITIES, etc., in case of accident.

2.6 DOCUMENT RELATING TO PROTECTION AGAINST EXPLOSIONS

The protection document should include the following, among other information:

- The **risks** of explosion that have been **determined and assessed**
- The **appropriate steps that would be taken** to comply with the protection objectives (technical and/or organisational)
- What are the **sites classified into zones**

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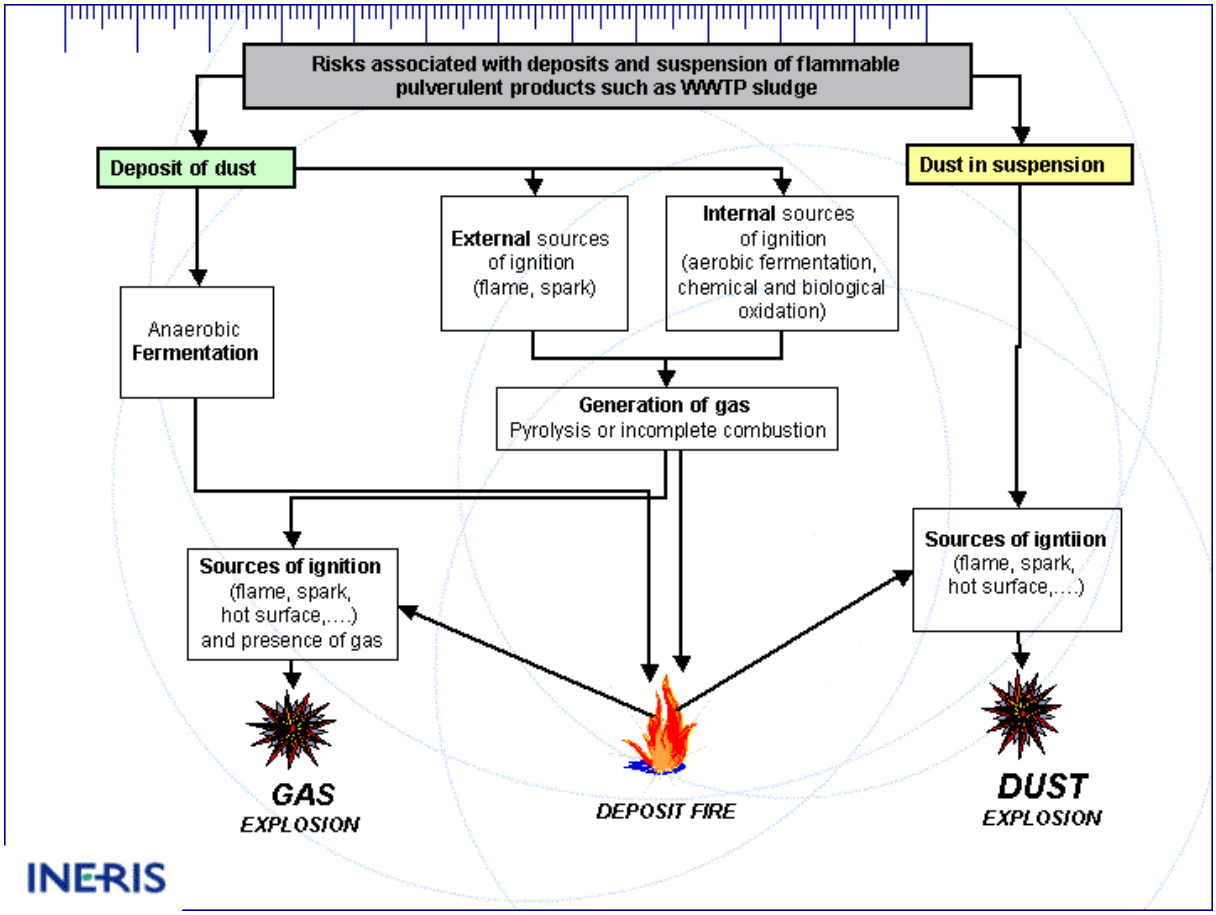
3. PHENOMENOLOGICAL ASPECTS: RISKS APPLIED TO SLUDGE

All risks applied to treatment sludge are described in the following chart:



Source: INERIS – STC 2006 Presentation.

In the specific case of sludge, **the associated risks** are:

- **Aerobic fermentation, chemical and biological oxidation of wet sludge:** All of which are exothermic reactions that could raise the temperature of the mass, giving rise to the **self-ignition of the sludge** (see the temperature-height curve of the layer)
- **Anaerobic fermentation:** exothermic reactions that could raise the temperature of the mass, giving rise to the **self-ignition of the sludge** (see the temperature-height curve of the layer) and/or the generation of **CH_4**, which is an **explosive gas**. Gasses such as H_2S and NH_3, released during thermal sludge drying operations, are not considered to be gasses that are likely to create dangerous explosive atmospheres

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- **Self-ignition of the sludge** implies a deposit **fire** and the generation of **CO**, which is an **explosive gas**, which, in the presence of a source of ignition, could generate a **gas explosion**.
- **Dust explosion:** When a **gas explosion** is generated, a mass of dust can be put into suspension, which could generate a **dust explosion**, in the presence of a source of ignition

The **specific conditions** for sludge in which these phenomena can occur are as follows:

- **Self-heating:**
  - Humidity > 20% with resistance times of over 48 hrs
  - Minimum ignition temperature of layer > temperature relation of product vs height of layer, indicated in the accompanying chart
  - Combustibility: Between BZ3-BZ5
- **Dust explosion:** Can occur in cases where the following conditions prevail
  - Minimum explosible concentration: > 60-500 g/m^3, according to the sludge
  - Maximum oxygen concentration > 12-17% v/v
  - Minimum ignition energy > 100-10,000 mJ
  - Minimum cloud ignition temperature > 360-550 ºC

Important note: An oxygen content of less than 10% (2% lower than the maximum oxygen concentration) prevents the explosion; however self-combustion of the layer is still a possibility

In the event of an explosion, the characteristics of explosions generated by sludge are:

- Maximum explosion pressure < 4.7-9.0 bar
- Constant characteristic (Kst or kmax)< 30-200 bar m/s

As can be observed, the conditions required for dust explosions to occur are in themselves quite restrictive (T > 360ºC and concentrations > 60-500 g/m^3), which means that it is not likely that an explosive atmosphere would be generated **solely** due to a dust explosion.

The greater probability of an explosive atmosphere being generated in sludge is associated with the following phenomenon:

1) **Self-ignition** of the layer
2) **Fire** and generation of **CO**
3) **CO explosion**
4) Wave of pressure which places a dust deposit into suspension
5) **Secondary dust explosion**

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Thus, the priority measure and the one that is the most effective is the obtaining of some conditions that allow us to prevent the self-ignition of sludge.

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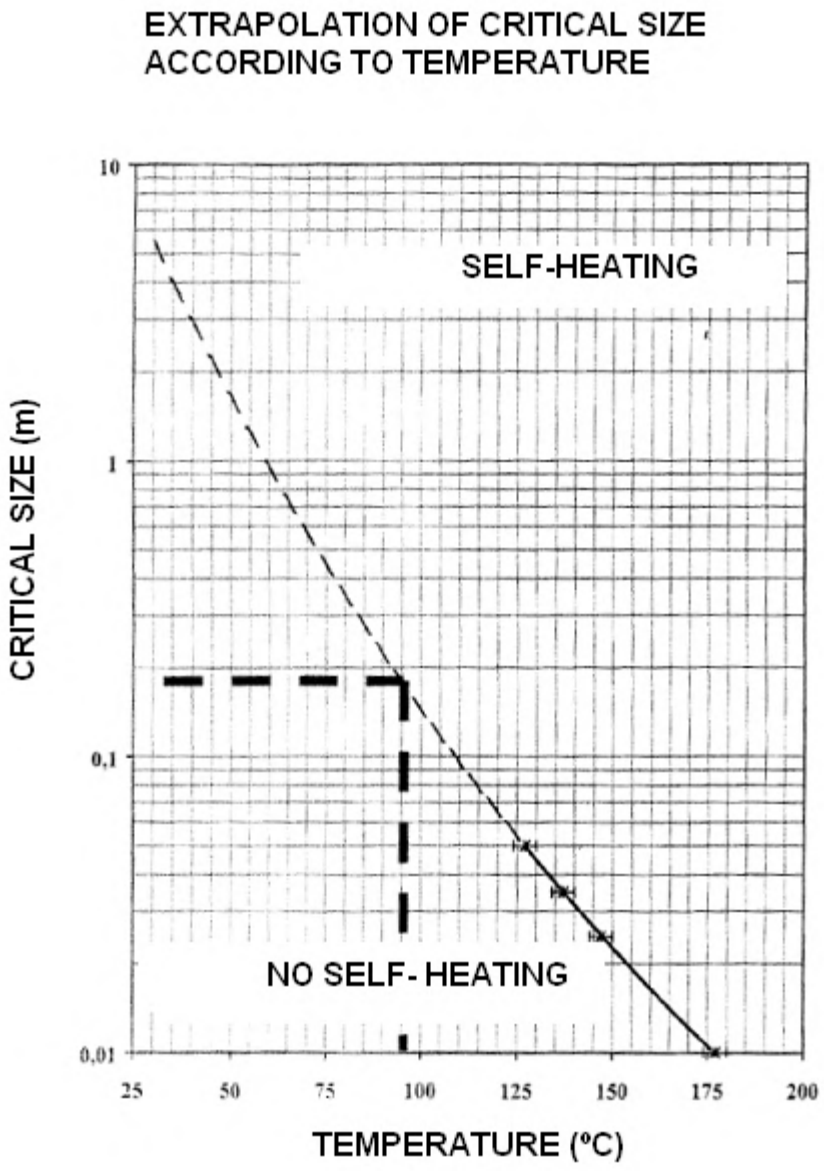
The following graph describes the critical size of a layer of **treatment sludge** according to temperature, which may or may not lead to a risk of self-ignition:



Source: INERIS – Report no. 81818/02

As can be observed from the graph, at a temperature of **100ºC, any layer with a height of more than 11 cm** is prone to self-ignition. For a **layer of 5 cm, a temperature of more than 125 ºC** is within the zone of possible self-ignition

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In the case of AQUALOGY STC equipment, the maximum possible temperature is 80ºC, hence the layer of sludge would need to be more than 30 cm, which is not possible in the configuration in which the equipment was designed.

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4. EXPLOSIVE ATMOSPHERE EVALUATION IN AQUALOGY STC EQUIPMENT

The explosive atmosphere assessment carried out by INERIS on AQUALOGY STC equipment led to the following conclusions, which are listed in a literal manner:

> "The company STC has requested that INERIS examine the level of safety in relation to risks of self-ignition, fire and explosion of a sludge-drying facility (dryer and peripheral equipment for the transportation of sludge).
>
> In relation to the dryer, as a concept, this type of process is already very secure, both in terms of normal function and during transitional phases (start-up, stopping, maintenance). Furthermore, the risk of self-ignition is negligible for produce deposited in the drying belt in the tunnel at working temperature. **This leads us to identify no explosive atmosphere zones for this equipment. This leads us to conclude that electrical and non-electrical materials contained in the tunnel do not require ATEX certification. Due to the absence of an explosive atmosphere involving gas or dust, we do not consider that this type of equipment needs to be operated in the presence of preventative inert gas.**
>
> In terms of peripheral equipment, only the upper part of the dry sludge silo is classified, which is, of course, normal. The risk of self-ignition is specified according to the size of storage and the temperature of the product.
>
> It has been recommended that the safety of the installation be improved under the supervision of our employees who have technical knowledge of the project. It may be possible to adapt these recommendations through discussion with STC's engineer who is responsible for the project.
>
> The recommended devices will heighten the already high level of safety in an inherent manner. They will lead to an improvement in the fire safety of the process and on auxiliary devices. We would like to reiterate that the conditions of operation and in particular those relating to the cleaning and maintenance instructions of the manufacturer play an important role in the safety of the equipment when in use."

Source: INERIS – Report 81818/05/2

For all other information, please see the complete report and translation, which are attached to this report.

5. CONTACT DETAILS

For additional information, please contact:

AQUALOGY SISTEMAS DE TRANSFERENCIA DE CALOR, S.A.

Avda. Hnos Bou s/n - Apdo. 1157 – E 12080 CASTELLÓN

Tel.: +34 964-261183 Fax: +34 964-260157

E-mail: stc@stcsa.es - www.stcsa.es

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VitAg Corporation / CDM Smith, Inc.

Dana G Taylor, VP Project Development
77 B West Street, West Hatfield, 01088
Tel:413-247-9316 ; Fax: 413-247-9401
Cell:413-530-5310
Email: dtaylor@vitagcorp.com
Website: www.vitagcorp.com

July 16, 2014

Mr. Mark Giovannetti

City of San Jose
200 E Santa Clara St
San Jose, CA 95113-1903
United States

VitAg Corporation ("VitAg") is pleased to participate in a joint response to your Request For Information (RFI) in coordination with CDM Smith for your consideration for a biosolids processing solution for the wastewater treatment facility operated by the San Jose-Santa Clara Regional Wastewater Facility(SJSCRWF).

Our VitAg Team approach offers the very best state-of-the-art biosolids technology in the VitAg proprietary Ammonium Mix ("*AM*") Process wherein the SJSCRWF biosolids would be used as an additive to create a very effective high nitrogen dry slow-release granular fertilizer that sells directly into the national wholesale commercial fertilizer distribution system. The VitAg approach is NOT a traditional biosolids land application program and it is NOT a biosolids-to-dry pellet project!

VitAg presently has an operating *AM* Process Demonstration Plant in Lakeland, FL. I would like to extend an invitation to the RFI Selection Committee to visit the Lakeland facility during the proposal review period at their convenience.

More importantly, VitAg has recently completed raising approximately $114 million of debt and equity capital to, among other things, commence construction of a VitAg plant in Zellwood, Orange County, Florida. VitAg and CDM Smith have completed the engineering and permitting for the first of its modular VitAg biosolids-to fertilizer facilities. This standard sized VitAg manufacturing plant is capable of processing approximately 239 wet tons per day at 16% solids (87,000 wet tons per year) of dewatered biosolids.

VitAg will market and distribute all of the resultant VitAg fertilizer made at the SJSCRWF to regional and national fertilizer distributors. The VitAg *AM* technology creates a product that meets the maximum standards that the U.S. Environmental Protection Agency (USEPA) (Class A) created for biosolids products as well as the Exceptional Quality (EQ) metal levels.

This VitAg project maximizes biosolids beneficial reuse. We know of no other commercial biosolids program that offers such a "green", beneficial and sustainable use.

Our primary project team of VitAg and CDM Smith provide an exceptionally experienced design-build-own and operate project and management team for this SJSCRWF Biosolids Project.

We thank you for the opportunity to submit our response to the SJSCRWF RFI to provide a biosolids management solution. If you have any questions or need any additional information with regard to this RFI, please contact me at 413-530-5310 or dtaylor@vitagcorp.com, any time.

Sincerely,
VitAg Corporation,

Dana G Taylor
Vice President, Project Development

City of San Jose
Request for Information (RFI 13-14-01)
Biosolids Transition Program

EXHIBIT A
RESPONSE INFORMATION

1.1 Corporate name(s) (if services would be provided under an affiliate or with other team member(s), please provide their names as well):

VitAg Corporation anticipates forming VitAg San Jose for this project. CDM Smith Inc. will provide design/build services to VitAg.

1.2 Contact Person, Address, Phone Number, and E-mail:

Dana G. Taylor, Vice President,-Project Development
VitAg Corporation
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Vitagcorp.com

Arvind Akela, P.E.; CEM; LEED AP (BD+C)
CDM Smith Inc.
100 Pringle Avenue
Suite 300
Walnut Creek, CA 94596
925-296-8078
AkelaAk@cdmsmith.com

1.3 Would your company be able to provide performance bonds under a service contract with the City? What are the restrictions on the amount/duration of such bonds?

VitAg Corporation expects that it will be able to provide appropriate performance bonds for the service contract for the City of San Jose-Santa Clara.

1.4 A description of the technology, service and/or biosolids end product (i.e. energy, fertilizer, ash, compost land application, etc.) (Limit response to 150 words)

The VitAg AM process converts biosolids into a safe, pathogen-free USEPA Class A fertilizer product. The resultant controlled-release, dry, granular fertilizer fits directly into the regional and national agricultural marketplace. The VitAg AM Process is a sophisticated production of organically enhanced ammonium sulfate fertilizer utilizing, concentrated acids, an ammonia

source, and a small portion (16 percent) of municipal wastewater biosolids. The process steps are as depicted in Figure 1.

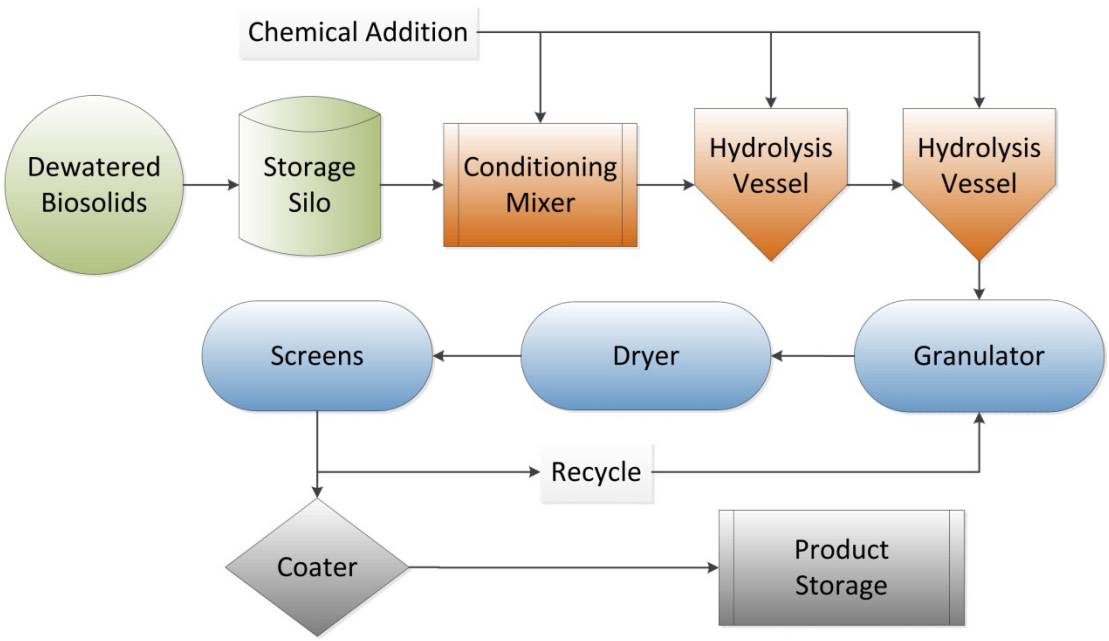

Figure 1 – Primary Components and Sequence of the VitAg Process

The Figure 2 schematic emphasizes the safe aspects of this process in that in addition to all microorganisms being destroyed in the hydrolysis vessels, biologically active organic molecules are denatured or cleaved, thereby reducing or eliminating their potential activity. Further, the reactions occurring in the hydrolysis vessel fuse or combine the plant nutrient molecules such as the ammonium ion or the sulfate ion or phosphate ion with the charged organic molecules thereby effectively creating this controlled release characteristic in the fertilizer product.

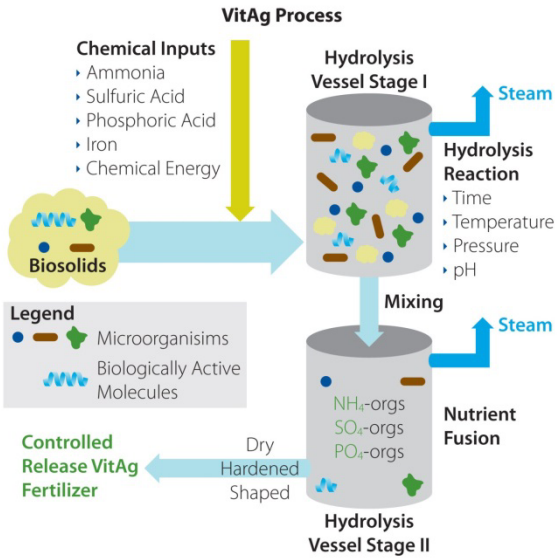

Figure 2 – The VitAg Process Sterilizes Microorganisms to Produce a Safe Product

1.5 A description of full scale implementations, services and/or agreements of your technology in municipal settings. (Limit response to 150 words)

Earlier this month, VitAg completed raising approximately $114 million of debt and equity capital to, among other things, commence construction of a VitAg plant in Zellwood, Orange County, Florida that will generate 78,000 tons per year of fertilizer product. Figure 3 is a three dimensional representative of the facility based on the 3-D design completed by CDM Smith. In the center of the figure is the granulation building which is directly connected to the warehouse, shown on the left. The figure also shows chemical storage facilities (foreground), odor control facilities (right) and biosolids storage facilities (rear).

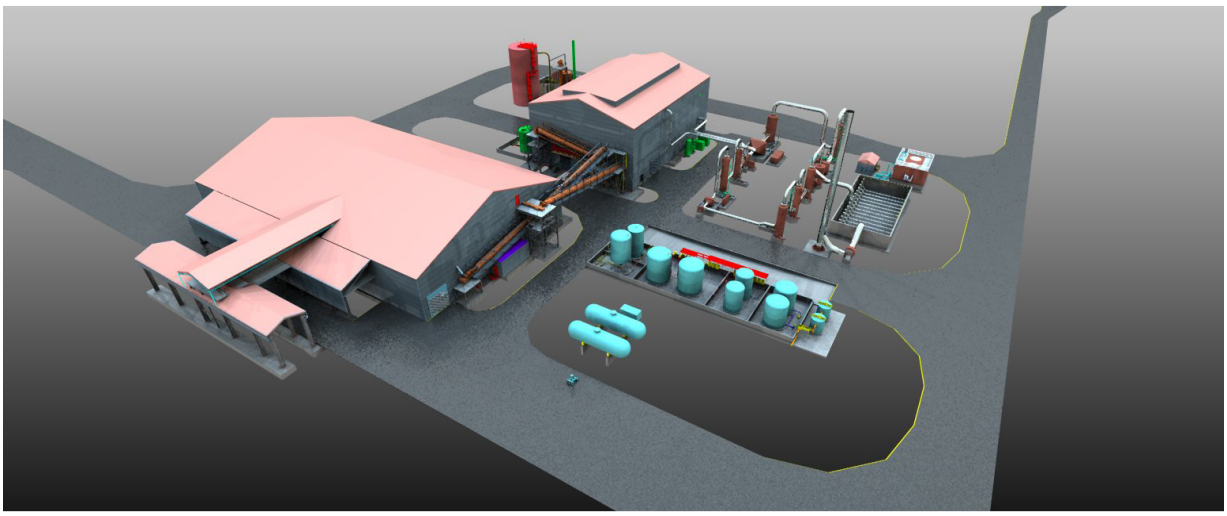

Figure 3 – 3D Image Showing Standard VitAg Plant Module

1.6 A description of risk/constraints associated with your technology and how they could be mitigated. (Limit response to 150 words)

The plant includes a sophisticated odor control system which is fully described in response to Question 2.10. VitAg has demonstrated its ability to mitigate any risks associated with the production of an organically-enhanced ammonium sulfur fertilizer through its design of the Zellwood facility. The other major safety features of the Zellwood facility include:

- **Ammonia Storage and Handling –** Dual steel tanks meeting code pressure rating, leak detectors with alarms, misting systems to remove vapors from the air, redundant valves, emergency relief valves, emergency shut-off, and use of fail-closed valves.

- **Hydrolysis Vessels –** Two steel, refractory-lined tanks meeting code requirements operated at moderate temperature (240-390°F) and relatively low pressure (40 psi).

- **Electrical System –** Power distribution configured to mitigate arc flash and short circuiting, lightning protection, smoke detectors, heat detectors, projected beam detectors, manual pull stations, gas detection, intrusion detection system, motor operated gates with intercoms, card readers, and CCTV.

- **<u>Instrumentation and Control</u> –** State-of-the-art hard-wired SCADA system automatically monitors eye wash stations, electrical systems status, fire alarm system, security system and hydrogen sulfide, carbon monoxide and ammonia monitoring. All critical measurements have independent secondary monitoring devices.

2.1 Type of reuse or intermediate processing that could be provided (check one):

[X] Other

VitAg intends to produce a Class A product that meets or exceeds the requirements of all local, state and federal regulations. The VitAg facility will be managed by a team that is highly experienced in the operation and maintenance of fertilizer manufacturing facilities. Some of the standards and operation procedures include employee safety training, anhydrous ammonia standard operating procedures, and safe work practices such as preventative maintenance systems and lockout/tag out procedures.

2.2 Would your company have to develop additional facilities or sites to provide these services? If no, please provide the name and location of the site/facility. If yes, please describe the facilities and sites; their size; the expected time frame before they become operational; and how you expect to fund development costs?

Yes.	Name/description of planned facility:	VitAg San Jose
	Anticipated operational date:	2018
	Capacity (wet TPD):	160 (This is the capacity of a standard VitAg module and represents approximately 45 percent of the San Jose-Santa Clara Regional Wastewater Facility solids production.)
	How development will be funded:	To be determined. See response to Question 3.

2.3 Please provide information related to your experience operating this type of processing or beneficial reuse facility.

The VitAg Corporation staff has more than 15 years of experience in the production of an organically-modified ammonium sulfate fertilizer. Starting in 1998 at a facility in Helena, Arkansas, more than 130,000 tons of fertilizer product were successfully produced and sold for agricultural use in 22 states and Mexico. From 2010 to 2011, VitAg operated a pilot plant in Lakeland, Florida which confirmed the basic process chemistry. Since 2011, VitAg has operated a larger demonstration plant at the Lakeland site which has led to a significant refinement in the acidification and ammoniation reactions.

2.4 What is the available and estimated capacity at your facility or site (minus dedicated capacity)?

Current:	0 (The proposed VitAg California facility would safely service the San Jose-Santa Clara RWF)
2018:	160 wet TPD
2023:	160 wet TPD
2028:	160 wet TPD

2.5 Are there any restrictions on available capacity, such as restrictions on the amount of tonnage that can be delivered or processed on a daily basis? If so, describe.

To provide the most cost-effective capacity to the City, VitAg would size the facility for a steady state loading of 160 wet TPD. The maximum daily receiving capacity will depend on the dewatered cake storage volume. For the Zellwood facility, the cake storage volume is approximately twice the average facility capacity. For the City facility, the storage capacity will depend in part whether dewatered solids are delivered by truck or conveyor to the VitAg facility and on the City's proposed dewatering schedule.

2.6 What is your available on-site storage, both prior to and post processing:

As discussed above in 2.5, the dewatered cake storage capacity has yet to be determined. The VitAg fertilizer product will be conveyed to an enclosed product warehouse. The warehouse capacity will be determined in part by the location and number of direct fertilizer users and fertilizer brokers. It is likely the facility will have two to four weeks of product storage capability.

2.7 Please describe restrictions on the type and quality of biosolids that you are able to or would prefer to accept (for planned future facilities indicate expected future conditions).

2.7.1 Class of Biosolids

- **What class of biosolids do you accept?**

  The VitAg process can accept any class of biosolids since the process itself results in a product meeting all of the EPA Part 503 Class A and Vector Attraction Reduction requirements. Biosolids received could be undigested, digested meeting Class B requirements, or digested meeting Class A requirements.

- **If you accept both Class A and Class B (not commingled), are there any capacity restrictions that apply to the Class B portion?**

  No.

- **If you accept only Class B, is there a timeframe over which you plan to restrict to only Class A?**

  NA

2.7.2 Percent Solids

- **Minimum percent solids of the biosolids you will accept?**

  20 percent (Range is 20 to 28 percent.)

- **Preferred percent solids of the biosolids you will accept?**

  A range of 24 to 26 percent is optimum for the VitAg process.

2.7.3 Energy-Related Processes

- **Are biosolids processed (dried) to fuel at your location?**

  No

- **If not, what is the range of net energy value you would require in a delivered biosolids fuel product?**

  NA

- **Other characteristics required for delivered fuel product?**

  NA

2.7.4 Other (describe)

VitAg produces a high nitrogen, dry, granular fertilizer. See response to Questions 1.4 and 2.8.

2.8 For each process/beneficial re-use, please describe your approach to marketing of the final product (i.e. direct reuse of final product, delivery of final product to end users under fixed price contracts, sale of final product via spot sales, etc.)

The VitAg fertilizer product 16-2-0-17-3-16 (N-P-K-S-Fe-Organic), containing 16% organic, represents a viable alternative to conventional fertilizer. In the VitAg process, nitrogen and sulfur are combined with biosolids producing an organically enhanced-ammonium sulfate fertilizer product. The advantage to having organics contained in the fertilizer gives the VitAg product a controlled release nutrient characteristic, which provides beneficial crop response in yield and quality. University research, supported by grower data, confirms the value of combining organic and inorganic fertilizer in a homogeneous granule. The benefit VitAg fertilizer product has over other organic products on the market is that VitAg's product contains a high nitrogen content (16 percent) combined with sulfur, giving the end user an economically-valuable, organically-enhanced product. The granule hardness of 6 to 7 pounds (which prevents dusting) is essential to shipping and handling the fertilizer material. The VitAg high value fertilizer is applied in pounds per acre, not tons per acre as with most biosolids-related land application strategies. The hardness allows the product to be applied by a variety of standard application devices onto the crops.

The commercial fertilizer market is growing not only in the U.S. marketplace, but worldwide, as China and India become major buyers of fertilizer to feed their growing population. The U.S. market consumed approximately 54 million tons of fertilizer material last year. The VitAg fertilizer manufactured from the VitAg facility serving the San Jose-Santa Clara Regional Wastewater Facility, approximately 78,000 tons per year, will represent less than 0.15 percent of U.S. fertilizer demand. The VitAg fertilizer has an agronomic and economic advantage to the end users on a variety of crops, turf, and vegetables.

Another advantage of the VitAg team is their experience in the marketing of organically-enhanced ammonium sulfate fertilizer. VitAg has developed key relationships with nationally known companies in the sale and distribution of specialty and commodity fertilizers. In addition, VitAg has recently entered into a long-term marketing agreement with Trammo, Inc., one of the largest global fertilizer and fertilizer raw materials merchandising and trading companies.

The beneficial organic components of VitAg fertilizer will enhance the turf and other specialty crops. VitAg fertilizer with controlled release nutrients and organic content becomes a very powerful force for the fertilizer market. It satisfies the need to reduce leaching and run-off from conventional soluble products such as ammonium sulfate, ammonium nitrate, diaammonium phosphate, and urea, while providing a steady flow of nutrients to the plant root and soil microbial systems.

2.9 For each process/beneficial re-use, please describe your approach when supply and demand are misaligned (i.e. your capability and service new markets).

VitAg does not anticipate any weakness in product demand based on the results of a comprehensive marketing assessment developed by the highly-respected firm of AgIndustries Research and Consulting, Inc. of Merced, California. VitAg fertilizer provides controlled-release qualities as well as, or better than, the more expensive synthetic fertilizers that are made expressly for this purpose. VitAg will concentrate on this specialty market because VitAg has a wholesale base of distributors who supply the higher end value customers like golf courses and vegetable farmers. As VitAg builds more plants and available fertilizer tonnage grows, VitAg will expand to the agricultural commodity market, which consumes the largest tonnage of fertilizer. Data shows U.S. consumption of nitrogen continues to grow. The world demand for plant food is the fastest growing new market in the world.

2.10 For each site, describe the environmental controls employed or that you plan to employ (add additional sheets as needed) at this site.

For siting of the facility VitAg's preference would be to locate the facility within a short distance of the proposed dewatering building so that truck transport of dewatered cake would not be necessary. This would allow direct loading to the VitAg pre-processing storage facility via conveyor, minimizing receiving costs and substantially reducing odors related to truck transport.

Regardless of whether the facility is co-located with dewatering, sited in another location within the City's wastewater treatment plant, or located off-site, VitAg will employ environmental controls on all aspects of the facility. The facility will be completely enclosed which will mitigate noise and eliminate surface or groundwater impacts. The odor control system is multi-stage with process air passing through bag houses, a venture scrubber, a packed bed ammonia

scrubber, an alkaline three stage sulfur compound scrubbing system, a condenser, and a biofilter.

2.11 Are there any required permits or permit limitations at the site?

VitAg does not believe there will be any permit limitations at whatever site is selected for the facility. VitAg is familiar with regulatory requirements for fertilizer production and has successfully obtained all permits for the Florida project.

2.11.1 The City envisions multiple biosolids end products and disposition options. Please indicate your willingness/ability to take all or a portion of the biosolids cake and what your preferred quantities might be?

At the present time, VitAg is interested in accepting an average of 160 wet TPD, the capacity of a standard module VitAg manufacturing facility, which would produce approximately 80,000 tons per year of fertilizer. Should the City decide it is advantageous, VitAg would consider building a second module to accept an additional 160 wet tons per day. We are confident these fertilizer volumes would be readily accepted to the California fertilizer market.

2.11.2 Please indicate the likely cost in 2014 dollars (per the ranges indicated below) assuming that the City implements dewatering at the wastewater treatment plant site and that a minimum of 20,000 wet TPY @25% solids would be delivered under a contract with your firm (absent transportation costs). Costs should assume carbon credits are retained by the City and should be net of any revenues received through sale of biosolids products:

Other: $20-60 per wet ton

VitAg's negotiated tip fee for a facility managing approximately 55,000 wet tons per year of biosolids at 25 percent solids will be very competitive and is expected to range from $20 to $60 per wet ton as expressed in 2014 dollars. The cost for managing biosolids using VitAg services is much lower than other Class A biosolids processes and service providers because nearly all of the company's revenues are derived from product sale and not tipping fees. In many portions of the United States, VitAg's tipping fee will be equivalent to tip fees for traditional Class B land application services without the inherent public concerns and risks associated with those practices.

The actual cost of VitAg services to the City would depend on a number of factors as described below:

- **Energy.** A significant amount of the heat needed to achieve a completely dry fertilizer product is generated during the hydrolysis phase of the VitAg process. Approximately 11 MMBTU/hr of supplement heat in the form of natural gas is utilized for the VitAg process dryer. If the City has available additional digester, landfill biogas or other suitable heat source, and the VitAg facility is located on-site then VitAg will purchase the energy or reduce the tipping fee based on the energy value of the heat source.

- **Facility Location.** If the City provides 5 to 6 acres of land adjacent to the dewatering facility, then VitAg can simplify the transported of dewatered biosolids without the need for truck transport. In that case, a significant reduction in tipping fee cost will occur. If the City provides a site on City owned land at or near the wastewater treatment facility the tipping fee can also be reduced, but not to the extent possible with a dewatering co-location.

- **Financing.** VitAg financed the Zellwood project using tax-exempt bonds and would expect to do the same thing for the City project. If the City directly funds all or a portion of the project capital requirements a significant reduction in tipping fee would result. Under this option, VitAg would consider a contract arrangement where the City owns and leases the facility to VitAg.

2.12 Do you typically provide or arrange for biosolids transportation services to your facility/site? Please describe and indicate basis of pricing.

The City would have the option of providing its own transportation of biosolids or including those services in the VitAg service scope.

3.1 Please indicate your preference with respect to contracting options:

[X] Service and Disposition

3.2 What type of commercial agreement/business model would most interest you?

VitAg is very flexible and willing to work with the City to determine the most cost-effective commercial arrangement. Options would include:

- VitAg design, build, operate, own and finance.
- VitAg design, build, operate and own.
- VitAg design, build, and operate.

3.3 What length of contract term would you prefer?

See response to Question 3.4.

3.4 What is the minimum contract term you would prefer (in years)?

If VitAg is responsible for all project financing, we would prefer a minimum contract term of 20 years. A shorter contract term will increase annual debt service costs and translate into higher tipping fees. Under alternative financing arrangements, a shorter contract duration may be possible.

4.1 The City is considering building a dewatering and loadout facility at its existing wastewater treatment plant site. Would your company be interested in contract operations for the facility?

VitAg is a fertilizer manufacturing company and is not currently focused on operating biosolids dewatering or any other biosolids processing facility.

4.2 If the City elects to develop additional biosolids processing facilities at its wastewater treatment plant, such as dryers or thermal greenhouses, would your firm also be interested in operating these types of facilities? What concerns would you have with operating these types of facilities?

See response to Question 4.1.

4.3 Is there anything else you would like to tell us about the biosolids reuse services that you provide that the City should consider?

VitAg announced on July 14, 2014 that it has closed on a $110 million financing facility to construct the first VitAg plant in Zellwood , Florida. Please see Appendix?

VitAg captures the value of biosolids to produce a high nitrogen, controlled-release fertilizer that delivers plant-available nitrogen at lower energy cost and with less greenhouse gases than comparable products. Production of ammonia or urea-based fertilizer is energy intensive, requiring approximately 32 MWh for every ton of nitrogen actually used by the crop. When VitAg fertilizer is utilized, much less is needed because of the slow release characteristics of the product. Total energy per ton of nitrogen utilized drops to approximately 24 MWh per ton – a twenty-five percent reduction.

Use of a VitAg product also significantly reduces greenhouse gas emission for the same reason as described for energy. Ammonia production plants are major emitters of carbon dioxide (CO_2) – in fact, ammonia plants world-wide are the largest single industry emitter of CO_2. Since fertilizer application rates are significantly lower with VitAg, total CO_2 emissions are lower by 40 percent. See Appended information for more details on this VitAg advantage.

There is no other biosolids process that offers the advantages of VitAg in terms of generating a high-value product that is easily incorporated into a growing worldwide enhanced efficiency fertilizer market, and doing so in energy and cost-effective manner that provides considerable benefit in terms of reduced environmental impacts and overall sustainability, as compared to conventional fertilizer products.

VitAg Closes on More than $110 Million in Financing

Proceeds to Help Fund Development of Florida Fertilizer Facility

ZELLWOOD, FL – July 14, 2014 – VitAg Corporation (VitAg, the "Company"), a specialty fertilizer company, announced today that the Company and its affiliates recently closed equity and debt financing of more than $110 million which will be used in part to construct a biosolids-to-fertilizer facility in Zellwood, Florida.

The financings consist of (i) an equity investment led by TPG Alternative and Renewable Technologies (ART), who is now the largest shareholder in the Company; (ii) a $64 million offering of 22-year tax-exempt bonds through the Orange County Industrial Finance Authority led by Citigroup Global Markets; and (iii) a credit facility from an affiliate of Tennenbaum Capital Partners. In addition to TPG ART, equity investors include strategic investors Agro-Iron, whose businesses include the production of iron micronutrients, and Shrieve Chemical, a supplier of industrial chemicals, active in the fertilizer industry. Other investors include Florida-based agricultural companies and individual investors. No additional terms were disclosed.

The new facility, to be located approximately 23 miles northwest of Orlando, is expected to produce slow release organically-enhanced premium fertilizer. The Company's fertilizer will be produced by combining biosolids, sulfuric acid and ammonia using a proprietary process, and is expected by the Company to be considered an enhanced efficiency fertilizer (EEF), as a significant portion of its nutrients are expected to be released over an extended period. This will allow the Company to benefit from macro trends favoring more productive fertilizers. In addition, the fertilizer will meet the US EPA's highest standards for land application of biosolids - Class A and EQ.

CDM Constructors, a leading provider of construction services for water and wastewater facility projects worldwide, will build the facility, and A. J. Sackett will design and fabricate the granulation and warehouse storage equipment. Trammo, Inc., one of the largest global fertilizer and fertilizer raw materials merchandising and trading companies, has entered into a multi-year marketing agreement with VitAg to sell its fertilizer.

"We are very excited about the ability to produce a very green and sustainable fertilizer product. Enhanced efficiency fertilizers are gaining traction globally because of their increased performance and protection of the environment. We now have the capital to bring this next generation fertilizer to more customers and into new regions," said Jeffrey C. Burnham, PhD, CEO and President of VitAg. "Equally important is the quality of our investors, which is a strong signal of support – TPG ART is a leading global renewable technologies investor, and our strategic investors intimately understand the fertilizer market and have strong contacts within the industry. This is an exciting time for VitAg, and we look forward to working with our new partners as we grow the Company."

About TPG Alternative & Renewable Technologies

TPG Alternative & Renewable Technologies ("TPG ART") is managed by TPG, a leading global private investment firm founded in 1992 with over $59 billion of assets under management and offices in San Francisco, Fort Worth, Austin, Houston, Beijing, Chongqing, Hong Kong, London, Luxembourg, Melbourne, Moscow, Mumbai, New York, Paris, São Paulo, Shanghai, Singapore and Tokyo. TPG ART partners with companies dedicated to developing and deploying alternative and renewable technologies. For more information please visit www.tpgart.com.

About VitAg

VitAg Corporation, a specialty fertilizer company, engages in the conversion of municipal biosolids into inorganic fertilizers. Its VitAg recycling technology brings together the wastewater and fertilizer industries to transform biosolids into slow release organically-enhanced inorganic granular fertilizers. Based in Beech Island, SC, the Company will sell its fertilizers through distributors in the United States and internationally. For more information please visit www.vitagcorp.com.

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Technical Memorandum 6
FINAL

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum 6

Subject: Waste Heat Recovery Analysis

Date: October 20, 2014

To: Lily Zhu, P.E., Senior Engineer, City of San José

From: Lloyd A. Slezak, P.E., Project Manager, Brown and Caldwell

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Limitations:

This document was prepared solely for City of San José in accordance with professional standards at the time the services were performed and in accordance with the contract between City of San José and Brown and Caldwell dated October 8, 2013. This document is governed by the specific scope of work authorized by City of San José; 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 City of San José 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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Section 1: Introduction

This Technical Memorandum (TM) 6 describes an analysis of waste heat recovery at the San José-Santa Clara Regional Wastewater Facility (SJSCRWF). The results of the waste heat recovery analysis are presented, options for drying biosolids with waste heat and conveying waste heat are described, and the assumed technology for the BCE analysis are identified.

1.1 Objective of the Study

The objective of this study was to identify the expected amount of waste heat available for biosolids drying, options for drying biosolids with waste heat and conveying waste heat from the cogeneration facility to a biosolids dryer, and the appropriate sizing for the biosolids dryer based on the amount of waste heat available.

1.2 Existing Conditions and Background

The SJSCRWF currently processes biosolids using sludge thickening, mesophilic anaerobic digestion, sludge storage lagoons, and air drying beds to produce Class A biosolids used beneficially as alternative daily cover (ADC) at the Newby Island Landfill. A Plant Master Plan (PMP) was developed that included thermal drying of 20 percent of biosolids production among other changes to the solids process train. The PMP anticipated transitioning to thermal drying and other post-digestion processes over a two-decade period in which use of sludge lagoons and drying beds would be gradually decommissioned. In order to meet a subsequent mandate set by the San José City Council to stop feeding digested sludge to the storage lagoons by 2018, the City of San José (City) engaged this Biosolids Feasibility Study to define projects that will more rapidly transition to a new biosolids processing configuration that does not include lagoons and drying beds and that fulfills the City's long-term objectives for biosolids management.

Concurrent to the development of the PMP, an Energy Management Strategic Plan (EMSP) was developed that recommended the installation of a new cogeneration facility at the SJSCRWF to replace the plant's existing engines. Based on the Project Definition Report (PDR) developed for the cogeneration facility, the new system will use low-speed internal-combustion engine-generators to meet the electrical power demand of the plant by burning digester gas blended with natural gas.

In addition, a fuel cell was brought into operation in 2012. The fuel cell can consume either natural gas or digester gas to provide electrical energy to the plant.

This TM is one part of an overall evaluation to support a recommended Biosolids Transition Strategy for the SJSCRWF. As part of that evaluation, Brown and Caldwell is evaluating alternative courses of action that could be taken in implementing the transition. (See TM 8, Business Case Evaluation). Two of the three[1] processing alternatives considered in TM 8 involve thermal drying and include:

- **Alternative 1: Modified Base Case with TPAD.** Alternative 1 would continue with the PMP recommendations but would change the digestion process from mesophilic digestion to temperature-phased anaerobic digestion (TPAD). The PMP (and Alternative 1) includes thermal drying of 20 percent of

[1] The third alternative does not include thermal drying.

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biosolids production using waste heat from the cogeneration facility with supplemental natural gas as needed;

Alternative 2: Base Case with a Blending Option. Alternative 2 would include blending thermally dried biosolids, solar dried biosolids, and some dewatered cake and taking the blended material to Newby Island Landfill until its closure. With this alternative, the timing of bringing drying technologies is accelerated, and the size of the thermal drying facility is downsized relative to Alternative 1. Specifically, the thermal drying facility is sized based on 2025 loads and based on suitable and available waste heat from the cogeneration facility.

1.3 Assumptions

In the analysis described in the following sections, a number of assumptions were made regarding the existing facility and previous work completed for the City:

- To facilitate calculations for the amount of waste heat available, the Wärtsilä engine-generators described in the cogeneration facility PDR were used to provide parameters such as engine exhaust temperature, power, efficiency, and capacity, among others. As the cogeneration facility design has not been completed, the exact manufacturer and engine-generator have not been selected and the assumed parameters could be different if another manufacturer is selected.
- The EMSP indicated that the fuel cell facility provides 1.4 megawatts (MW) of electrical power to the plant. It is assumed that the power output from the fuel cell is constant and that the cogeneration facility will meet the plant electrical energy demand that is in excess of the power produced by the fuel cell. Further, it is assumed in this analysis that the fuel cell provides 2 million British thermal units per hour (MMBtuh) of low-grade heat to the plant.
- Electrical power demand at the plant was estimated based on the expected power demand reported in the cogeneration facility PDR.
- The quantity of biosolids produced by the plant was estimated based on the flows and loads described in the PMP.
- The dewatering process being considered is assumed to produce a 25 percent dry dewatered cake..
- Biosolids that will be used for ADC are assumed to be a 60 percent dry product, which provides some safety factor over the assumed minimum dryness of 50 percent required by the Newby Island Landfill.

Section 2: Waste Heat Recovery Analysis

The plant's cogeneration facility will produce both electrical power and recoverable heat. This heat can be used to meet the plant's heat demands including space heating, anaerobic digestion process heating, and biosolids drying. The amount of heat recoverable from the cogeneration system is related to the load at which the engines operate, which, in the City's case, is equal to the plant's electrical power demand.

Heat from the cogeneration facility can be recovered from the jacket water on the engines and from the engine exhaust. These two heat sources provide heat at different temperatures. The engine jacket water operates at approximately 195 degrees Fahrenheit (°F) and the engine exhaust operates at 740° to 830°F. Similarly, the temperature of the heat required by the plant varies based on its end use: heat needed for space heating and the anaerobic digestion process will require a heat loop operating at approximately 170° to 200°F, while recovered heat for thermal drying of biosolids is effective at 350°F or higher. For simplicity, we have defined these two heat demands as low-grade heat and high-grade heat, respectively. Due to the high temperature required for biosolids drying, the only source of heat from the cogeneration facility that is

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suitable for biosolids drying is the engine exhaust; the engine jacket water is too cold to be used for biosolids drying.

To estimate the amount of high-grade heat available from the cogeneration facility, we have assumed that the engine exhaust from the cogeneration facility would be cooled to 500° to 550°F to recover high-grade heat and then, if necessary, cooled to 350°F to supplement the low-grade heat recovered from the engine jacket. This staged heat recovery is required for the alternatives being considered that include TPAD. In order to heat the sludge entering the TPAD process to thermophilic temperatures (135°F) using reasonably sized heat exchangers, the temperature required for the low-grade heat loop is 195° to 200°F. This range of temperatures is equal to or greater than the temperature available from the engine jacket water (195°F), driving the need for a staged heat supply in which low grade heat demands are met by recovering heat from the jacket water and then "topping it off" with heat from the engine exhaust. Figure 1 demonstrates the staged exhaust heat recovery assumed.

Figure 1. Staged exhaust heat recovery to recover high-grade and low-grade heat for TPAD

For alternatives using mesophilic digestion, there is no need to supplement the low-grade heat loop with staged cooling of the engine exhaust as the temperature of the engine jacket water exceeds that of the low-grade heat loop. In either case, exhaust heat would be recovered after exhaust treatment to meet air emissions requirements as the exhaust treatment equipment works most efficiently at higher exhaust temperatures.

Based on the power demand expected from the plant and the expected low-grade heat demand, the amount of high-grade heat available for drying biosolids is estimated to vary between 9 and 10 MMBtuh during the 2018 to 2025 time period and up to 12 MMBtuh in 2040. Table 1 summarizes the average low grade heat demand and high grade heat available during the design years.

Table 1. Summary of Heat Demand and Waste Heat Available

Design Year	Average Low Grade Heat Demand [1, 2]	Average High Grade Heat Available [1, 3]
2025	19 MMbtuh	9 MMbtuh
2030	22 MMbtuh	9 MMbtuh
2040	24 MMbtuh	12 MMbtuh

(1) Average heat is provided. Actual heat demanded and available will vary both above and below this average during the year.
(2) Low grade heat is defined as heat available at temperatures up to 200°F. Low grade heat demand assumes TPAD process heat demand.
(3) High grade heat is defined as heat available at temperatures of 350°F or higher.

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It is important to stress that these are annual average estimates and can be used for planning purposes only. These estimates should not be used for designing the heat recovery equipment as the equipment would need to be sized to recover both higher and lower amounts of heat. Over the course of a day or a year, the amount of available heat will vary just as the amount of power demanded by the plant will vary. During low flow conditions, less heat would be available as the cogeneration facility is producing less power and heat and during high flow conditions the opposite would be true. During cold weather, either supplemental boilers would be needed to maintain process temperatures, or more of the heat from the engine exhaust would be needed to supplement the low-grade heat demand.

The amount of waste heat available would also depend on how the engines are loaded. Engines function more efficiently at full loads and, in the case of heat recovery, more efficient means less waste heat to recover. Therefore, three engines operating at full load will produce less waste heat than four engines operating at a partial load, even if they are providing the same amount of power. For this analysis, we have assumed that the City will operate the engines in the most efficient manner to reduce the plant's consumption of natural gas. This is why the amount of high grade heat available shown in Table 1 appears constant between 2025 and 2030 and then increase by 2040. Between 2030 and 2040, the amount of electrical energy demanded by the plant is expected to increase to the point four engines are needed instead of just three. Due to the reduction in efficiency of operating four engines, the amount of waste heat therefore increases at the same time.

Section 3: Biosolids Drying

The use of the waste heat available from the cogeneration facility would be impacted by the type of dryer used to dry the biosolids. A description of the two classes of biosolids dryer is provided below as well as a discussion on biosolids dryer sizing and coordinating operation of the dryer and the cogeneration facility.

3.1 Biosolids Drying Types

Biosolids dryers can be divided into two types depending on the means by which heat is transferred to evaporate water from the input material. The two types, direct dryers and indirect dryers, are described further below.

3.1.1 Direct Drying Systems

In direct dryers, moisture removal is achieved predominantly by convective heat transfer. As an example, convective heat transfer is similar to using a hair dryer. Air is blown over a hot surface, transferring the heat with the flow of the air. For a direct dryer, hot air is produced through the combustion of fuel in a furnace (or burner), the use of an air-to-air or liquid-to-air heat exchanger with a high-grade heat source, or a combination of the two. The resulting hot air is exhausted directly into the drying vessel. The hot gases come into direct contact with the dewatered cake, causing the water within the cake to evaporate. Direct dryers are capable of making a high-quality biosolids product consisting of uniform, hard, spherical pellets similar in appearance (with the exception of color and odor) to commercial inorganic fertilizer products. Most of the largest thermal drying operations in the United States use direct dryers to create their biosolids products. Two types of commonly used direct dryers are described further below.

3.1.1.1 Drum Dryer

A process schematic of a drum dryer system is shown in Figure 2. Dewatered cake is first mixed with already-dried biosolids pellets upstream of the drying drum to control the moisture content of the mixture within the dryer. This first step in the drying process accomplishes two important functions:

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- It provides a means of reincorporating "fines" and undersized particles that are separated from the product in the screening step following the dryer.
- The physical form of the dewatered cake is altered so it does not stick to the internal parts of the drying drum.

This preliminary mixing step is critical to producing a pellet product from the dryer. The triple-pass drying drum rotates as hot air and the biosolids particles pass through. The biosolids particles exiting the drum are screened to separate product of the desired particle size for cooling and temporary storage while awaiting distribution to market outlets. Oversized particles are crushed and returned to the head-end of the process, along with undersized particles and fines. The dryer off-gases are treated with a condenser prior to recycling back to the furnace or discharging to the atmosphere following treatment in a regenerative thermal oxidizer. Recycling a large portion of the warm process air serves to decrease the volume of air requiring treatment prior to discharge and to increase the thermal efficiency of the process.

Drum dryers typically require hot air that is 800° to 1,100°F to achieve a dried product. As such, using waste heat is not easily done with a drum dryer and in the City's case would require significant supplemental natural gas to increase the temperature of the waste heat conveyance media to an appropriate temperature. Therefore, a drum dryer is not considered appropriate for use with waste heat recovery.

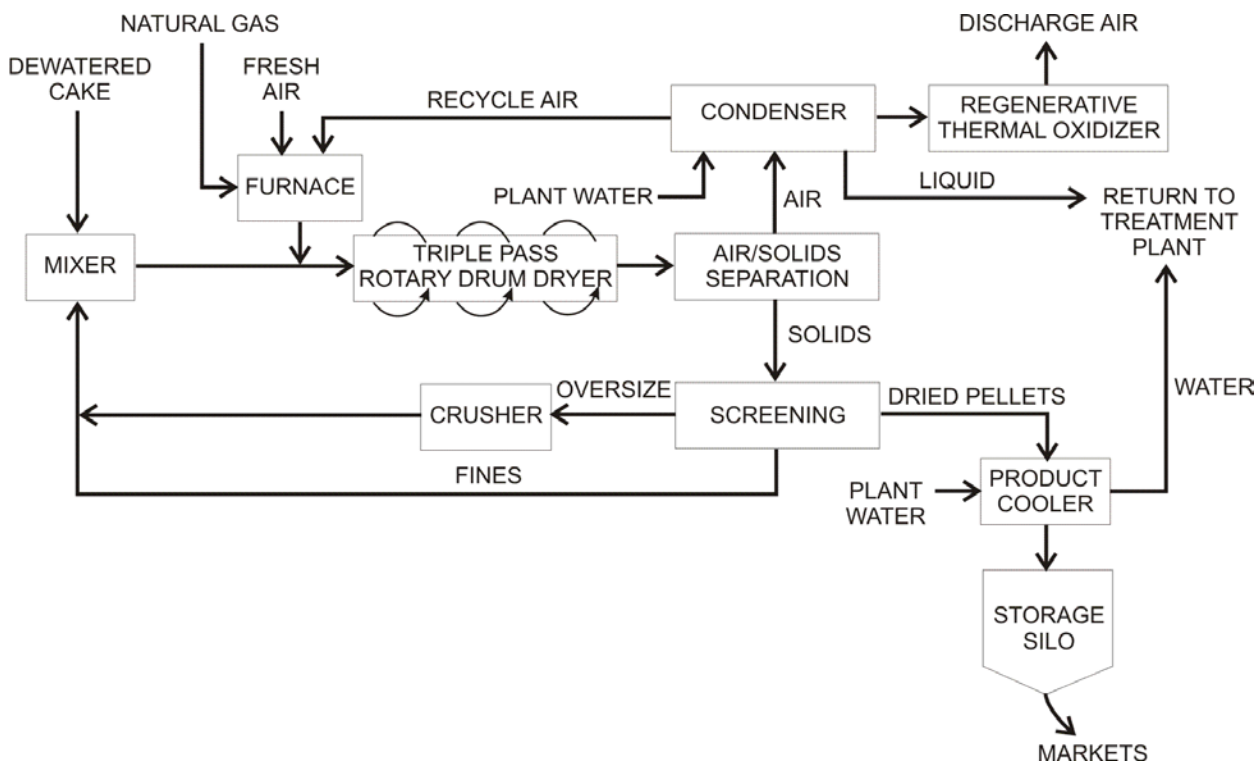

Figure 2. Schematic of a drum dryer

3.1.1.2 Belt Dryer

A process diagram of a typical belt drying system is shown in Figure 3. Dewatered cake is conveyed, or extruded through nozzles or perforated plates, onto a porous belt. Hot air is circulated across the biosolids traveling on the belt to evaporate moisture. Heat energy can be supplied directly from a furnace, indirectly through heat exchangers, or a combination of both. The product is cooled with air at the end of the dryer.

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The cooled product is placed in temporary storage in a silo while awaiting distribution to market outlets. Vapor from the dryer passes through a condenser prior to treatment in a biofilter and discharge.

An advantage of the belt drying systems is that they operate at lower temperatures than the indirect or the direct drum dryers, and typically create an air stream with fewer odors. They can use low-grade waste heat at temperatures as low as 140°F, although their physical size becomes significantly larger to facilitate the necessary heat transfer at lower temperatures. The typical operating temperature for the hot air in a belt dryer is 280° to 350°F. As such, a belt dryer is well suited to using high-grade waste heat from the cogeneration facility.

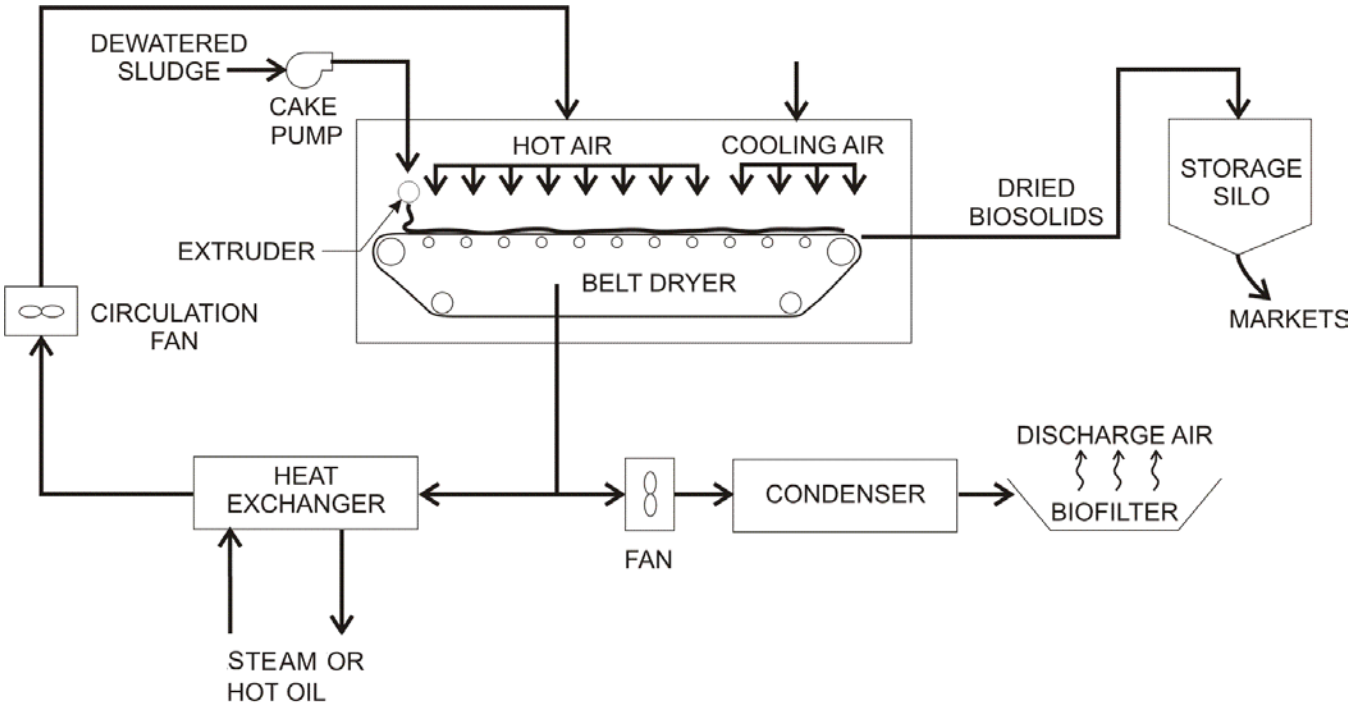

Figure 3. Schematic of a belt dryer

3.1.2 Indirect Drying Systems

Indirect dryers achieve moisture removal predominantly by conductive heat transfer, and the biosolids are kept separate from the primary heated drying medium. An example of conductive heat transfer is frying an egg in a skillet. The skillet is heated by the stove and transfers heat into the egg through the surfaces in physical contact with the egg. This is referred to as indirect heating because the egg is not in direct contact with the heating medium (i.e., the stove).

In an indirect biosolids dryer, the biosolids are heated through physical contact with the heated surfaces of the dryer. The indirect dryer consists of a stationary vessel with an internal agitator and stirring assembly that is heated with a heat conveyance medium that is either heated in a boiler or comes from another high-grade heat source. The dewatered cake enters the stationary vessel of the indirect dryer and is continuously agitated and stirred during the drying cycle. The heat is then transferred from the drying medium to the cake by circulating the medium through the stirring mechanisms, augers, shafts, disks, dryer casing, or other equipment that comes into contact with the cake. Indirect dryers are typically identified by the internal

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mechanism used to agitate and convey the material in the dryer. Thus, these dryers are commonly known as screw dryers or paddle dryers.

A process diagram of a typical indirect thermal drying system is shown on Figure 4. Dewatered sludge is introduced to the drying chamber, which is heated with hot oil or steam. Moisture evaporates from the cake as it moves through the machine. Dried biosolids exiting the dryer are cooled prior to temporary storage in a silo while awaiting distribution to market outlets. Vapor from the dryer passes through a condenser prior to treatment in a biofilter or other odor control process and discharge to the atmosphere. The volume of air that must be treated is significantly smaller than the direct drying systems because hot air is not used to remove the moisture in the biosolids as is the case with direct dryers. Because the volume of air in contact with the biosolids is smaller for an indirect dryer, the size of the odor control system is also smaller.

Indirect dryers may be operated on a continuous basis or batch-operated and can use waste heat if the waste heat is at a temperature of 350° to 400°F.

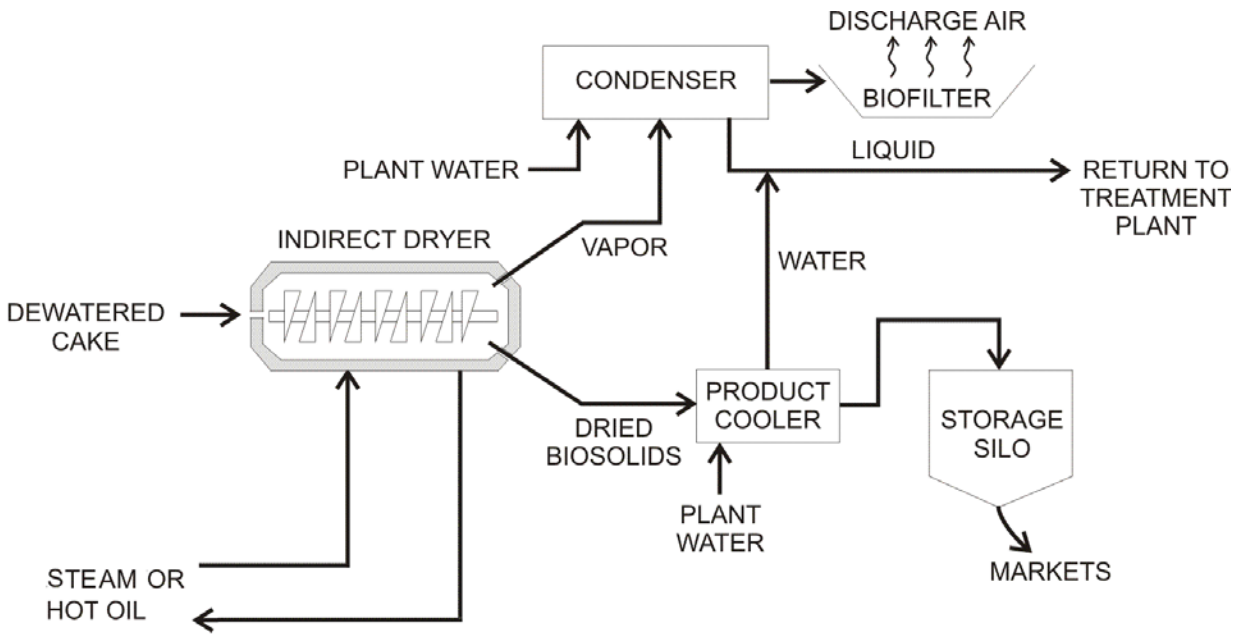

Figure 4. Schematic of an indirect thermal dryer

Unlike the direct dryers, the indirect drying systems generally do not include product screening and recycle. The solids take a granular form as they pass through the dryer through mechanical sheering action. As a result, the product leaving the indirect drying system typically has a different appearance from the product leaving the direct drying system. The indirectly dried biosolids particles are more angular in appearance and have a wider variety of particle shapes and sizes than the direct dryer product. As a result, an indirectly dried biosolids product has a higher fines content and is a dustier product to store and use.

3.2 Dryer Sizing

Different approaches were investigated for sizing the biosolids dryer for the two alternatives. These approaches are described further below and the approach used for the BCE analysis is defined.

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3.2.1 Alternative 1: Modified Base Case with TPAD

The PMP recommended installing sufficient dryer capacity to dry 20 percent of the plant's biosolids. With TPAD, drying 20 percent of the digested solids load in 2030 would equate to drying 7,400 dry tons or 20 dry tons per day (dtpd). Typical operation of biosolids dryers at municipal wastewater treatment plants (WWTPs) is such that the dryer is operated 24 hours per day for 5 consecutive days each week or 10 consecutive days every 2 weeks. This allows for downtime to perform necessary preventive and corrective maintenance on the dryers. Assuming that the biosolids dryer is operated 5 out of every 7 days, to achieve 7,400 dry tons in 2030, the dryer would need to be sized for 28 dtpd. This size could be reduced if a fully redundant dryer is included as a dryer could be operated 24 hours per day, 7 days per week with maintenance done on one dryer or the other. Providing a fully redundant dryer is atypical at municipal wastewater treatment facilities however.

Based on the amount of high-grade waste heat available and an assumed thermal efficiency of 1,600 Btus per pound of water evaporated (Btu/lb-water), 28 dtpd of biosolids cannot be dried with waste heat alone. The amount of waste heat available could dry approximately 16 percent of the biosolids and would require 2 MMBtuh of supplemental heat from natural gas (for a total of 11 MMBtuh) to dry the remaining 4 percent.

The results are similar for the alternative in which the PMP approach is implemented with mesophilic digestion. To meet 2030 loading, the dryer would need to be sized to dry 31 dtpd and waste heat available from the cogeneration facility would be sufficient to dry only 17 percent of the biosolids produced by the facility.

This utilization of additional natural gas in order to dry 20 percent of the plant's annual production of biosolids may require additional permitting as the greenhouse gas emissions from the plant would increase with the additional fossil fuel consumption.

3.2.2 Alternative 2: Base Case with a Blending Option

For Alternative 2, the biosolids dryer would be sized based on the amount of waste heat available in 2025 to coincide with the maximum drying capacity prior to the expected closure of the Newby Island Landfill. The amount of waste heat available results in about 18 percent of the biosolids being dried and used for ADC in 2025. Two options were considered to provide a 60 percent dry product for ADC, which are described in the following paragraphs.

The first option considered for this alternative was to dry the biosolids to 90 percent dry matter, as is typical for biosolids dryers. Assuming a thermal efficiency of 1,600 Btu/lb-water, the dryer would be sized to produce 23 dtpd with the amount of high-grade waste heat available. To create a material suitable for use as ADC at the Newby Island Landfill, this 90 percent dry product could be blended with 25 percent dry dewatered cake to produce a 60 percent dry ADC product. To achieve 60 percent dryness, 6 dtpd (22 wet tons per day) of dewatered cake would be blended with the 23 dtpd of dried product to produce 29 dtpd (or 48 wet tons per day) of ADC product.

The second option would be to partially dry the dewatered cake to 60 percent (instead of the normal 90-95 percent) and eliminate the blending process. In this case, because less water is removed from the product but the amount of high-grade heat available is the same, more product can be sent through the dryer and the dryer becomes slightly larger. Although use as ADC at the Newby Island Landfill does not require it, one disadvantage of this approach is that biosolids that are dried to only 60 percent dry are not considered Class A biosolids. If Class A biosolids are required in the future, batch tanks would still need to be added to the TPAD process even with the partial drying facility. Drying to 90 percent has the advantage of achieving Class A with or without the batch tanks.

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Discussions with biosolids dryer manufacturers indicated that an indirect dryer would be required for this application as the direct dryers require some recirculation of material to the head-end of the dryer to facilitate the pelletization and drying process. This precludes the ability to only partially dry the product.

Discussions with the indirect dryer manufacturers led to a strong recommendation to proceed with full drying of the biosolids instead of partial drying. The reasoning behind this recommendation was that as biosolids are dried, they undergo a number of physical property changes. One of these phases is a plastic phase in which the biosolids become noticeably more sticky and difficult to handle. This phase is typically between 40 and 65 percent dryness. Biosolids at 60 percent dryness would be difficult to convey as they cannot be pumped or conveyed with a conveyor. Due to this significant increase in material handling difficulties, the indirect dryer manufacturer recommended drying the biosolids to 90 percent dryness and blending with dewatered cake to achieve a 60 percent dry material. The blended biosolids would not have the same sticky quality as biosolids dried to only 60 percent dryness because they would be a mixture of 25 percent and 90 percent dried biosolids instead of a homogenous 60 percent dry product.

3.3 Cogeneration Facility and Dryer Facility Coordination

Operating the biosolids dryer facility with waste heat from the cogeneration facility would require special care and coordination. Cogeneration facilities are complex facilities that occasionally have unexpected downtime. As such, the amount and quality of heat available from the cogeneration facility for drying biosolids should be expected to vary throughout the life of the two facilities. To allow for continued operation of the drying facility should there be an unexpected shutdown of the cogeneration facility, it is recommended that any dryer type selected include a backup natural gas or digester gas fired furnace to provide heat to the dryer as needed. If necessary, all three dryer types discussed above can be operated with a furnace as their heat supply instead of heat recovered from the cogeneration facility.

3.4 Summary of Advantages and Disadvantages

To compare the relative benefits and drawbacks of the dryer types described above, Table 2 is provided as a summary.

Table 2. Comparison of Dryer Types

Dryer Type	Advantages	Disadvantages
Direct: drum	• High-quality, pelletized product • Least amount of dust in final product • Good for very large applications	• Lots of waste air requiring odor treatment • Cannot use waste heat • Highest capital cost
Direct: belt	• Can operate at relatively low temperatures • Low capital cost	• Lots of waste air requiring odor treatment • Higher dust content in final product • Requires additional equipment to produce a pelletized product
Indirect	• Little waste air requiring odor treatment • Lowest capital cost • Can couple directly with high-temperature heat loop	• Higher dust content in final product • Irregularly shaped and sized product • Plug flow requires clean-out at shutdown

3.5 Technology Assumed for BCE Analysis

For Alternative 1 (and the Base Case), any of the three types of dryers could be used as there are no restrictions on end product quality or using only waste heat. A drum dryer may be preferred for the greatest

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flexibility in end product use due to the higher quality of dried biosolids pellet, although this approach may come with a higher capital cost. A belt dryer or indirect dryer could be preferred to maximize the amount of waste heat used for drying as there may be periods during the year when the cogeneration facility would provide enough heat to dry 20 percent of the plant's biosolids production.

While further analysis will be required prior to selecting any specific dryer technology, the BCE analysis assumes an indirect dryer (paddle dryer) designed to use waste heat supplemented by a natural gas furnace. This is based on the lower capital cost and size associated a paddle dryer compared to a belt dryer.

For Alternative 2, the recommended approach is to dry the biosolids to 90 percent dryness using either a belt dryer or indirect dryer. A drum dryer is not appropriate as it cannot use waste heat to dry the biosolids. Furthermore, sizing the dryer for a 90 percent dry end product is recommended in light of the recommendations from the indirect dryer manufacturers regarding material handling concerns associated with partially drying biosolids..

For the BCE analysis, an indirect dryer (paddle dryer) is also assumed for this alternative because of the lower capital cost of an indirect dryer compared to a belt dryer. Again, this is an assumption for planning purposes and is not intended to imply a technology recommendation for the program.

Section 4: Heat Conveyance

Using high-grade heat from the cogeneration facility in a biosolids dryer would require a means to transfer the heat from the cogeneration facility to the dryer facility. This section describes the options for conveying high-grade heat and summarizes the relative advantages and disadvantages for each option.

4.1 High-Pressure Hot Water

The typical means of conveying heat at a municipal WWTP is through a low-pressure hot water loop. This approach is appropriate when heat is conveyed to meet low-grade heat demands as the temperatures typically needed are below the boiling point of water at low pressures (i.e., 15–100 pounds per square inch gauge [psig]). However, for recovering and using high-grade heat, the temperature required for the end use is such that a traditional low-pressure hot water system is not feasible.

One means of conveying heat while still using water is by pressurizing the hot water loop beyond the typical low-pressure hot water loop application. Because the boiling point of water increases as the pressure the water is under increases, a liquid hot water loop can be maintained at the temperatures needed for biosolids drying if it is kept under high pressure. For operating temperatures between 350° and 400°F, a hot water loop would need to be pressurized to 300 to 400 psig.

This type of system is not frequently employed, especially at WWTPs, but it does allow for high-temperature heat transfer without the use of flammable liquids (thermal oil) or gas (steam or engine exhaust) systems. Technical challenges associated with this type of system include the requirement for equipment and piping designed to withstand high pressures and temperatures that are not typical and are therefore more expensive. In addition, there is a significant safety risk with a high-pressure hot water system as any leaks in the system would flash to steam when subjected to atmospheric pressure. Flashing to steam can result in a dangerous expansion in volume. For example, one pound of 400°F liquid water would expand from 0.018 cubic foot (ft^3) to 1.86 ft^3 as it is converted to steam, an increase in volume of over 10,000 percent.

This type of system could be used with either a direct or indirect dryer, although our discussions with indirect dryer manufacturers indicated that they cannot directly use high-pressure hot water in their dryer. Instead, for both types of dryers, a heat exchanger would be needed to transfer heat from the water to the medium used to dry the biosolids (i.e., air for a belt dryer and hot thermal oil or steam for an indirect dryer).

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4.2 Steam

An alternative to pressurizing a hot water loop to keep it in a liquid state would be to allow the water to boil to steam and use the steam to transfer heat from the cogeneration facility to the biosolids dryer.

Although steam is not very common at WWTPs, steam is used as a means to convey heat at some WWTPs, especially larger facilities. For example, the SJSCWRF currently uses a steam system for cooling the engine-driven blowers in the secondary blower building. The heat from this system is captured and supplements the plant's heat loop. Furthermore, the use of steam has a long history in industrial settings to produce power and transfer heat. Steam was the driving force behind the Industrial Revolution and is still used as the working fluid in approximately 90 percent of all electricity generated today. Due to its long and extensive history, steam has very well understood and documented properties with detailed steam tables available at the pressures and temperatures contemplated for this application.

For the application considered here, a steam system would operate at saturated conditions and use the latent heat of vaporization to transfer a significant amount of heat in a compact manner. The vapor phase would operate at 360°F, 150 psig to meet the pressure limits of the dryer with a condensate return line operating in a liquid state at 230°F, 6 psig. This condensate would return to the cogeneration facility and be vaporized back to 360°F, 150 psig with heat from the engine exhaust.

Steam has significantly more energy stored in it than a liquid hot water system. Liquid water at 400°F, 232 psig has an enthalpy of 375 Btu/lb but once it has been vaporized, the steam at the same temperature and pressure would have an enthalpy of 1,200 Btu/lb. This is more than three times the energy in the liquid water. Because of this increase in stored energy, operating a steam system requires specialized safety measures and equipment. Municipal regulatory requirements commonly adopt the recommendations of the National Board of Boiler and Pressure Vessel Inspectors and require a stationary engineer to be on site at all times that the steam system is operational. Although the City already operates a steam system, the existing system operates at approximately 10 psig, which is below the 15 psig trigger for the stationary engineer requirement. The new system would operate at greater than 15 psig and thus would require a stationary engineer whenever the system is operating. Due to the extended amount of time required to take a steam system offline and then bring it back online, the steam system would likely need to be operated 7 days per week even with a biosolids dryer only operating 5 days per week. Thus, with a steam system, a stationary engineer would likely need to be on site at all times.

Indirect dryers sometimes use steam as their working fluid and thus a steam system could be used to transmit heat from the cogeneration facility directly to an indirect dryer. For a belt dryer, steam could still be used but would require a heat exchanger to transfer the heat in the steam to the air used to dry the biosolids.

4.3 Hot Thermal Oil

Instead of using water as the working fluid, a thermal-fluid heat transfer medium could be used to transmit the thermal energy from the cogeneration facility to the biosolids dryer. This thermal-fluid heat transfer medium is often referred to as a hot thermal oil (HTO). Examples of HTOs and their manufacturers include:

- Dowtherm: synthetic organic fluid manufactured by Dow
- Syltherm: silicone polymer manufactured by Dow
- Paratherm: mineral oil based heat transfer fluid manufactured by Paratherm Corp.

These fluids have high boiling points (500° to 700°F) and can be used to transfer heat at temperatures below their auto-ignition temperature (the temperature at which the fluid would ignite without an ignition source) but routinely operate above their flash and fire points (the temperatures at which the media can

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momentarily and continuously sustain a flame, respectively). HTOs have low specific heat (0.5 to 0.7 Btu/lb-°F) and low viscosity properties at the operating temperatures and pressures contemplated here. Due to the low viscosity and low surface tension of HTOs, these fluids are more prone to leakage than water.

For the biosolids drying application, an HTO system would operate at temperatures of 350° to 450°F and pressures typical of a low-pressure hot water system (i.e., 15–100 psig). Due to contaminants within it, the HTO will smolder and smoke if exposed to ambient pressures at its working temperature. In addition, because an HTO loop would operate at temperatures above the HTO's flash and fire points, any leakage would be a fire hazard. As such, special care would need to be taken to identify and mitigate any potential pipe and joint failures. To avoid leaks, welded joints are recommended wherever possible and the number of pipe penetrations for instrumentation should be minimized as potential sources of leaks. Flanged connections may be used but would require specialized gaskets and high-torque bolts to minimize the potential for leakage. Overhead piping would also need to be limited to minimize the risk of collisions and subsequent leaks.

In addition to minimizing leaks, the flammable nature of HTOs also requires specialized equipment to prevent exposing the HTO to air. For example, specialized nitrogen purge systems are required for thermal expansion tanks and pumps used in HTO systems. The HTO will also degrade over time and require replacement. This replacement should be expected every 3 to 5 years and would require repurchasing the entire volume of HTO used.

Indirect biosolids dryers typically use HTOs as the medium to transfer heat to the biosolids. As such, an HTO system could be coupled directly with an indirect dryer. For a belt dryer, an HTO system could still be used and would transfer heat to the air used to dry the biosolids through the use of a heat exchanger.

4.4 Engine Exhaust

The final heat transfer medium considered is the engine exhaust from the cogeneration facility. Direct dryers frequently use the exhaust from combusting a fuel source in a furnace to heat the air used to dry biosolids. Thus, using engine exhaust instead would be well suited for this type of application. An indirect dryer could not directly use engine exhaust as the heat transfer medium.

This medium has the benefit of allowing for more complete use of the heat available in the exhaust. With the other media considered, the engine exhaust would be used to heat the media and thus there would need to be a difference in temperature between the engine exhaust and the heat transfer media to drive the transfer of heat. With direct use of the engine exhaust, this difference in temperature is not needed and the heat in the exhaust would be fully utilized.

Technical challenges associated with this option include:

- The need to manifold the exhaust discharge from each engine together to transfer all of the cogeneration facility heat to the dryer. This can be a serious safety concern as pulsations or exhaust explosions from one engine could impact the other engines if the exhaust systems are manifolded together.
- Controlling thermal expansion of exhaust ductwork at high temperatures would be difficult, especially over long distances and if the exhaust systems were manifolded together. With one or more engines not operating, there would be a significant difference in thermal expansion between exhaust ductwork of the operating engines and that of the idle engines.
- To minimize back-pressure while maintaining flow through the necessary exhaust treatment equipment and dryer, very large ductwork would be needed. In addition, because of the high exhaust temperature, this large ductwork would have to be stainless steel as carbon steel does not have sufficient yield strength at elevated temperatures.

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- Direct use of the engine exhaust would also eliminate the ability to supplement the low-grade heat supply for TPAD heating needs. Instead, supplemental boilers would be required to boost the low-grade heat loop above the temperature available from the engine jacket water.

Due to the large ductwork or piping needed to convey the exhaust to the dryer, this option would have significant cost increases if the cogeneration facility and biosolids dryer facility are not located in the same building or adjacent to each other. In addition, concerns regarding heat loss and engine exhaust back-pressure would arise if the two facilities were not collocated.

4.5 Summary of Advantages and Disadvantages

Table 3 below summarizes the relative advantages and disadvantages of each of the heat transfer media described above.

Table 3. Comparison of Heat Transfer Media

Heat Transfer Medium	Advantages	Disadvantages
High-pressure hot water	• Operates as a liquid at high temperatures • Non-toxic, non-flammable medium • No need for 24/7 supervision	• Not commonly used at WWTPs or with biosolids dryers • Very high-pressure system requiring specialized equipment • Safety concerns regarding leaks flashing to steam
Steam	• Commonly used, well known medium for heat transfer • Non-toxic, non-flammable medium • Operates at medium pressures • Can be used directly with indirect dryer • Energy-dense fluid results in smaller pipe sizes	• Energy-dense fluid results in large release of energy if the system leaks • Requires 24/7 supervision • The steam and condensate phases require independent and unique transfer systems
Hot thermal oil	• Operates as a liquid at high temperatures • Operates at low pressures • No need for 24/7 supervision • Can be used directly with indirect dryer	• Flammable material • Some types are toxic • Greater tendency to leak and would smoke upon exposure to air • Difficult to control for thermal expansion due to greater tendency to leak • Expensive medium to purchase and resupply • Requires specialized equipment to prevent leakage and exposure to air
Engine exhaust	• Greatest thermal efficiency • Operates at low pressures • Can be used directly with direct dryer • No need for 24/7 supervision	• Operates at highest temperature • Greatest heat loss per 1,000 ft • Difficulty in controlling thermal expansion • High cost for large, stainless steel ductwork • Back-pressure limitations • Safety concerns regarding manifolded exhaust systems

Common to all of these media are the technical complexities associated with operating a high-temperature heat loop. The high temperatures would require pipe insulation to prevent contact with exposed piping or ductwork and to limit heat loss. In addition, water contacting the bare pipe or ductwork would flash to steam at the high temperatures required for biosolids drying. High temperatures would also require special attention to control thermal expansion and to keep the pipe insulation covering the entire length of pipe as the heat loop pipe expands and contracts.

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Also common to all of the options would be the likely need to operate the system 7 days per week, even with the biosolids dryer operating only 5 days per week. Although it is feasible to shut down the high-temperature heat loop when the biosolids dryer is shut down, all of the systems would require an extended period to cool down from their operating temperature and heat back up prior to restarting the dryer. In addition, shutting down the high-temperature heat loop when the biosolids dryer was offline would require an engine exhaust bypass to prevent overheating of the heat transfer medium while the high-temperature heat loop is offline. The simpler approach would be to maintain the operation of the high-temperature heat loop and waste the recovered heat collected in a radiator if the dryer is offline for short periods of time (2–3 days).

4.6 Technology Assumed for BCE Analysis

The assumed approach to transferring heat from the cogeneration facility to the biosolids drying facility is contingent on the location of the biosolids dryer. At none of the distances would a high-pressure hot water system or direct use of the engine exhaust be considered appropriate. These types of systems are too infrequently used at WWTPs and pose too many technical challenges to be considered further.

If the dryer is located at a significant distance from the cogeneration facility (e.g., greater than 50 feet), a steam system is the only heat transfer medium that could be used. (For example, locating the thermal dryer at either Sites A, B, C, or D would require a steam system). A steam system provides the most compact means of transferring heat and has well understood properties and characteristics for this type of application. At extended lengths, the HTO system poses too great of a safety hazard due to the potential for leakage and the resulting fire hazard.

If the dryer facility is located very near or adjacent to the cogeneration facility (e.g., within 50 feet), a steam system or HTO system could be used to transfer heat. At short distances, an HTO system becomes more viable as the potential for leakage and the effects of thermal expansion can be better controlled. If the City wishes to eliminate the need for a steam operator on site at all times, a HTO system may be preferred over a steam system.

For the BCE analysis, a steam system is assumed because it allows for heat transfer independent of where the dryer is located.

Section 5: Summary of Analysis

This TM evaluated the expected amount of high-grade waste heat available from the cogeneration facility that could be used for drying biosolids. The different types of biosolids dryers were described along with how they would interface with the cogeneration facility and with a high-temperature heat loop. Finally, options for the medium with which high-grade heat could be transferred from the cogeneration facility to the biosolids drying facility were identified. A summary of the results of these analyses are as follows:

- Based on the expected power demand at the SJSCWRF, expected flows and loads, and expected low-grade heat demands, the amount of high-grade heat available for biosolids drying is expected to range between 9 and 10 MMBtuh between 2018 and 2025 and to grow to 12 MMBtuh by 2040.
- Using waste heat for biosolids drying would require a backup heat source should the cogeneration facility have an unexpected outage.
- For the the Base Case and Alternative 1 any of the three dryer types described could be used for biosolids drying. A belt dryer or indirect dryer such as a paddle dryer could be used to take full advantage of waste heat recovery, while a drum dryer could be used to produce the most uniform and versatile end product.

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- Because the amount of waste heat available for biosolids drying is insufficient to dry 20 percent of the plant's biosolids in 2030, the Base Case and Alternative 1 would require consumption of natural gas to supplement or replace the use of waste heat from the cogeneration facility.
- For the BCE analysis, an indirect dryer (paddle dryer) using waste heat from the cogeneration facility supplemented by a natural gas furnace will be assumed.
- For Alternative 2, either a belt dryer or indirect dryer could be used with waste heat recovery from the cogeneration facility. An indirect dryer will be assumed for the BCE analysis.
- All of the heat transfer media evaluated have significant safety concerns. To minimize these concerns, the medium used is dependent on the distance between the cogeneration facility and the biosolids dryer:
  - HTO could be used up to a distance of approximately 50 feet
  - Steam could be used at any distance
- For the BCE analysis, a steam system is assumed for transferring waste heat from the cogeneration facility to the dryer facility.

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Technical Memorandum

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 7

Subject: Evaluation of Candidate Sites for New Biosolids Processing Facilities

Date: December 19, 2014

To: Lily Zhu, P.E., Senior Engineer, City of San José

From: Lloyd A. Slezak, P.E., Project Manager, Brown and Caldwell

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Limitations:

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Section 1: Introduction

1.1 Purpose

This Technical Memorandum (TM) 7 presents the results of a siting evaluation for potential new biosolids processing facilities being considered for the San José-Santa Clara Regional Wastewater Facility (RWF). Four candidate sites are evaluated to identify constraints (e.g., available space, existence of sensitive environmental conditions, and presence of existing and planned facilities) and capacity to accommodate potential new biosolids facilities. In addition, a fifth location near San José's planned cogeneration facility was evaluated to assess its ability to accommodate a thermal drying facility.

The Plant Master Plan (PMP) provides for transition from the current, open-air biosolids process that utilizes stabilization lagoons and drying beds to enclosed treatment processes for the biosolids. As part of the Biosolids Transition Study, Brown and Caldwell has evaluated a number of alternatives to implement the biosolids transition plan identified in the PMP. The alternatives evaluated are briefly described below and details are provided in TM8, *Biosolids Program Business Case Evaluation*.

- Base Case -- PMP Recommendation with Mesophilic Digestion. This includes mesophilic digestion, digested sludge storage, mechanical dewatering, thermal drying, and solar drying.
- Alternative 1 – Modified Base Case with TPAD. This alternative uses the same processes as the Base Case except that temperature-phased anaerobic digestion (TPAD) is utilized rather than mesophilic digestion.
- Alternative 2 – Base Case with Blending Option. This alternative is designed to maximize use of biosolids as alternative daily cover (ADC) at Newby Island Landfill. The treatment process is similar to Alternative 1 but uses a smaller thermal dryer and adds a blending facility. Unit processes include TPAD digestion, digested sludge storage, mechanical dewatering, thermal drying, solar drying, and blending. This alternative also calls for acceleration of the on-line dates for drying technologies.
- Alternative 3 – TPAD with Future Batch Tanks. This alternative is designed to provide a future path to producing Class A biosolids via the addition of batch tanks. The unit processes under this alternative are: TPAD, batch tanks, and mechanical dewatering. As a part of this site evaluation, the potential for adding additional processing, such as soil manufacturing, was also considered in terms of space requirements.

Note that some of the sites evaluated in this TM are not capable of accommodating all of biosolids processing facilities included in some of the above listed alternatives.

1.2 Existing Conditions and Background

The RWF currently processes biosolids using sludge thickening, mesophilic anaerobic digestion, biosolids storage lagoons, and air drying beds. The overall process produces dried Class A biosolids that are used beneficially as ADC at the Newby Island Landfill.

The current treatment, storage, and final disposition process has been very economical since it was first implemented nearly 25 years ago. Nonetheless, a number of factors will soon affect this operation, including the following:

- the aging of the existing sludge thickening and digestion facilities
- the policy direction to reduce odor impacts to neighboring communities
- anticipated changes in future biosolids regulations
- the possible closure of the Newby Island Landfill in 2025
- long-term land use changes for the plant site

The San José City Council has directed the RWF to cease discharging digested sludge to the lagoons with a target date of 2018 and to decommission the lagoons and drying beds with a target date of 2024. These changes will require the implementation of new biosolids treatment processes that do not rely on storage lagoons and/or open air drying of biosolids. Additionally, disposition alternatives other than the Newby Island Landfill must be implemented by 2025 which is the year the landfill is scheduled to stop accepting materials.

Although the PMP identified a location for the new biosolids facilities, alternative sites are evaluated in this TM because:

1. During the PMP EIR process, it was determined that the planned location of the proposed biosolids facilities contained potential wetlands and aquatic habitat. Siting facilities in such a location would likely trigger extensive environmental mitigation and a lengthy permitting process. The resulting schedule delays would push project completion out well beyond the 2018 goal. Therefore, alternative sites needed to be evaluated.
2. The CIP Program team conducted a detailed project validation process of all PMP projects in early 2014. This validation effort led to a change in assumption from a large, covered open biosolids storage area near the lagoons (sized for 180 days of storage) to a managed, short-term enclosed storage facility. This significantly reduces the required storage footprint allowing smaller sites to be considered for the new biosolids facilities.

1.3 Assumptions

Several assumptions are made in this siting evaluation. These assumptions do not reflect technology selection decisions, but instead represent assumptions made for planning purposes. In general technologies that would result in more conservative estimates of space requirements were assumed. The overall assumptions are described in more detail below.

1. Digested sludge storage capacity is assumed to be provided through the conversion of two existing digesters in the group of Digesters Nos. 9 through 16 (applies to all alternatives).
2. Dewatering is assumed to use centrifuges as a basis for developing footprints; the actual dewatering technology will be determined through a technical evaluation during dewatering facility concept design.
3. The footprint of the thermal drying facility (applies to Alternatives 1 and 3) has been developed assuming belt dryers would be used because that technology has the largest footprint of conventional drying technologies and therefore results in a conservatively estimated facility footprint. The estimated cost for the thermal drying facility, however, is based on using paddle dryers because that technology is typically the most cost effective alternative for dryers within the needed capacity range. The actual thermal drying technology has not yet been selected.
4. A blending facility that blends dewatered biosolids with dried biosolids is included to maximize the amount of material that can be sent to Newby Island Landfill (applies to Alternative 3).
5. As discussed above, a potential soil manufacturing facility was also evaluated as a possible future action. The facility was sized assuming it would accept 30% of the dewatered biosolids, which is equivalent to the amount accepted by drying technologies under the Base Case and Alternative 1. Future market investigations would be required to determine the demand for any soil manufacturing facility and the appropriate capacity.

Section 2: Footprint Determinations

Footprints (i.e., space requirements) have been established for each biosolids processing facility included within each alternative. Footprint requirements for the cogeneration facility were provided by San José.

2.1 New Facilities

New facilities that are required under each alternative are itemized in Table 1.

Table 1. Unit Processes Required for Each Process Configuration Alternative

Unit Process	Base Case with Mesophilic Digestion	Alt #1 Modified Base Case with TPAD	Alt #2 Base Case with Blending	Alt #3 TPAD with Future Batch Tanks
Rehabilitate 4 Mesophilic Digesters	X			
Convert 4 Mesophilic Digesters to Thermophilic (resulting in TPAD process)		X	X	X
Digested Sludge Storage – Conversion of two existing digesters to storage	X	X	X	X
Pumping and Conveyance from Digesters to Dewatering	X	X	X	X
Mechanical Dewatering and Cake Loadout	X	X	X	X
Thermal Drying Facility	X	X	X	
Solar Drying (Greenhouse)	X	X	X	
Blending Facility			X	
Batch Tanks				Future addition

2.2 Approach to Determining Footprint Requirements

Footprint requirements for each processing facility were developed by identifying space requirements for similar facilities at other treatment plants that are constructed and in operation. Space requirements for facility elements such as process equipment and associated sub-systems, mechanical and electrical rooms, piping systems, ventilation equipment and ductwork, control rooms, restrooms, and similar elements were determined. Space provided for maintenance access around equipment, stairways, and access platforms was also taken into account.

Preliminary equipment selections were obtained from equipment vendors to ascertain the actual sizes of process equipment and associated sub-systems based on the needed processing capacity. Equipment footprints were then integrated into the space required as determined from the review of other similar existing facilities to arrive at an estimated footprint for the structure.

2.3 Facility Descriptions

Footprints for each facility have been established based on the required processing capacity as described in Section 3.1.1 of TM8, *Biosolids Program Business Case Evaluation,* and the vision of each new facility as

described in the following sections. Facility descriptions are solely for the purposes of establishing footprint sizes and costs; more detailed and specific facility layouts, sizing of components, and building configurations will need to be developed during preliminary design.

2.3.1 Digested Sludge Storage Facility (all alternatives)

Sludge storage is needed to provide a means for storing digested sludge during times when the dewatering facility is not in operation. Storage for 4 days has been established as a reasonable estimate of required storage capacity; this accounts for long weekends and times when all, or a portion of, the dewatering facility is out of service for more than 2 days (typical weekend shutdown). We have assumed that digested sludge storage capacity will be developed by converting two existing digesters in the group of digesters Nos. 9 through 16 into storage tanks. It is also assumed that digested sludge will be pumped to the storage tanks by the existing DSEPS.

2.3.2 Dewatering and Truck Loading Facility (all alternatives)

At this time, the dewatering facility is assumed to use centrifuges for dewatering digested sludge. Digested sludge would be pumped from the storage facility to the dewatering facility.

The facility is envisioned to consist of a new concrete two-story (ground level and second floor) building with a partial basement and integral truck loading bay. The assumed building footprint 150 by 200 feet and provides space for five centrifuges (4 duty units and one standby unit). The above-grade portion of the building is assumed to be about 40 feet high. The basement level is assumed to contain digested sludge day tanks and progressive cavity feed pumps for feeding sludge from the day tank to the centrifuges. The building is assumed to also include the following:

- polymer storage room with neat polymer storage tanks, aging tanks, and polymer solution pumping systems
- electrical room
- mechanical room with supply and exhaust ventilation fans
- foul air fans and ducting to a packaged odor treatment system
- operations/control room with small sample collection/operators "lab" area for routine testing
- men's and women's restrooms

Truck loadout is assumed to be an integral part of the dewatering facility. The truck loading area is assumed to have two live bottom storage hoppers that will provide 24 hours of cake storage capacity each at the average annual biosolids production rate. The hoppers are assumed to be equipped with pneumatic slide gates at the discharge points, roll-up doors at both ends of the drive-through, a small control booth, and ventilation systems. A packaged foul air treatment system is assumed to be provided outside the building.

2.3.3 Thermal Drying Facility (Base Case and Alternatives 1 and 2)

Dewatered biosolids would be hauled from the dewatering facility to the thermal drying facility in dump trucks, the trucks would then unload the dewatered cake into a hopper, and progressive cavity type pumps would pump the material from the hopper to the dryers.

The thermal drying facility is envisioned as a two-story (ground level and second level) building with a partial basement and a truck loading bay. The assumed building footprint is approximately 200 by 190 feet which provides space for two dryers (two duty units without a standby unit), electrical room, mechanical room, and small operations/control room. The building is assumed to be about 45 feet in height. The partial basement would contain the dewatered biosolids hopper and the dryer feed pumps.

The truck loading area is assumed to be a drive-through corridor similar to the truck loading area at the dewatering building. Two dried biosolids product silos are assumed.

Foul air fans and a packaged odor treatment system are assumed to be located outside thermal drying the building.

2.3.4 Solar Drying Facility (Base Case and Alternatives 1 and 2)

The solar drying facility is assumed to consist of a series of modular greenhouses that use solar radiation and fans to evaporate water from the digested biosolids to attain a dried (75 percent solids) product. Approximately 10 percent of the dewatered biosolids would be processed through the solar drying facility. Dewatered sludge would be hauled by truck from the dewatering facility to the solar drying facility and deposited in one of the available greenhouses. Dried biosolids would be unloaded from the greenhouse by a front end loader and deposited in dump trucks for hauling off site.

Initially, five separate greenhouses, each measuring approximately 50 feet wide and 250 feet long, are assumed to meet 10 percent of the 2030 sludge production. The facility would be expanded by one greenhouse to meet 10 percent of the 2040 biosolids production. Each greenhouse is assumed to be equipped with a ventilation system with ducting routed to an in-ground biofilter for foul air treatment.

2.3.5 Blending Facility (Alternative 2)

Alternative 2 assumes that dewatered biosolids (assumed to be 25 percent solids) would be blended with dried biosolids from both the thermal dryer (90 percent solids) and the solar dryers (75 percent solids) to form a product that is approximately 60% solids and suitable for use as ADC at Newby Island Landfill. Each feedstock material would be trucked to the blending facility from its respective processing area (i.e., dewatered biosolids from the dewatering facility).

Blending is assumed to be undertaken as a batch process that is placed into operation approximately every 3 to 4 days and that would then process the inventory of stored biosolids in 1 day of operation. Such a facility would provide storage for up to 4 days' worth of dewatered biosolids and dried biosolids, plus 4 days' worth of blended product. Operating on a more regular basis may reduce the scale of the facility and the benefits of this approach could be evaluated during a preliminary design phase.

The blending facility is assumed to consist of concrete storage bunkers for each feedstock material. Mixing would be accomplished in a batch process with a pug mill. The operation would be contained within a 200-foot-long by 150-foot-wide pre-engineered metal building with a concrete floor slab. The building would provide containment for odors and dust. Sufficient space is included within the footprint for foul air treatment.

2.3.6 Batch Tanks (Future Facility to Achieve Class A Biosolids – Alternative 3)

Under Alternative 3, batch tanks would be utilized in a staged digestion configuration to achieve a Class A biosolids product via digestion by meeting the time/temperature requirements of Alternative 1 of EPA's 40 Code of Federal Regulations (CFR) Part 503. Four thermophilic batch tanks would be used following first-stage thermophilic digestion phase. The tanks operate in parallel with fill, hold, and draw batch sequences. Each batch tank would be sized to provide approximately 12 hours of detention time. Following the required detention time, pumps would pump the digested biosolids to the storage facility.

2.3.7 Soil Manufacturing Facility (Possible Future Facility – Alternative 3)

A soil manufacturing facility is one "possible future" process that could be added any time after batch tanks are installed should Alternative 3 be selected. While such a facility is not assumed to be part of Alternative 3 in the TM8, *Biosolids Program Business Case Evaluation*, the space requirements were evaluated as part of this site evaluation. Such a facility would take Class A biosolids and blend them with other materials, such as sand and sawdust ("feedstocks") to create a top soil product. Research into the availability of feedstock

materials and the viability of the market for manufactured soil in the San José area would need to be completed before a decision is made to implement such a facility.

The assumed space requirements for such a soil manufacturing facility are generally modeled after the TAGRO facility operated by the City of Tacoma, Washington. For space planning purposes, we have assumed that digested Class A biosolids would be dewatered in a dewatering facility that would be dedicated to the soil manufacturing facility.

Sand and sawdust would be stored in concrete bunkers within the soil manufacturing facility. Dewatered biosolids will be mixed with the sand and sawdust by placing the materials on a concrete slab and mixing them together using front end loaders. To reduce odor potential, the dewatered biosolids storage area would be contained and ventilated with the foul air treated in a packaged biofilter unit. The mixing process may potentially generate odors as well. Containment and/or collection and treatment of foul air from the mixing area would be more difficult with the large space and open building and therefore may require interior partition walls and a packaged biofilter system.

The mixing area would be contained within a pre-engineered metal building with open ends. Concrete walls would be constructed at the perimeter of the building along the long dimension. The total footprint of the mixing area is approximately 42,000 square feet (sf) as scaled up from TAGRO facility. This represents a building that is about 140 by 300 feet.

In addition to the mixing facility, the dewatering facility (approximately 20,000 sf) and product storage areas would be provided.

2.3.8 Summary of Facility Footprint Requirements

Table 2 summarizes the required footprint for each new biosolids processing facility. The overall footprint with associated infrastructure takes into consideration features such as parking, buffer areas, separation from other facilities, and vehicle access. When phasing dictates that one facility will be constructed after another adjacent facility is built and in service, separation distances also take into consideration space needed for construction. For simplicity, idealized rectangular-shaped footprints are used, the actual shape of facilities will be developed in the preliminary design phase.

Table 2. Summary of Footprint Requirements of New Unit Processes

Unit Process	Basic Sizing Criteria to Establish Footprint	Footprint of Required Structure	Overall Footprint with Associated Infrastructure[1]	Notes
New Digested Sludge Storage	4 days volume at 2040 average annual biosolids production rate	2 – 100' diameter tanks + pump building	175' x 300' 53,000 sf	Rehabilitation and conversion of existing digester tanks is an alternative to constructing new storage capacity
Mechanical Dewatering and Cake Loadout	2040 peak 2-week biosolids production rate 24 hours per day, 5 days per week operation	150' x 200' 30,000 sf	200' x 225' 45,000 sf	Required in all alternatives
Thermal Drying Facility and Loadout	20% of 2040 average annual biosolids production rate 24 hours per day, 5 days per week operation	200' x 190' 38,000 sf	220' x 300' 66,000 sf	Assumes belt dryer technology, 2 duty units
Solar Drying (Greenhouse)	10% of 2040 average annual biosolids production rate	6 modular greenhouses @ 250' x 50' 75,000 sf	325' x 400' 130,000 sf	Overall footprint includes space for staging trucks and vehicle movement
Blending Facility	2025 average annual biosolids production rate	200' x 150' 30,000 sf	350' x 400 140,000 sf'	Overall footprint includes space for feedstock bunkers, pug mill/truck loading
Batch Tanks (Future facility)	2040 peak biosolids production rate	80' x 80' 6,400 sf	100' x 100' 10,000 sf	Only required for Class A biosolids production
Soil Manufacturing (Possible future facility)	30% of 2030 average annual biosolids production rate	Mixing Area 150' x 300' 45,000 sf Dewatering Facility 100' x 200' 20,000 sf	14 acres	Scaled up from Tacoma facility

1. *Related infrastructure includes driving roadways, vehicle parking, buffer from other structures, space for electrical transformers, space needed for maneuvering vehicles, etc.*
2. *A dewatering facility associated with soil manufacturing represents one potential solution for addressing regrowth risk. A dedicated dewatering facility tied to soil manufacturing may or may not be required pending further research into the regrowth issue and other factors.*

Section 3: Candidate Sites for Biosolids Processing Facilities

Four candidate sites at the RWF have been identified as sites that may be suitable for construction of potential new biosolids processing facilities. The sites were evaluated to determine their capacity to accommodate the new facilities based on the footprint requirements and ease of operations. Environmental conditions were investigated by ESA Associates (ESA) and have been described in reports referenced below; the findings in these reports were also taken into consideration as part of the site evaluation.

3.1 Description and Characteristics of Candidate Sites

Candidate sites are identified in Figure 1 and described in the following paragraphs. Permitting and environmental requirements are described based on information contained in the following reports:

- "Habitats and Wetlands Site Assessment Memo for Parcel C and D" dated August 11, 2014 prepared by ESA
- "Biosolids Alternative Sites A, B, C and D – Permitting and CEQA Constraints" dated October 11, 2014 prepared by ESA
- "Wetland Delineation Summary for Alternative Biosolids Sites A and C" dated October 20. 2014 prepared by ESA

These reports indicate that jurisdictional wetlands and other sensitive habitats were identified on or adjacent to two of the candidate sites (Sites A and D). Subsequent information from ESA indicates that Site C may also be jurisdictional, but this is yet to be confirmed. The general extent of the wetland areas are described in those ESA reports and summarized in this TM; refer to the reports from ESA.

3.1.1 Potential Thermal Drying Sites Adjacent to Cogeneration Facility

TM 6, *Waste Heat Recovery Analysis*, concludes that conveyance of heat from the cogeneration facility to the thermal drying facility could have significant technical complexities and concerns regarding operator safety. Regardless of which conveyance technology is used (hot water, steam, hot thermal oil, engine exhaust), locating the thermal dryer in close proximity to the planned cogeneration facility is desirable because it would the length of required conveyance.

Two locations for the thermal drying facility that are within the immediate vicinity of the planned cogeneration facility were proposed by San José and investigated by Brown and Caldwell. One location is south of the planned future cogeneration facility (refer to Figure 2), and the second location is north of the planned future cogeneration facility (refer to Figure 3)

In the first location, the thermal drying facility would be located between the existing fuel cell facility and the planned cogeneration facility. An existing buried 84-inch-diameter nitrification influent pipe that is roughly parallel to Zanker Road is on the east edge of this candidate location. These existing facilities constrain the available space to a point where there appears to be insufficient space to accommodate the facility footprint.

The second location, north of the planned cogeneration facility, provides slightly more space than the south location but would result in difficult access for biosolids hauling trucks and, based on available mapping, would likely require relocation of the existing 84-inch diameter pipeline so that it is not within the building footprint.

Thus, it appears that siting thermal drying adjacent to the cogeneration facility may not be feasible from an available space perspective; however, the facility footprint could change based on technology selection, final layout of the facility, truck traffic routing, and capacity decisions made during the design phase. In that event, San José should re-evaluate these adjacent locations once those design decisions are made.

3.1.2 Area for Sidestream Treatment

Planning evaluations for the liquid stream process have concluded that separate sidestream treatment is unlikely to be required unless future regulatory changes further restrict nitrogen and ammonia discharge limits. Nonetheless, because a separate sidestream treatment process could be required at some point in the future, space requirements for such a system are taken into consideration by reserving space for this process. Preliminary layouts suggest that the footprint of the sidestream treatment facility, including buffer areas, will require about 43,000 square feet.

Depending upon the specific arrangement of biosolids processing facilities between the sites, sufficient space is available on both Site A and Site D for a future sidestream treatment facility if areas within the plant (such as the west primary sedimentation tanks or aeration basins) are unavailable. The time needed to secure permits would be longer for Site D than for Site A due to the wetland and streambed features that exist on Site D. As a result, we recommend reserving Site D for future sidestream treatment, leaving Site A, which should prove easier to permit, for biosolids processing facilities, some of which will be required in the nearer term.

3.1.3 Site A

Site A is a triangular-shaped, 23 acre parcel located on the east site of Zanker Road in the southwest corner of the existing sludge drying operation. Site A is shown in Figure 4. Site A is not within the operational area of the treatment plant as delineated in Figure 3-3 of the *San José/Santa Clara Water Pollution Control Master Plan Draft Environmental Impact Report* dated January 2013. However, Site A is located within existing buffer land as shown in the PMP (refer to the un-numbered figure on page 46 in the PMP) and within the area designated in the PMP as being allocated for future liquid stream treatment processes (refer to the un-numbered figure on page 43 in the PMP).

As described in the October 11, 2014 memorandum prepared by ESA, Site A is bordered on the east by riparian habitat that is supported by an internal linear seasonal wetland (these features are outside of the Site A boundary). Zanker Road is on the western edge of the site. The northern boundary of Site A coincides with the boundary of Site C and the southern boundary coincides with the property line of the adjacent property.

In the past, Site A has been used to process and stockpile soil for placement in the drying beds to replace soil lost through the biosolids drying process.

3.1.3.1 Existing Conditions/Demolition

An existing building identified as Tempco Building on plant drawings, is located on the western edge of the site. A well is located in the center of the site. Vehicle access to the site is currently available from Zanker Road.

3.1.3.2 Environmental Description and Permitting Limitations

Environmental conditions and permitting implications are described in detail in ESA's October 11, 2014 and October 20, 2014 memoranda which are referenced in Section 3.1 of this TM. Information in these memoranda has been used in the following paragraphs to summarize key elements of the environmental conditions and permitting limitations associated with Site A.

ESA undertook a delineation evaluation of previously identified potential wetland areas on Site A to:

- Confirm the existence of wetland areas on Site A;
- Identify the extent of wetlands that may potentially be jurisdictional waters of the U.S. or of the State;
- Gather physical evidence necessary for a jurisdictional determination; and
- Determine whether the identified areas met the federal regulatory definition of a wetland.

Based on information obtained through the detailed assessment, ESA reached the following conclusions:

- The previously identified potential wetland area in the southern portion of site does not meet the three criteria required for federal geographical jurisdiction under Section 404 of the federal Clean Water Act. Furthermore, the wetland is isolated and as such also would not be subject to federal regulation. However, the wetland feature may still be subject to regulatory authority of the Regional Water Quality Control Board (RWQCB) as waters of the state under the Porter-Cologne Water Pollution Control Act.

- Of the four potential wetland areas in the northern portion of the site, only one meets the geographical criteria for federal jurisdiction however, this feature appears to be isolated and may also not be jurisdictional at the federal level. The feature is approximately 0.03 acres (1,300 square feet) in size. The feature may still be jurisdictional at the state level.

With regards to permitting implications, the October 11, 2014 ESA report states if the jurisdictional (federal and state) wetland features on Site A can be avoided (taking into account a buffer up to 100 foot around the wetland features), then Site A could be developed without the need for any of the permits and approvals required by jurisdictional (federal and state) agencies. If impacts cannot be avoided, ESA recommends the City assume that the RWQCB will regulate the features as waters of the state under Porter-Cologne. Permitting for impacts and seeking an approved jurisdictional determination from the USACE would be expected to take 12 to 18 months.

ESA's October 11, 2014 memorandum states that much of Site A is within the boundary of the Santa Clara Valley Habitat Plan (SCVHP). Development within the SCVHP area would be mitigated through fees.

3.1.4 Site B

Site B is located within the operational area of the existing RWF, encompassing existing Digesters Nos. 1 through 4, the digester control building, diesel and water storage tanks, the Digested Sludge Export Pump Station (DSEPS), and an existing butler building that is used to store maintenance items. Utility tunnels are located below grade. Site B is 3.6 acres in size and is shown in Figure 5.

3.1.4.1 Existing Conditions

The existing structures within the Site B boundary will require demolition to create space for new biosolids processing facilities. In addition, some of the current facilities and functions located in this area would need to be relocated to other areas of the existing RWF. It is assumed that the DSEPS will remain in service as the central point for collecting digested sludge from all digesters and pumping the material to the digested sludge storage facility. It is also assumed that the digested sludge force main from the DSEPS to the existing sludge storage lagoons can continue in service. Tie-ins to the force main would be made to route digested sludge to the new storage facility.

3.1.4.2 Environmental /Permitting Limitations

As described in ESA's October 11, 2014 memorandum, Site B is paved and supports almost no vegetation with the exception of a small cluster of trees and/or shrubs in the northern-most portion of the site. This vegetation is not expected to be suitable for nesting birds or other protected wildlife; consequently biological constraints are expected to be absent or negligible. Based on this assessment, the October 11, 2014 ESA memorandum concludes that CWA 404/401, Porter-Cologne, or CDFW 1600 Code permits are not expected to be required and no mitigation associated with habitat or jurisdictional features would be required.

3.1.5 Site C

Site C is a rectangular-shaped, 9-acre site located east of Zanker Road and south of the equalization basins. The north boundary of the site is along the entrance road into the existing biosolids management facility. Site C is outside of the boundary of the operational area of the treatment plant as delineated in Figure 3-3 of the *San José/Santa Clara Water Pollution Control Master Plan Draft Environmental Impact Report* (EIR) dated January 2013. Additionally, Site C is located within existing buffer land (refer to figure on page 46 in the PMP) and is within the area designated in the PMP as being allocated for future liquid stream treatment processes (refer to figure on page 43 in the PMP). Site C is shown in Figure 6.

3.1.5.1 Existing Conditions

Site C is periodically used as an emergency overflow storage basin for primary effluent. The basin has been created by constructing earthen berms at the perimeter of the site. Beside the berms, the only structures that exist on the site appear to be small concrete structures.

3.1.5.2 Environmental / Permitting Limitations

A wetland delineation of Site C was undertaken by ESA in early October 2014 to identify the extent of wetlands that may potentially be jurisdictional. Findings from this investigation are described in ESA's October 20, 2014 memorandum. While some wetland indicators (hydrologic, soil, and vegetation features) were identified, ESA indicated that the site might qualify as a waste treatment pond and a component of a waste treatment system. If that were to be the case, the site would be exempt from Section 404 or 401 permits. However, the City will need to demonstrate the site has acted as a component of the waste treatment system to the USACE, which could be difficult given that little documentation exists. Thus, at this point it is not clear whether or not the City could successfully qualify for the exemption. If the USACE were to determine that the exemption does not apply, then the wetlands could be subject to federal regulation. Until a definitive determination is obtained from the regulatory agencies, the specific status of Site C is uncertain and ESA advises that the City should assume that the entire basin could be jurisdictional and subject to federal and/or state regulation.

ESA describes a "worst case" scenario in which the basin is not considered an exempt component of a waste treatment system, Section 404 and 401 permits are required for development, and Waste Discharge Requirements (WDRs) are issued by the RWQCB under Porter-Cologne. Under this scenario, the entire basin would be a state- and federally-jurisdictional wetland; permit acquisition would be challenging and could take between 1 and 5 years depending upon whether it qualifies for a Standard Individual 404 Permit; and a high degree of compensatory mitigation would be required.

3.1.6 Site D

Site D is a 9-acre site located south of existing Sludge Storage Lagoons L-1, L-2, and L-3 and east of the Zanker Road Landfill as shown in Figure 7. The site is on the north side of Los Esteros Road along the roadway curve that serves as a transition between Los Esteros Road and Zanker Road.

Site D is outside of the boundary of the operational area of the treatment plant as delineated in Figure 3-3 of the January 2013 EIR. A rectangular area in the eastern portion of Site D is identified in Figure 3-9 of the EIR as "B2-P2 Dewatering Phase 2", however, the remainder of Site D not designated on that figure as within the boundaries of the biosolids processing improvement areas. The un-numbered figure on page 39 of the PMP however indicates Site D is within the area designated for future solids handling.

The northern boundary of Site D abuts the existing lagoon embankment. San José has indicated that this boundary potentially could be expanded into the lagoons if necessary to create additional space for new biosolids facilities.

3.1.6.1 Existing Conditions

A small stormwater pump station is located in the center of Site D; otherwise the site is vacant.

3.1.6.2 Environmental / Permitting Limitations

The October 11, 2014 memorandum prepared by ESA describes the eastern portion of Site D as vegetated and mowed on a regular basis. The parcel is considered unsuitable habitat for burrowing owls. Additionally, it is unlikely that this portion of the site supports any special status plant species.

ESA's October 11, 2014 memorandum describes two potentially jurisdictional wetland/streambed features within Site D. The first is a drainage channel on the eastern boundary of Site D; the location of this feature is not shown on mapping of Site D. The second feature is also a drainage channel that is located west of the berm that bisects the site. The channel runs east-west across the northern part of the parcel and then turns north-south to bisect the property. ESA's October 11, 2014 memorandum concludes that these two drainage features would be jurisdictional at both the state and federal level and would also be considered streambed features regulated by the California Department of Fish and Wildlife (CDFW). As a result, development that would impact these features would be expected to require Section 404 and 401 CWA permits from the USACE and RWQCB, respectively. In addition, ESA's memorandum states that RWQCB would regulate these features as waters of the state under Porter-Cologne and a CDFW 1600 Code permit is expected to be required for the alteration of these streambeds.

Wetlands were also identified in Sludge Storage Lagoons L-1, L-2, and L-3; in the event the northern boundary of Site D is expanded into these lagoons, impacts to these areas would need to be addressed.

3.1.7 Summary of Candidate Sites

Information on the candidate sites is summarized in Table 3.

Table 3. Summary of Candidate Sites for New Unit Processes

	Site A	Site B	Site C	Site D
Size, acres	23	3.6	9	8.6
Existing Land Use[1]	Buffer Area	Operational Area	Undefined	Undefined
Future Use (with reference)	Future Liquids Treatment Processes (PMP pg 39, 43)	Operational Area, Biosolids Dewatering (EIR Figure 3-9)	Future treatment (PMP pg 43) Solids dewatering and drying (PMP pg 43)	Solids Handling, Advanced Process Control and Automation (PMP page 43)
Constraints (see also wetlands and permitting in this table)	Existing well, commercial building,	Existing structures on site and immediately adjacent to site boundary	Existing use as backup overflow basin by RWF	Small stormwater pump station located in the center of Site D
Demolition requirements	Relocation of existing well and a permit for the construction of a new well may be required"	Digesters Nos. 1 through 4, Maintenance Storage Bldg (Butler Building), utility tunnels, storage tanks	Minor structures	Stormwater PS
Sensitive Plant Species	No	None	None observed	None observed
Wetlands	Yes	None	Potentially	Yes
Permitting	Permits related to RWQCB jurisdiction pertaining to waters of the State under Porter-Cologne[2] Possibly USACE permit for northern wetland if not isolated.	None expected	Possibly exempt; if not, may require Section 404 and 401 CWA permits (USACE) and RWQCB approvals under Porter-Colgne. A variety of permitting scenarios are possible.	Sections 401, 404 CWA permits (RWQCB and USACE); waters of the state under Porter-Cologne; CDFW 1600 Code permit

1. Existing land uses as identified in the un-numbered figure on page 46 of the PMP except where noted.

2. Only if impacts to wetland area cannot be avoided.

Section 4: Ability of Each Site to Accommodate Alternatives

This section evaluates the extent to which each site can accommodate the specific facilities included within each alternative.

4.1 Site A

Site A is the largest of the four sites under consideration. Utilization of this site differs slightly among the three alternatives. Descriptions of how the site could be used under each alternative are provided in the following paragraphs.

4.1.1 Base Case: PMP Recommendation with Mesophilic Digestion

A conceptual layout of the facilities on Site A is presented in Figure 8. New facilities required under this alternative (in addition to digested sludge storage) include centrifuge dewatering/truck loadout, thermal drying, and solar drying. Site A can accommodate all of these facilities within the southern portion of the site where federally jurisdictional wetlands have not been identified and without impinging on the riparian buffer, thereby avoiding certain environmental impacts and the need for certain permits.

As shown in Figure 8, dewatering/loadout would be positioned in the southwest corner of the site, maximizing the remaining available space for solar drying and thermal drying. The thermal drying facility and solar drying facility would be located to the east and north of the dewatering facility to minimize the hauling distance for trucking dewatered biosolids. The thermal drying facility is located as far north as possible to minimize the length of the steam piping between the cogeneration facility and the thermal drying facility. The solar drying facility is located in the southeast corner of the site. This represents just one possible layout for these facilities on Site A; others would be possible and should be evaluated during design.

4.1.2 Alternative 1: Modified Base Case with TPAD

The facilities required in Alternative 1 are the same as in the base case: digested sludge storage, dewatering, thermal drying and solar drying. The layout of new facilities on Site A would be as shown in Figure 8 for the Base Case.

4.1.3 Alternative 2: Base Case with Blending Option

A conceptual layout of the facilities on Site A under this option is presented in Figure 9. The arrangement places the blending facility between the three facilities that will provide feedstock materials: dewatered biosolids, thermally dried biosolids, and solar dried biosolids. This arrangement is desirable from a truck travel perspective.

As shown in Figure 9, Site A can accommodate all facilities required for this alternative within the central and southern portion of the site where federally jurisdictional wetlands have not been identified and without impinging on the riparian buffer, thereby avoiding certain environmental impacts and the need for certain permits.

4.1.4 Alternative 3: TPAD with Future Batch Tanks

Under Alternative 3, batch tanks are added to dewatering to produce a Class A soil amendment. Batch tanks would be located in the vicinity of the digesters; Site A has sufficient space for the planned dewatering facility.

We also evaluated the ability of Site A to accommodate a possible future soil manufacturing facility should San José chose to implement such a facility at some point in the future. One conceptual layout of the dewatering facility and potential future soil manufacturing facility on Site A is shown in Figure 10. Dewatering

is located in the southwest corner which would preserves as much space as possible for future facilities. Other layouts would be possible and should be evaluated during design.

4.2 Site B

A conceptual layout of the facilities that fit on Site B is presented in Figure 11. Site B, the smallest of all candidate sites, can only accommodate the dewatering/loadout facility however, locating the dewatering facility at Site B is not recommended for reasons outlined in Section 6 of this TM.

4.3 Site C

Site C will accommodate a variety of arrangements under each alternative. These are described in the following paragraphs.

4.3.1 Base Case (PMP Recommendation with Mesophilic Digestion) and Alternative 1 (Modified Base Case with TPAD)

Following the digestion process, the facilities required under both the base case condition and the modified base case alternative are identical. New unit processes under these two approaches are: dewatering, thermal drying and solar drying. Site C is large enough to accommodate all three facilities as shown in Figure 12. Co-locating these facilities on the same site consolidates trucking of dried biosolids. Locating the thermal drying facility on Site C would reduce the distance for steam conveyance from the cogeneration facility; therefore locating the drying facility on Site C would be advantageous from this perspective.

4.3.2 Alternative 2: Base Case with Blending Option

Site C has sufficient space to accommodate dewatering, thermal drying, and solar drying as shown in Figure 13, but cannot also accommodate the blending facility. Separating the blending facility from the other three facilities, such as locating the blending facility at Site A, would increase trucking of the dewatered and dried biosolids.

4.3.3 Alternative 3: TPAD with Future Batch Tanks

Site C can accommodate the dewatering facility but would not be large enough to also accommodate potential future soil manufacturing. Future batch tanks would be located within the RWF.

4.4 Site D

4.4.1 Base Case (PMP Recommendation with Mesophilic Digestion) and Alternative 1 (Modified Base Case with TPAD)

New unit processes under these two alternatives are: dewatering, thermal drying and solar drying. Site D is large enough to accommodate all three facilities as shown in Figure 14; however the potential wetland areas noted by ESA would be impacted.

4.4.2 Alternative 2: Base Case with Blending Option

Site D has sufficient space to accommodate two of the four facilities (dewatering, thermal drying, solar drying, and blending) required under Alternative 2.

4.4.3 Alternative 3: TPAD with Future Batch Tanks

Site D can accommodate dewatering with batch tanks in the vicinity of the digesters. Site D would not have sufficient space to accommodate a possible future soil manufacturing facility.

Section 5: Evaluation of Alternative Sites

A number of factors related to siting new facilities on the candidate sites have been taken into consideration as part of this evaluation. Environmental and permitting limitations, and the physical space that each site may provide to accommodate the various new facilities have both been evaluated and described in previous sections; discussion regarding these factors will not be repeated in this section of the TM. Instead, additional factors such as conflicts with existing facilities, vehicle access and traffic considerations, accessibility for RWF operations and maintenance staff, and proximity to related facilities are taken into account and described in this section and summarized in Table 4.

Table 4. Comparison of Candidate Sites

Comparison Factor	Site A	Site B	Site C	Site D
Conflicts and Construction Issues	Relocation of existing well	Significant demolition of existing facilities and relocation of existng functions adding cost to project	No significant issues	No significant issues
Vehicle Access and Traffic Considerations	New entrance needed	Would generate significant truck traffic	Reasonable access using existing entrance, upgrading likely required	Site distance restrictions due to curve on Zanker Road. Upgrading likely required for access.
Personnel Access	Furthest from RWF, need to cross Zanker Road (requires a safe means for plant staff to access the site, possibly a below-grade tunnel)	Within RWF, easily accesed by plant personnel	Plant staff at RWF would need to cross Zanker Road to gain access onto site (requires a safe means for plant staff to access the site, possibly a below-grade tunnel)	Plant staff at RWF would need to cross Los Esteros Road to gain access onto site (requires a safe means for plant staff to access the site, possibly a below-grade tunnel)
Proximity to Neighbors	Closest	None (within RWF)	Lowest among candidate sites	Moderate (adjacent to sites with similar uses)
Operations /Proximity to Related Facilities	Furthest from related processes at RWF	Co-located with other solids processing facilities,	Separated from RWF, depending upon alternative, new facilities likely separated due to space constraints	Separated from RWF, depending upon alternative, new facilities likely separated due to space constraints

5.1 Conflicts with Existing Facilities and Utilities

Site B, located within the RWF, contains significant buried and aboveground facilities that would need to be relocated and demolished to allow construction of the new facilities. These include digester tanks and other concrete structures, underground utility tunnels, piping and electrical systems, storage tanks and similar items.

For the most part, only minor facilities and utilities exist on the other three sites. Existing minor items that could require demolition or relocation to resolve conflicts with the new facilities include a well on Site A and miscellaneous small concrete structures on both Site C and Site D.

5.2 Vehicle and Personnel Access and Traffic Considerations

Access and traffic were considered as part of the site evaluation.

Vehicle access onto Sites A, C and D would be from Zanker Road or Los Esteros Road. A new entrance onto Site A would be required but existing entrances could be utilized for Sites C and D. As a safety measure, the City can consider constructing a below-grade (tunnel) crossing beneath Zanker Road or Los Esteros Road to provide a means for plant personnel to access Sites A, C, and D while avoiding traffic on these surface roadways.

Should the dewatering facility ultimately be located at Site B (refer to Section 6.1), truck traffic through the RWF would increase.

5.3 Proximity to Neighbors

Of the four candidate sites, Site B would have the least impact to adjacent properties since it is located within the RWF. Site A is the closest to neighbors to the south and east. Sites C and D are adjacent to properties with similar functions and uses (such as landfills and materials processing facilities) and therefore would be expected to have a low impact.

5.4 Proximity to Related Facilities

Co-locating facilities on the same site or in proximity to each other has certain operational advantages. As discussed in detail in TM6 and in this TM, locating the thermal drying facility close to the cogeneration facility is desirable because it reduces the length of the steam conveyance pipeline and reduces risks associated with high pressure pipeline operating conditions.

Locating dewatering, thermal drying, and solar drying in close proximity to each other would be advantageous because truck hauling distances are reduced. Reduced hauling distances will result in lower fuel costs, vehicle maintenance costs, and roadway maintenance costs. When similar facilities are located together, operations tasks become more centralized which tends to improve efficiency.

Section 6: Recommendations

This section summarizes overall conclusions and recommendations related to the siting evaluation.

- Of the four candidate sites evaluated, Site A provides the greatest area and flexibility for future biosolids facilities. Site A also offers easy access from Zanker Road and eliminates truck traffic through the central operational area of the Plant. In addition, it is likely that dewatering as well as other facilities could be developed at Site A without the need for extensive environmental (federal wetlands) permitting. Thus, we recommend that Site A be reserved for biosolids processing facilities. Plant staff would need to cross Zanker Road to access facilities located at Site A, therefore a means to do this safely should be incorporated into the design.
- Site C could be preferable for thermal drying due to its proximity to the planned cogeneration facility. However, as reported by ESA in their October 11, 2014 TM, the jurisdictional status of Site C is dependent on the USACE's and other agencies' interpretation of wetland and surface water conditions. ESA has recommended the City should assume that the entire basin could be jurisdictional and subject to federal and/or state regulation. Permit acquisition under this worst case scenario would be challenging and could take between 1 and 5 years and require a high degree of compensatory mitigation. Thus, we recommend that the City initiate efforts to resolve these jurisdictional issues to determine if Site C might be feasible for thermal drying in the longer run.

- Site B could only accommodate dewatering. However, a working meeting with San José staff on September 24, 2014, resulted in concurrence that Site B should be eliminated as a candidate site for the dewatering facility due to the following factors:
  - Higher costs for construction due to constricted site and the required demolition of existing facilities
  - Potential for conflicts with other planned construction activities
  - Need to relocate certain functions and facilities
  - Ongoing traffic conflicts post construction
  - Unknowns with respect to decommissioning certain facilities

  Nonetheless, we recommend that other locations internal to the RWF, if available, be considered for a dewatering facility during conceptual design. Sites that are internal to the RWF may prove to be beneficial in terms of reducing the centrate pipeline length and resulting struvite impact and may potentially create operational efficiencies by locating dewatering within the current operational area.
- Environmental permitting for Site D will be more extensive and require a longer period of time than permitting efforts for Site A. We therefore recommend that the City reserve Site D for future sidestream treatment, if required.

Attachment A: Figures

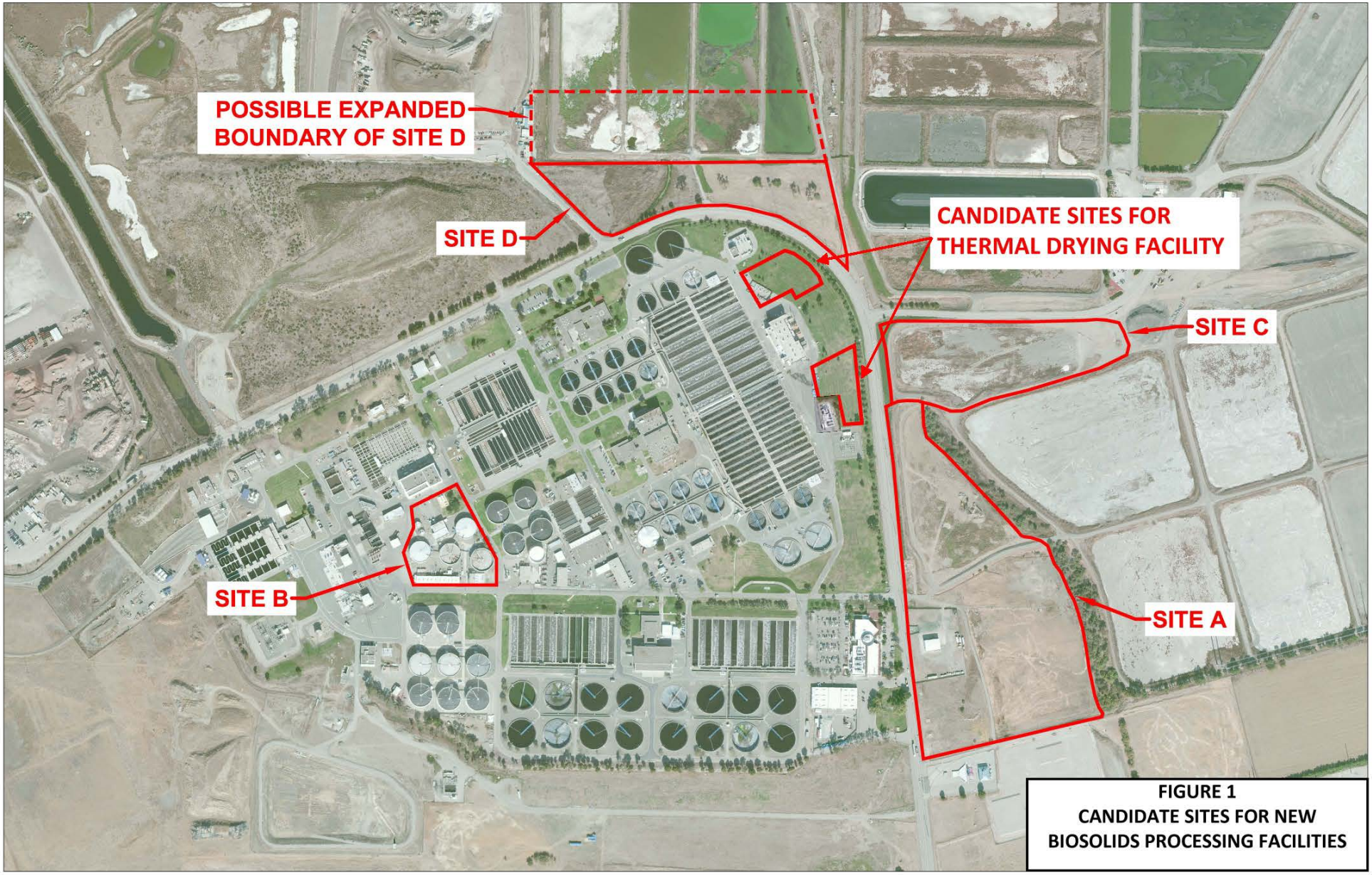


FIGURE 1
CANDIDATE SITES FOR NEW BIOSOLIDS PROCESSING FACILITIES

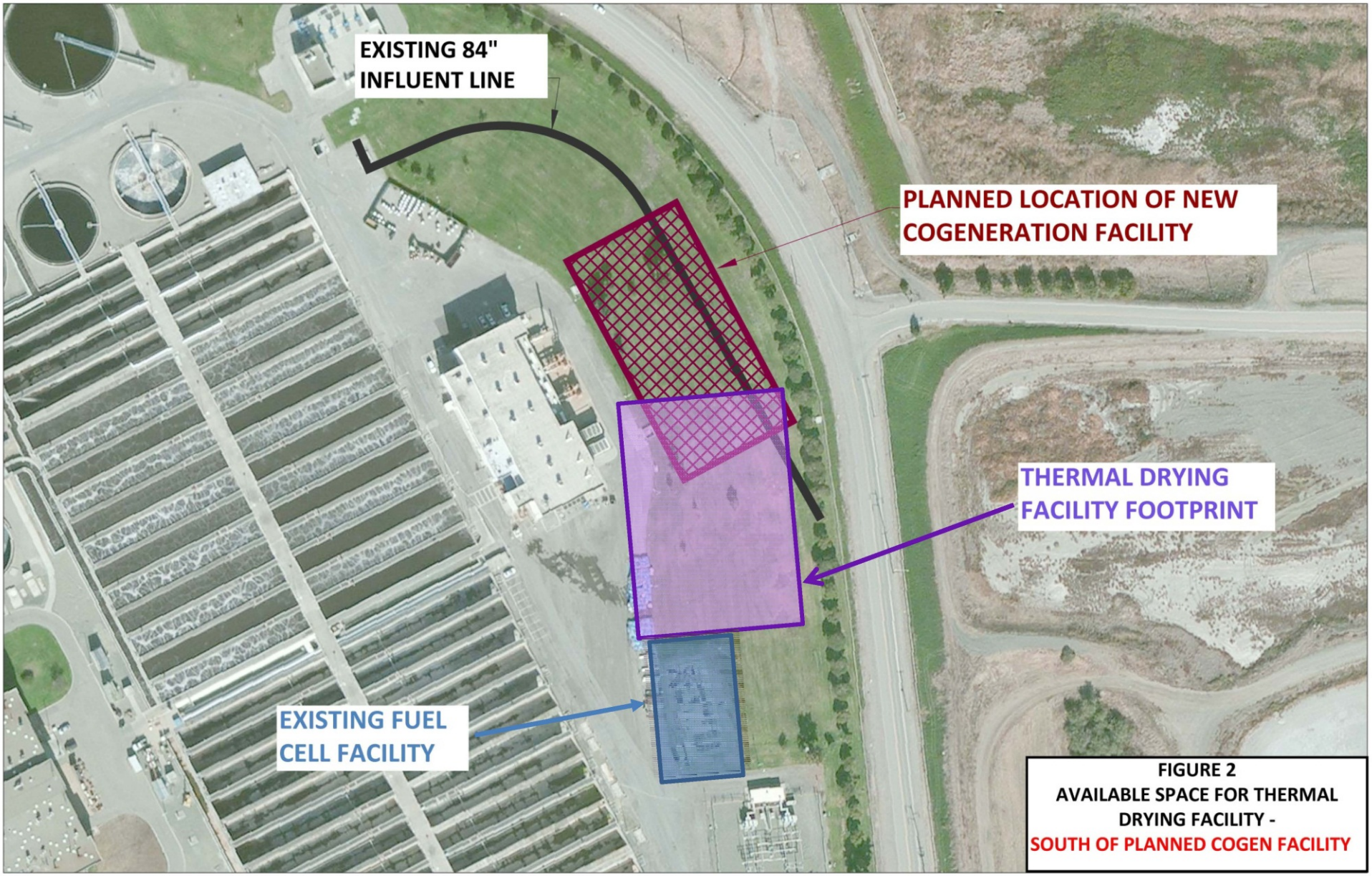


FIGURE 2
AVAILABLE SPACE FOR THERMAL DRYING FACILITY -
SOUTH OF PLANNED COGEN FACILITY

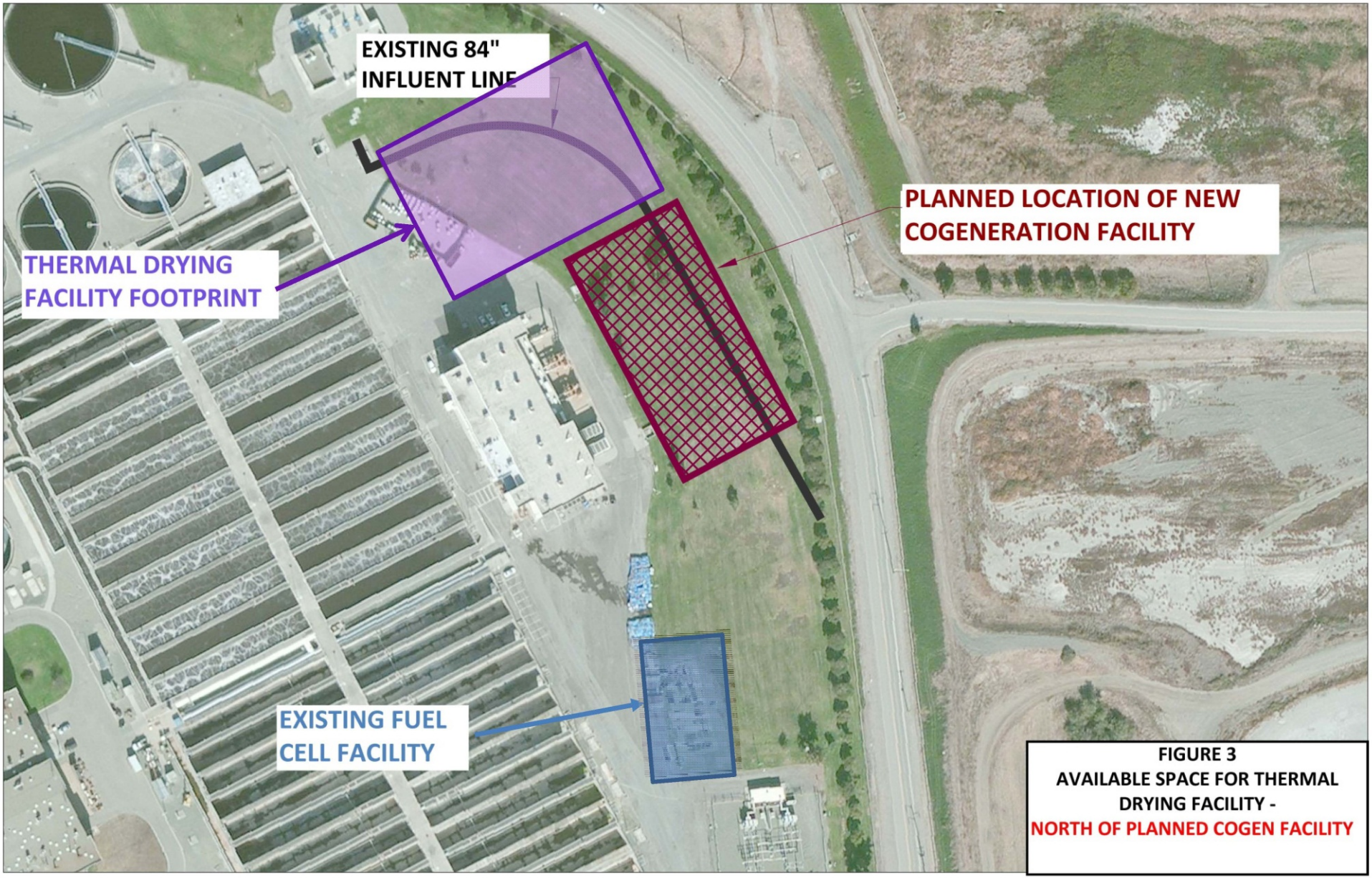


FIGURE 3
AVAILABLE SPACE FOR THERMAL DRYING FACILITY -
NORTH OF PLANNED COGEN FACILITY

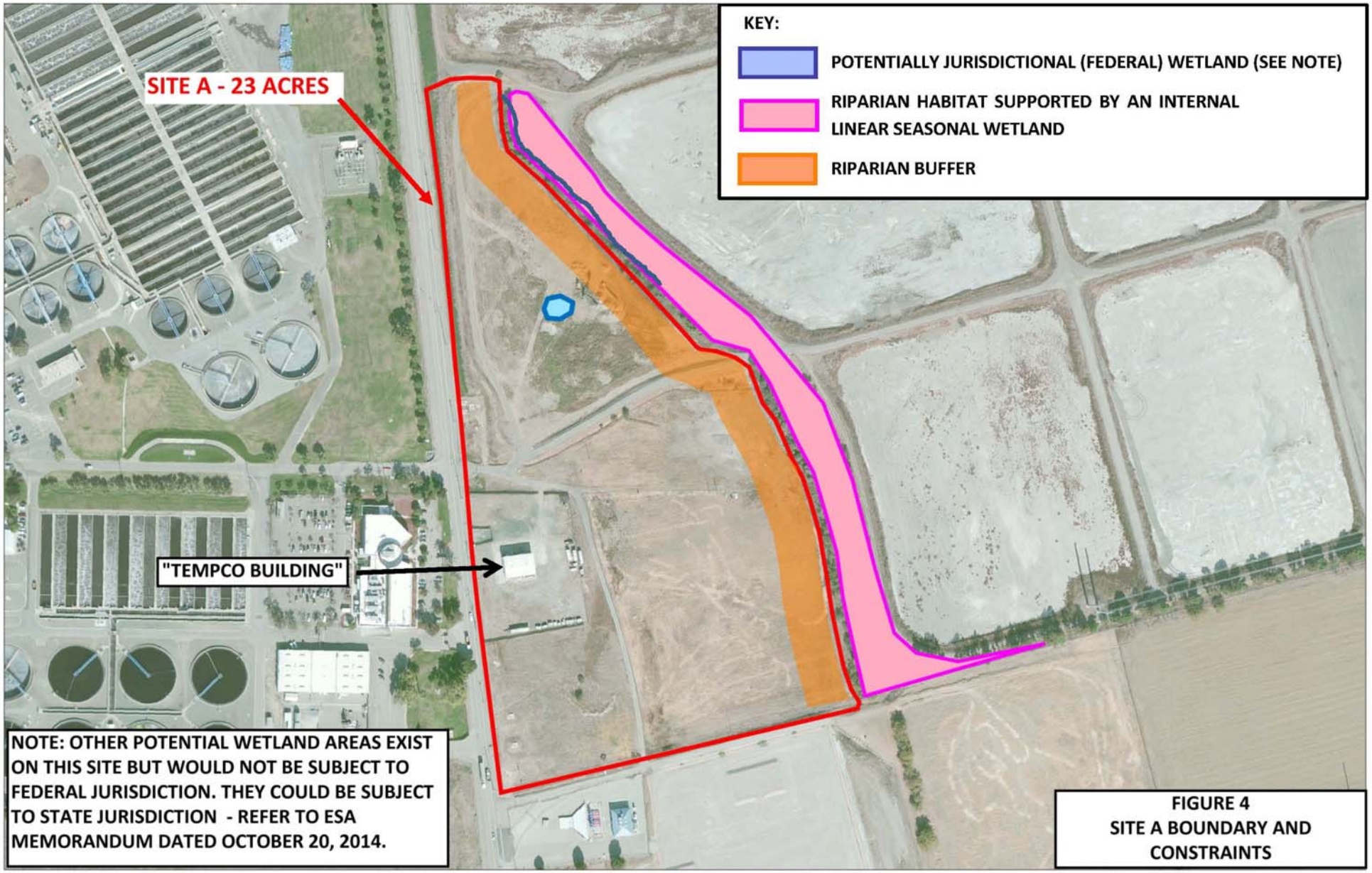


FIGURE 4
SITE A BOUNDARY AND CONSTRAINTS

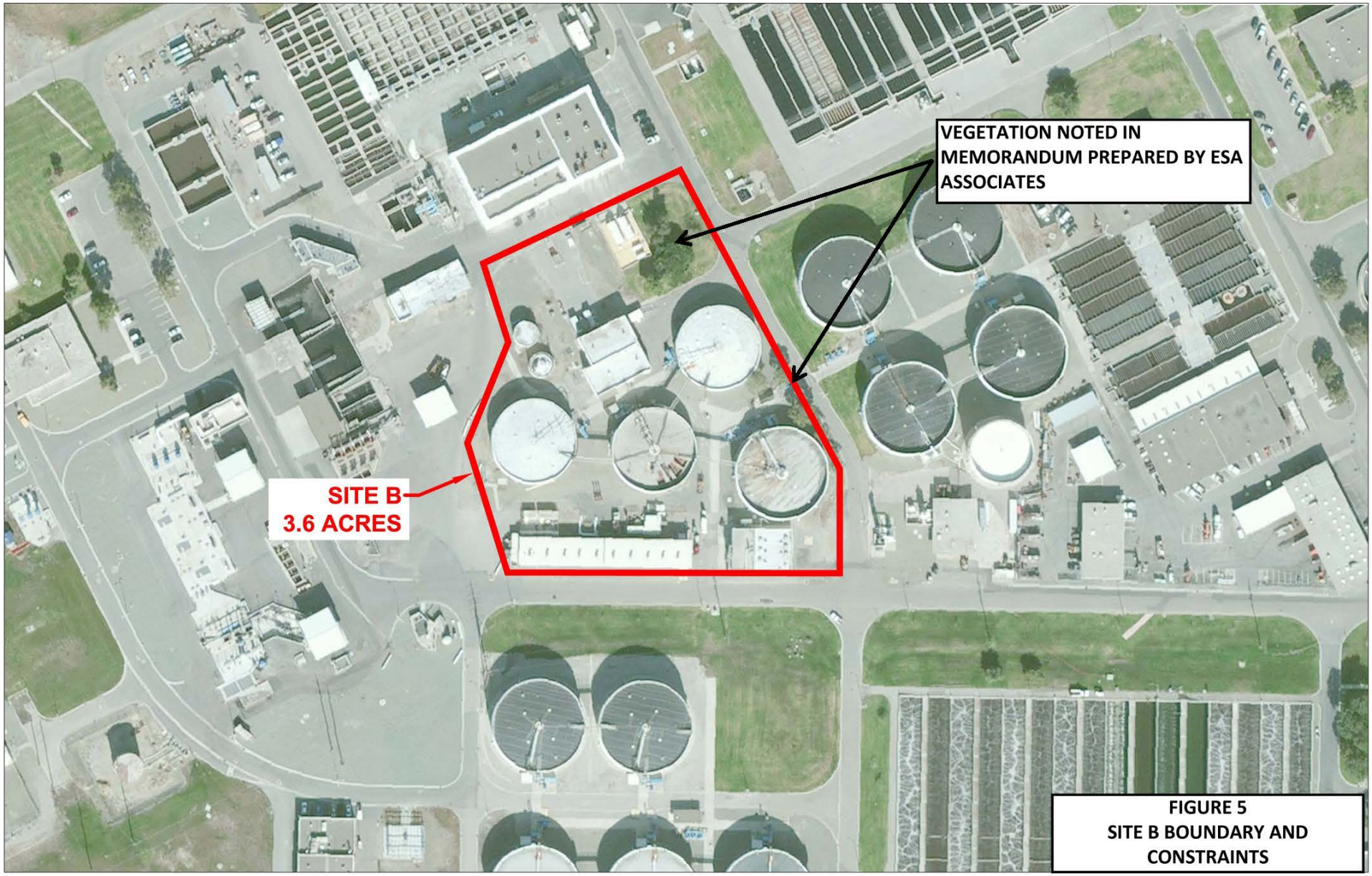
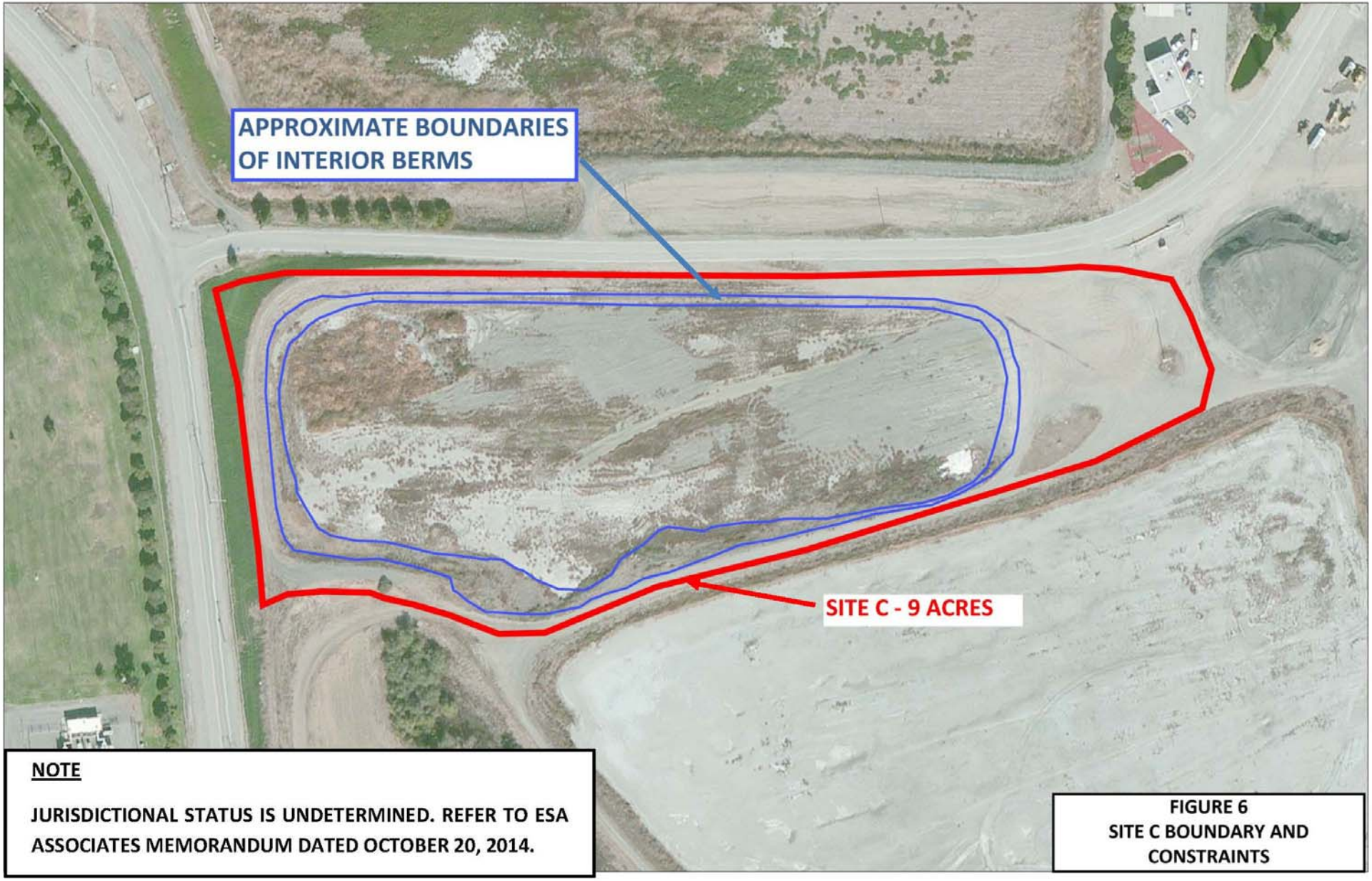


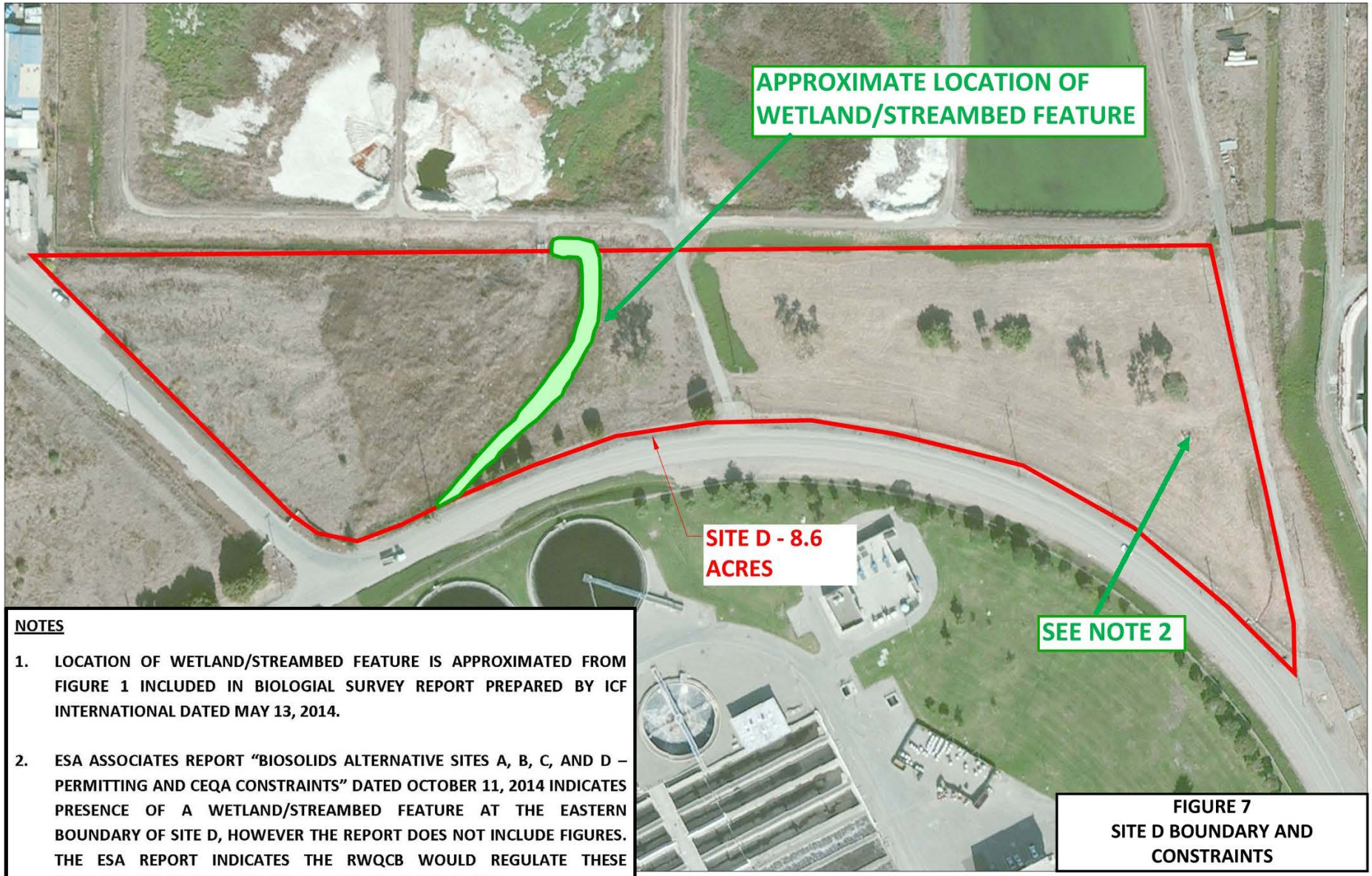
FIGURE 5
SITE B BOUNDARY AND CONSTRAINTS



NOTE

JURISDICTIONAL STATUS IS UNDETERMINED. REFER TO ESA ASSOCIATES MEMORANDUM DATED OCTOBER 20, 2014.

FIGURE 6
SITE C BOUNDARY AND CONSTRAINTS



NOTES

1. LOCATION OF WETLAND/STREAMBED FEATURE IS APPROXIMATED FROM FIGURE 1 INCLUDED IN BIOLOGIAL SURVEY REPORT PREPARED BY ICF INTERNATIONAL DATED MAY 13, 2014.

2. ESA ASSOCIATES REPORT "BIOSOLIDS ALTERNATIVE SITES A, B, C, AND D – PERMITTING AND CEQA CONSTRAINTS" DATED OCTOBER 11, 2014 INDICATES PRESENCE OF A WETLAND/STREAMBED FEATURE AT THE EASTERN BOUNDARY OF SITE D, HOWEVER THE REPORT DOES NOT INCLUDE FIGURES. THE ESA REPORT INDICATES THE RWQCB WOULD REGULATE THESE WETLAND/STREAMBED FEATURES AS WATERS OF THE STATE.

FIGURE 7
SITE D BOUNDARY AND CONSTRAINTS

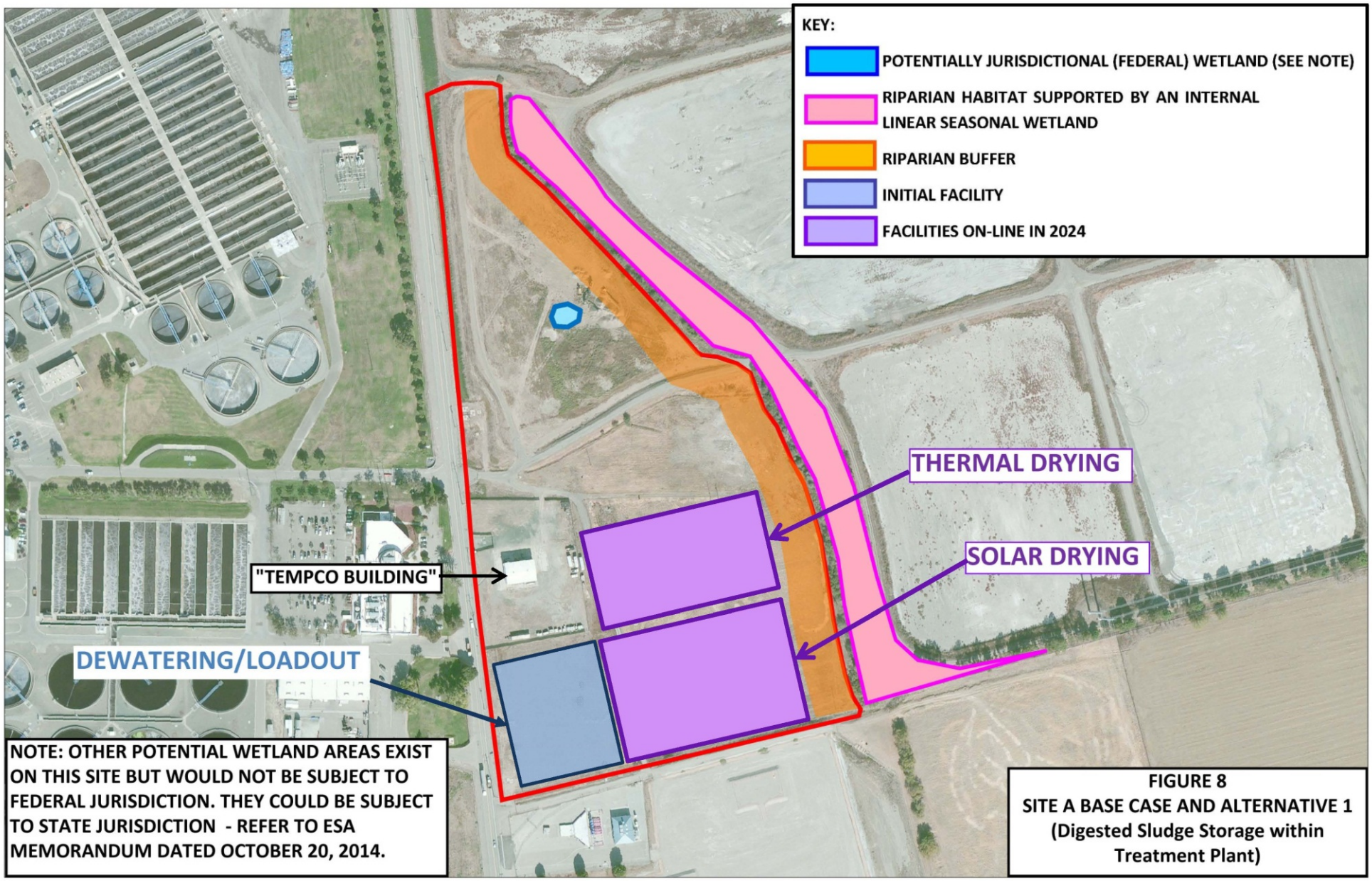


FIGURE 8
SITE A BASE CASE AND ALTERNATIVE 1
(Digested Sludge Storage within Treatment Plant)

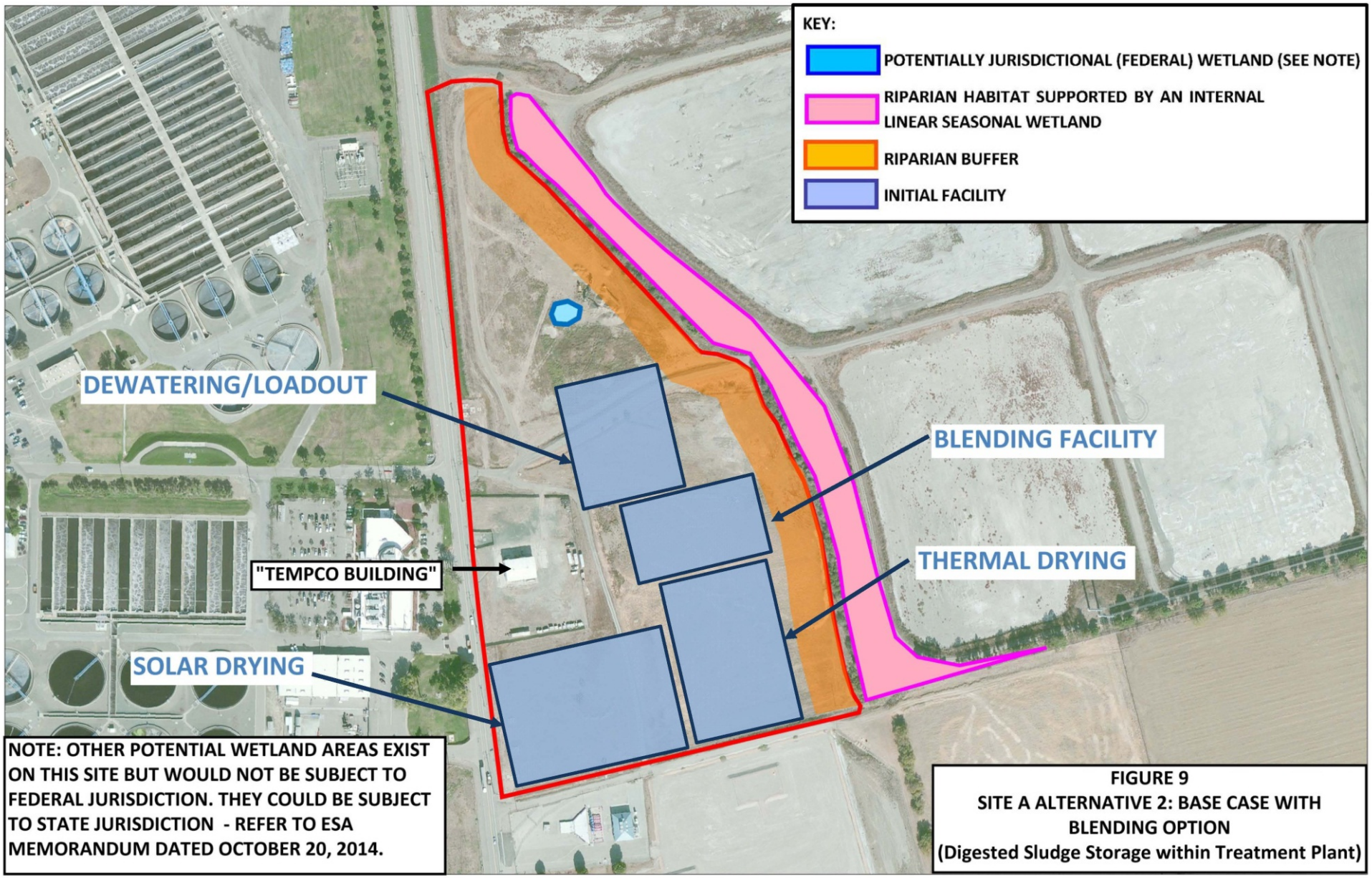


FIGURE 9
SITE A ALTERNATIVE 2: BASE CASE WITH BLENDING OPTION
(Digested Sludge Storage within Treatment Plant)

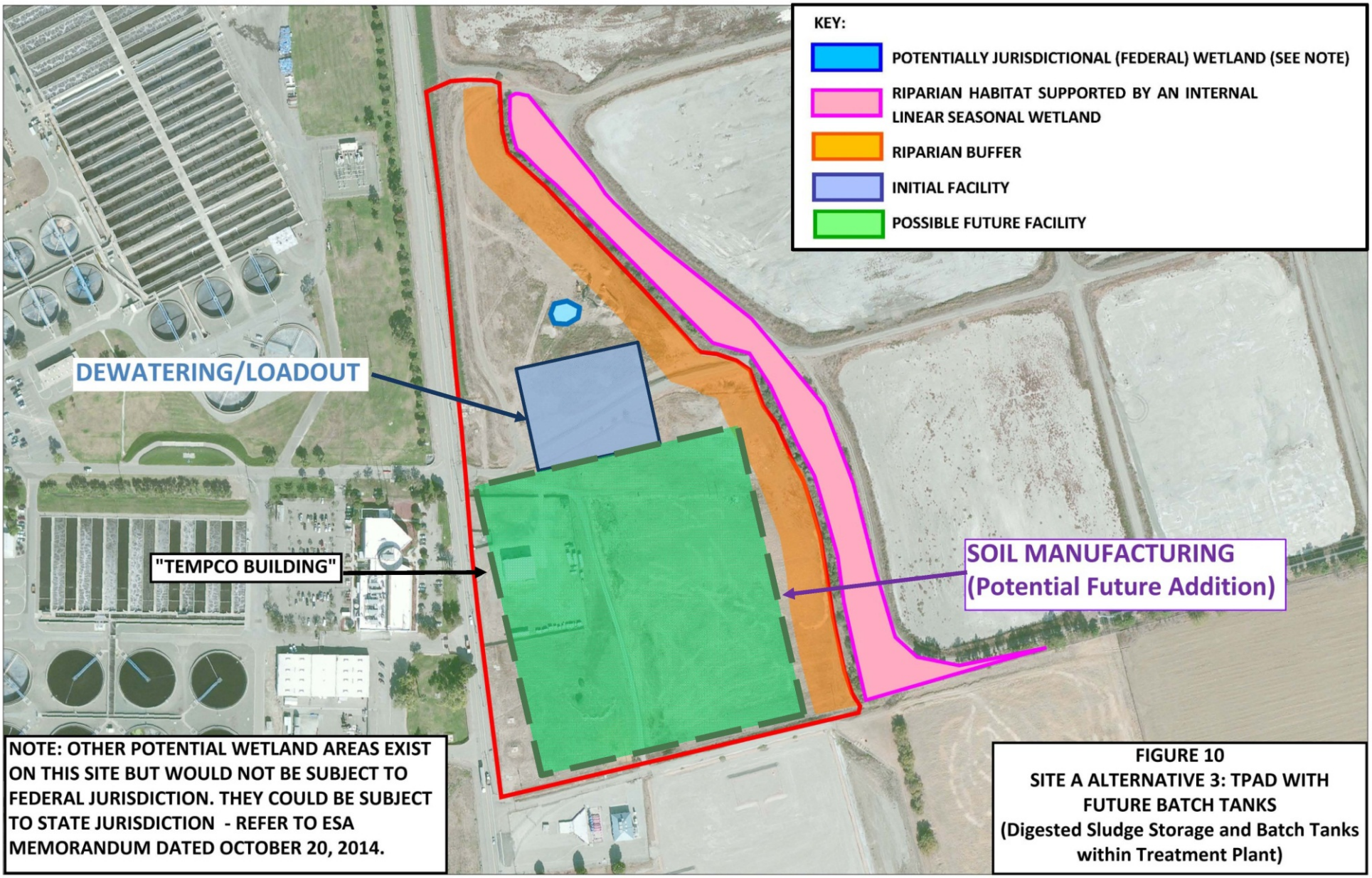


FIGURE 10
SITE A ALTERNATIVE 3: TPAD WITH FUTURE BATCH TANKS
(Digested Sludge Storage and Batch Tanks within Treatment Plant)

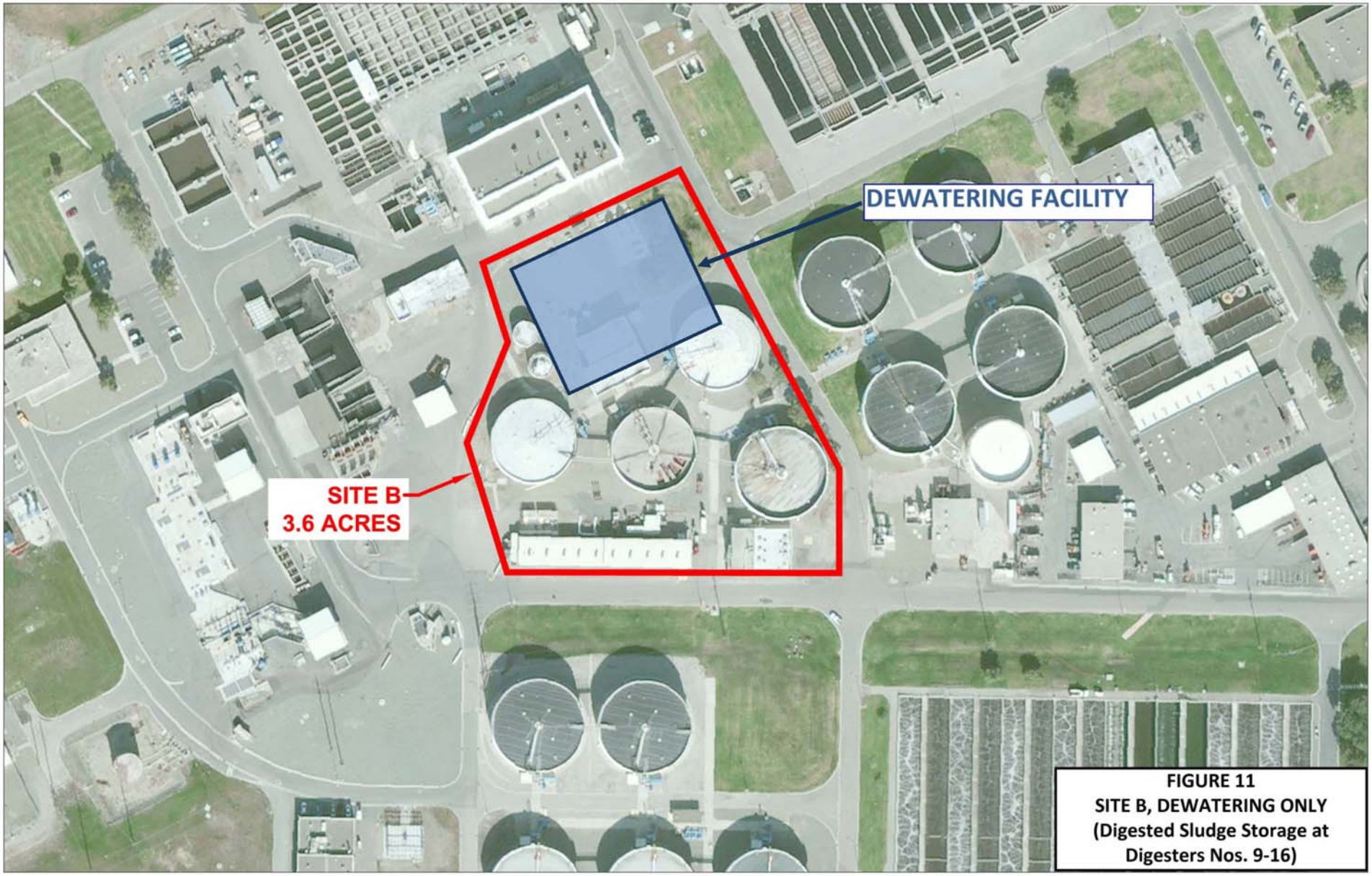
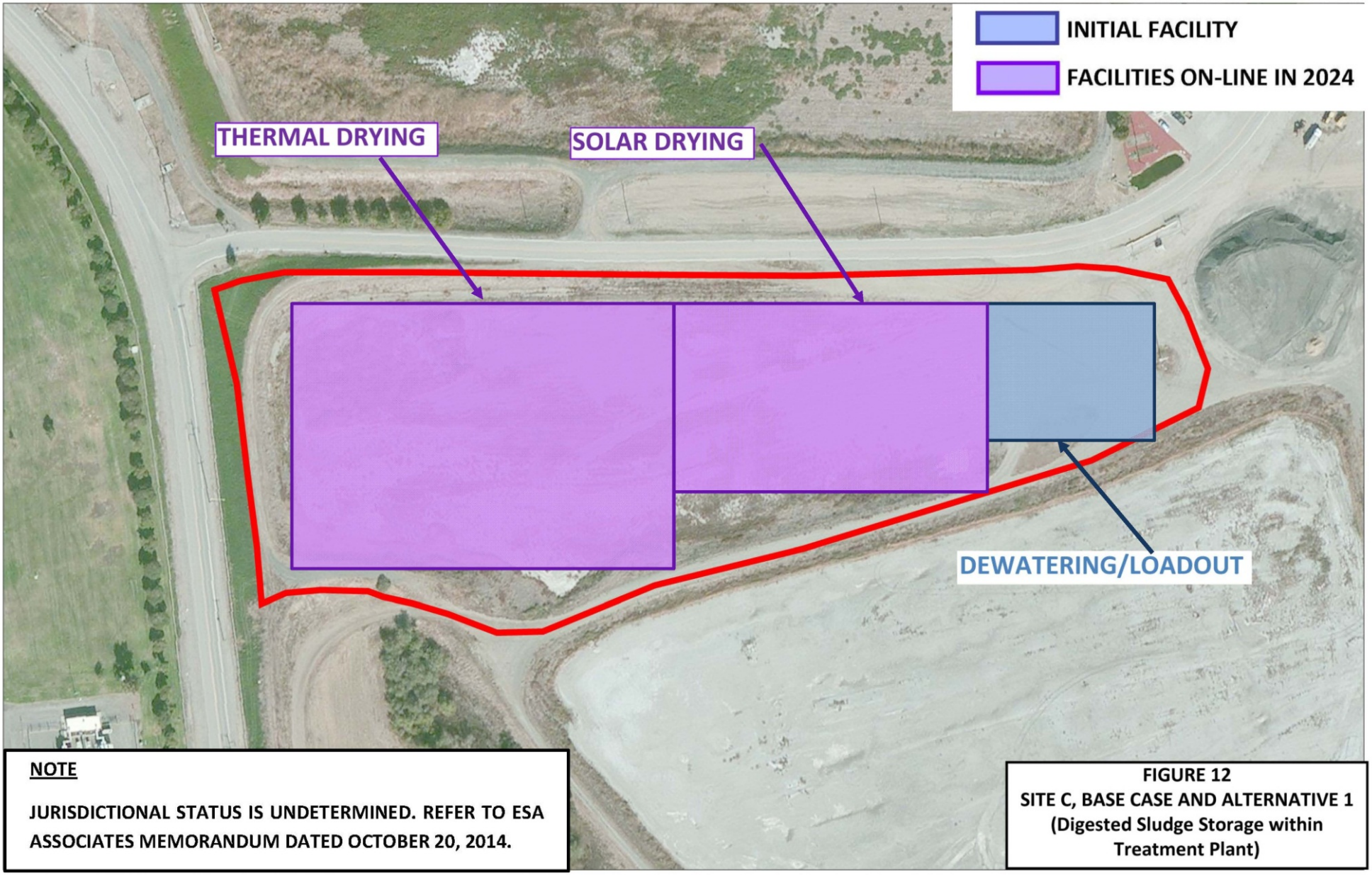


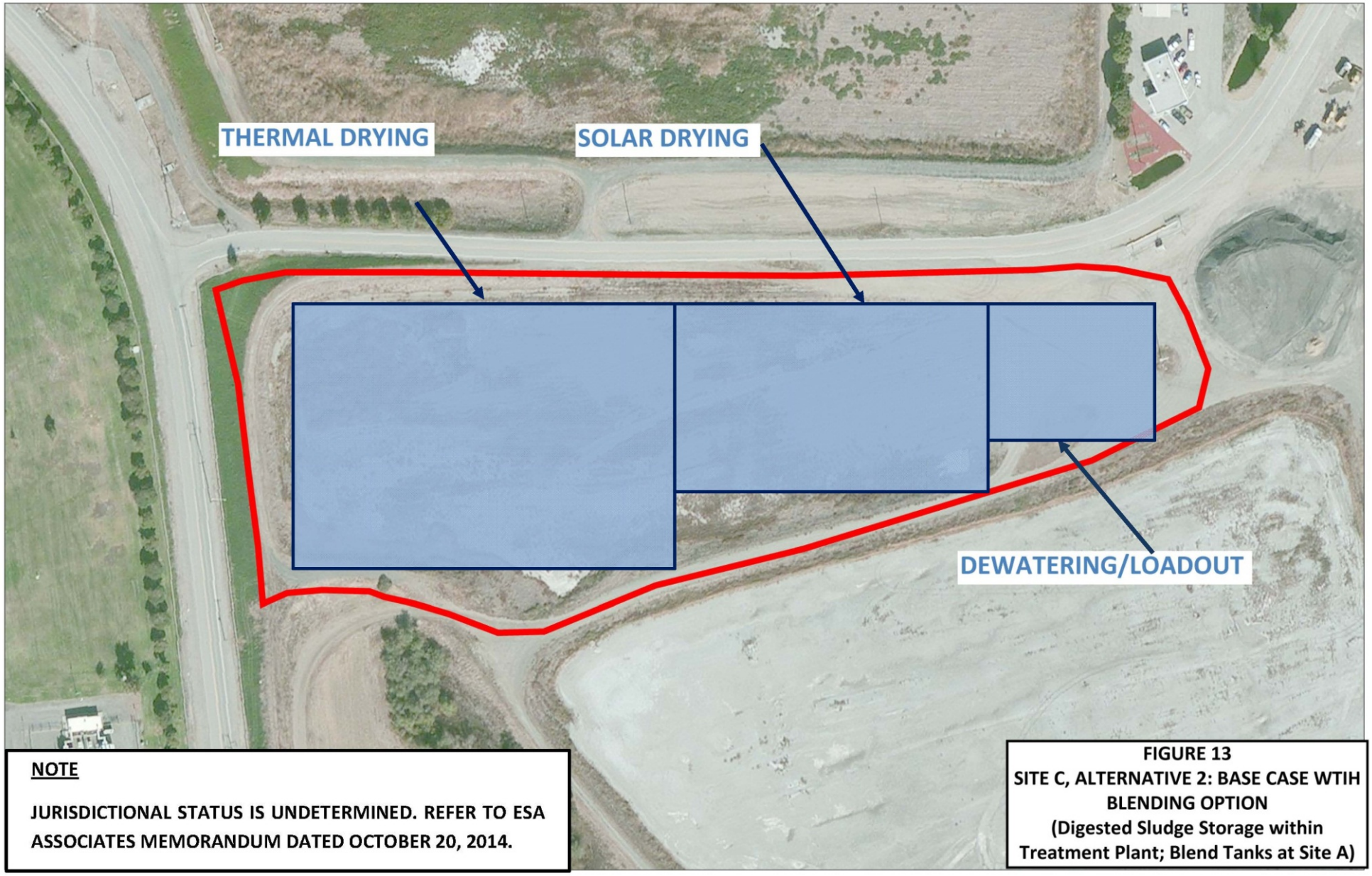
FIGURE 11
SITE B, DEWATERING ONLY
(Digested Sludge Storage at Digesters Nos. 9-16)



NOTE

JURISDICTIONAL STATUS IS UNDETERMINED. REFER TO ESA ASSOCIATES MEMORANDUM DATED OCTOBER 20, 2014.

FIGURE 12
SITE C, BASE CASE AND ALTERNATIVE 1 (Digested Sludge Storage within Treatment Plant)



NOTE

JURISDICTIONAL STATUS IS UNDETERMINED. REFER TO ESA ASSOCIATES MEMORANDUM DATED OCTOBER 20, 2014.

FIGURE 13
SITE C, ALTERNATIVE 2: BASE CASE WTIH BLENDING OPTION
(Digested Sludge Storage within Treatment Plant; Blend Tanks at Site A)

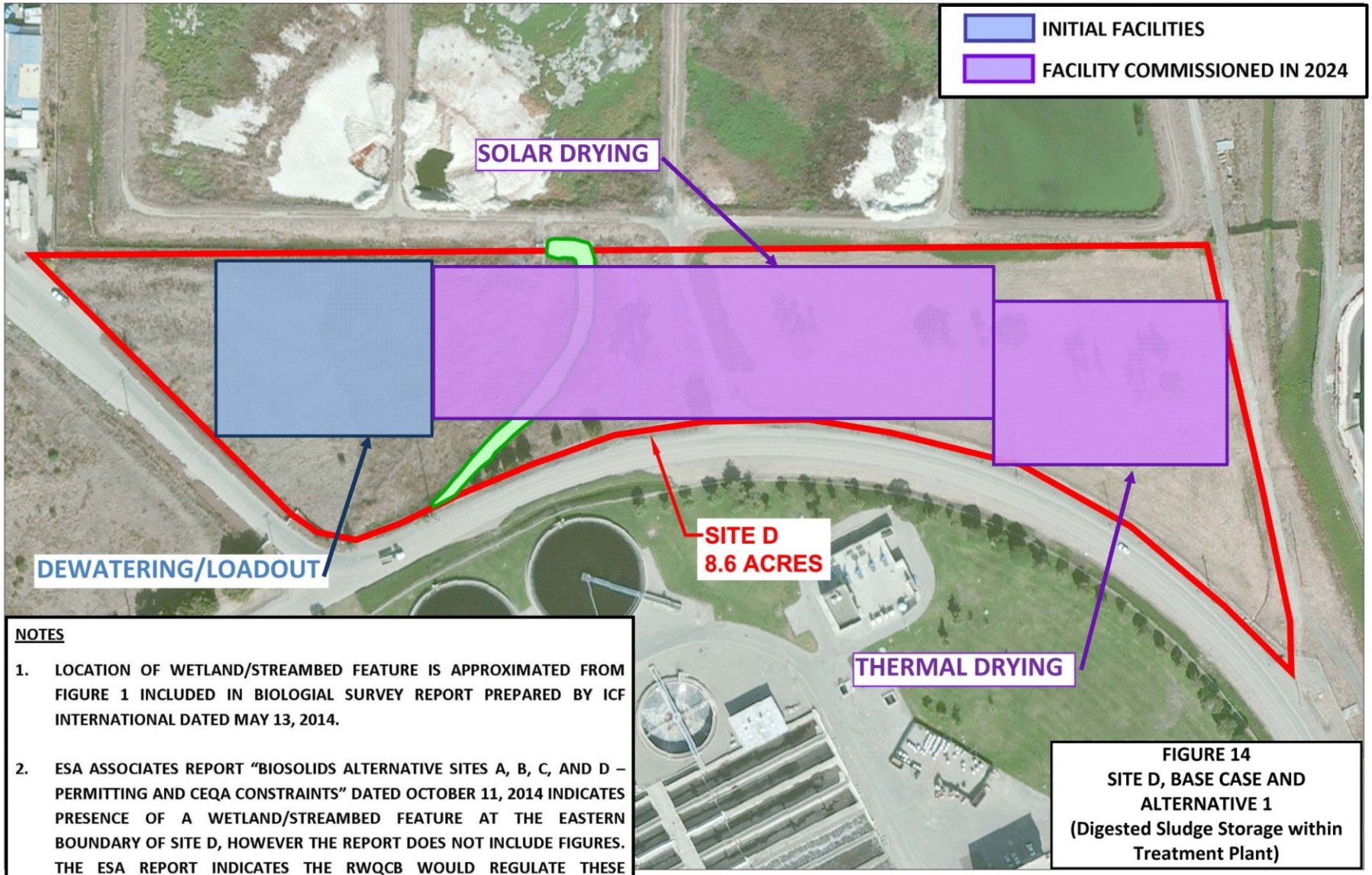


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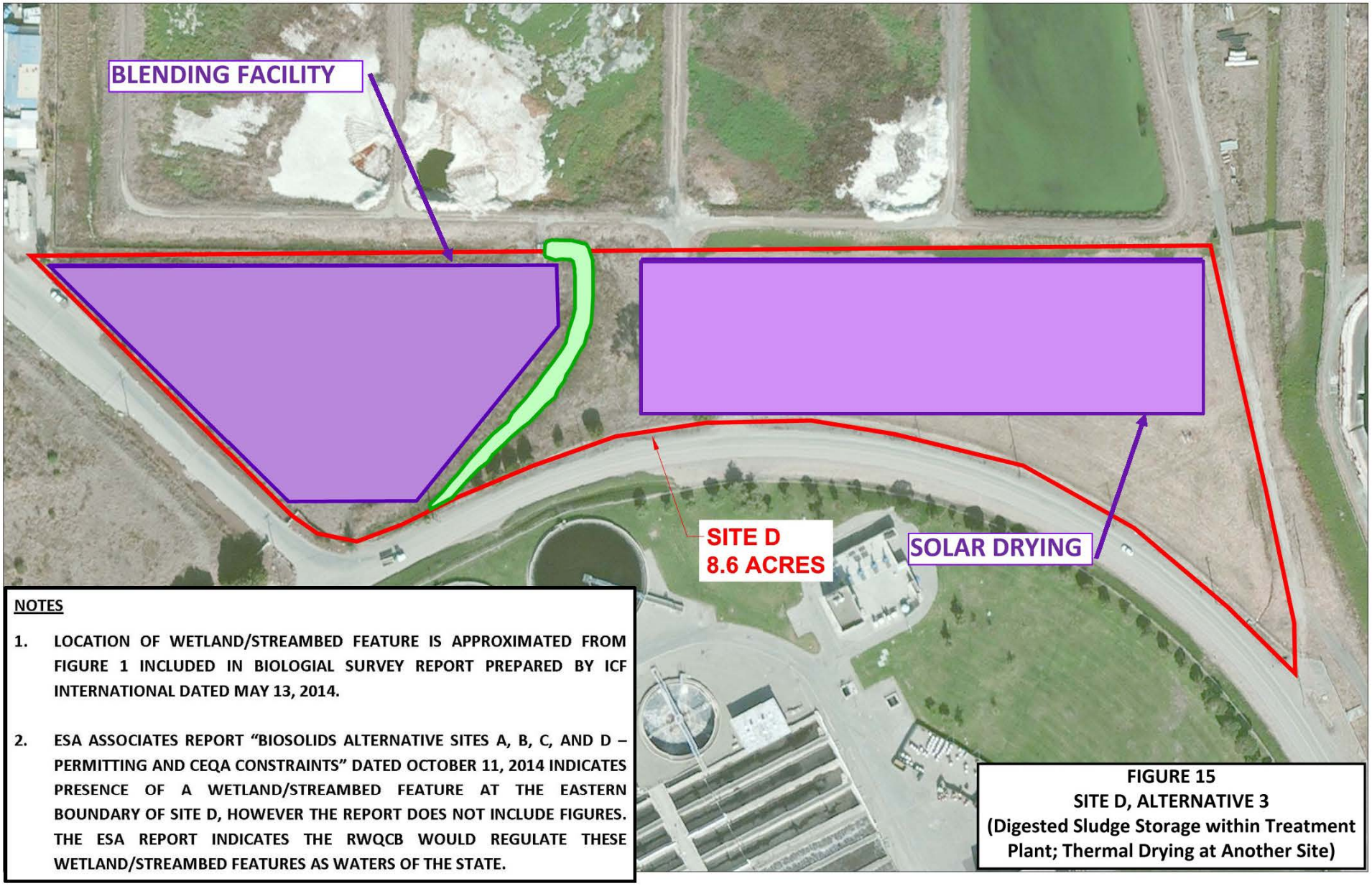
FIGURE 14
SITE D, BASE CASE AND ALTERNATIVE 1
(Digested Sludge Storage within Treatment Plant)



NOTES

1. LOCATION OF WETLAND/STREAMBED FEATURE IS APPROXIMATED FROM FIGURE 1 INCLUDED IN BIOLOGIAL SURVEY REPORT PREPARED BY ICF INTERNATIONAL DATED MAY 13, 2014.

2. ESA ASSOCIATES REPORT "BIOSOLIDS ALTERNATIVE SITES A, B, C, AND D – PERMITTING AND CEQA CONSTRAINTS" DATED OCTOBER 11, 2014 INDICATES PRESENCE OF A WETLAND/STREAMBED FEATURE AT THE EASTERN BOUNDARY OF SITE D, HOWEVER THE REPORT DOES NOT INCLUDE FIGURES. THE ESA REPORT INDICATES THE RWQCB WOULD REGULATE THESE WETLAND/STREAMBED FEATURES AS WATERS OF THE STATE.

FIGURE 15
SITE D, ALTERNATIVE 3
(Digested Sludge Storage within Treatment Plant; Thermal Drying at Another Site)

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Technical Memorandum

Prepared for: City of San José

Project Title: Feasibility Study and Contracting Strategy Review for Biosolids Processing

Project No.: 145119

Technical Memorandum No. 8

Subject: Biosolids Program Business Case Evaluation

Date: December 22, 2014

To: Lily Zhu, Senior Engineer, City of San José

From: Pat Tangora, Managing Engineer, Brown and Caldwell

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Limitations:

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Section 1: Introduction and Purpose

This Technical Memorandum No. 8 (TM 8) recommends an overall strategic direction to the planned biosolids management program at the San José-Santa Clara Regional Wastewater Facility (RWF).

Current biosolids management includes mesophilic anaerobic digestion, followed by multi-year stabilization in facultative lagoons, dredging and air drying in a series of drying beds, and trucking the dried biosolids to Newby Island landfill for use as alternative daily cover (ADC).

Due to the planned closure of Newby Island landfill in 2025, the owners of the RWF have long recognized the need for changes to the biosolids management program. A final draft Plant Master Plan (PMP) issued in 2010 called for new biosolids processing and storage facilities, decommissioning the lagoons and drying beds, and a diversified approach to beneficial reuse of the RWF's biosolids; this plan was adopted in 2013.

Subsequently, the San José City Council directed RWF staff to accelerate the date when the RWF would cease discharging sludge to the existing lagoons (accelerated from 2025 to 2018) and to accelerate the date when existing lagoons and drying beds would be fully decommissioned so that current odor discharges from the existing biosolids operations would cease by 2024.

In addition, the programmatic CEQA EIR conducted for the PMP's recommended biosolids program concluded that a lengthy project-specific EIS and permitting process would be required prior to developing biosolids facilities because much of the legacy lagoon area (the preferred location identified in the draft PMP) was determined to be wetlands and habitat for protected species. Consequently, during the program validation phase, the City decided to eliminate the 180 days of covered lagoon storage for digested biosolids that was included in the 2010 draft PMP and look for other sites to construct necessary process upgrades.

This TM reconsiders the overall direction identified in the draft PMP in light of these changes, and specifically addresses the following key questions developed in Workshops 2 and 3 for the Biosolids Feasibility Study:

- **Biosolids Processing:** what overall strategic direction should guide development of post-digestion biosolids processing facilities at the RWF?
  - Should the RWF continue to follow the path set forth in the PMP with limited modifications (Base Case)? The Base Case includes the following on-site biosolids processing facilities: digestion, dewatering, thermal drying, and solar drying.
  - Or, should further modifications to the PMP be implemented?
    - Based on further evaluation of advanced digestion technologies, as was called for in the PMP, should the RWF incorporate temperature-phased anaerobic digestion (TPAD) in addition to the recommended rehabilitation of the existing mesophilic digesters (Alternative 1)?
    - Should the thermal drying facility be downsized, and should the timing of thermal and solar drying be accelerated so that dewatered biosolids can be blended with the dried material to take maximum advantage of lower cost disposition at Newby Island Landfill until 2025 or beyond should the life of the landfill be extended? (Alternative 2)
    - Should initial onsite facilities be limited to TPAD and dewatering (Alternative 3), given the lack of a market driver for Class A biosolids at this time?
- **Potential Ways to Accelerate the Transition:** Should short-term contracts for mobile dewatering and off-site disposition be employed as a means of managing schedule risk and possibly accelerating the decommissioning of the lagoons and drying beds? What actions related to project delivery might accelerate the on-line date?
- **Longer-Term Actions:** What other actions should San José take to be ready for the transition and to manage the longer term biosolids program?

Section 2: Results of Previous Technical Evaluations

This TM builds on the results of a number of other technical evaluations conducted for the biosolids program as a whole and for the digester design project. In summary, these include:

- **Flows and Loads.** Consistent with the approach used for the digester design project, this TM assumes some projects will be phased with the first phase based on 2030 loading (with imported materials such as FOG). A second phase of work will be required to expand the capacity to 2040 loading conditions (with imported materials).[1]
- **TM1: Biosolids Hauling and Disposition Cost Projections.** The expected future costs for off-site processing and disposition of biosolids allows for the evaluation of alternatives to consider system-wide (both off-site and on-site) biosolids management costs. This TM reviewed the costs, including haul costs, that nearby California wastewater utilities have incurred for various off-site processing and disposition options. These costs were used in subsequent SWET modeling and this Business Case Evaluation. (Note that sensitivity cases with higher disposition costs were also evaluated in this Business Case Evaluation based on input received from the RFEI responses (TM 5)).
- **TM 2: SWET Modeling.** An initial screening analysis of biosolids processing alternatives was conducted using Brown and Caldwell's Solids-Water-Energy Tool ("SWET") – a computer model that quantifies fundamental material and energy flows and provides a general estimate of life cycle costs. SWET modeling helped screen out less favorable alternatives. Among other things, the SWET analysis concluded that producing 100% Class A biosolids,[2] either by expanding planned on-site drying capacity or by sending 100% of the dewatered biosolids to an off-site composting facility, would not be cost-effective relative to other alternatives. The SWET analysis further concluded that TPAD digestion, coupled with batch tanks, appeared to be one of the more cost effective methods for producing Class A biosolids. The SWET model also concluded, however, that a number of potential alternatives appeared to be essentially equivalent from a cost perspective and recommended that further analysis including non-economic factors was warranted.
- **TM 3: Site Visits.** Site tours of comparable facilities in the Bay Area, Southern California, and the Pacific Northwest offered the opportunity for staff and consultants to see similar process equipment to that envisioned in the PMP and to discuss key features and issues with facility operators. Facility elements of particular interest included thermophilic digestion, temperature-phase anaerobic digestion (TPAD), centrifuge dewatering and thermal drying.
- **TM 4: Sidestream Treatment.** Dewatering facilities produce a sidestream – liquid removed from the biosolids as part of the dewatering process, requiring treatment. These liquids typically account for less than one percent of the flow through a wastewater treatment plant but are high in nitrogen, accounting

[1] Note that while the PMP also called for biosolids facilities being developed in two phases, the first phase was based on 2/3 of the required 2040 capacity rather than on 100% of the required 2030 capacity. Further analysis indicates that installing a first phase based on 2/3 of the required 2040 capacity would result in facilities that are undersized to meet forecast 2030 loads. Therefore one of the modifications to the Modified Master Plan Alternative evaluated in this BCE is to assume initial facility installations generally would be based on 2030 flows and loads. It should also be noted, however, that assumed flows and loads are under review and may be revised; such revision is not expected to affect the relative comparison of alternatives against the Base Case.

[2] Class B and Class A designations for biosolids relate to the level of pathogen reduction in the end product. Class B biosolids are considered stabilized sufficiently to reduce odors and attraction of 'vectors' (flies, birds, and rodents) that could transmit pathogens and diseases resulting from contact with the sludge. Management practices such as limiting crop type and preventing immediate public access to Class B application sites are considered protective. Class A biosolids are considered essentially pathogen free. Risks associated with contacting or handling Class A biosolids are considered minimal so there are fewer restrictions for product use.

from 15 to 30% of the influent nitrogen load. Planning evaluations for the RWF's liquids stream have concluded that separate sidestream treatment will not be needed in the absence of future regulatory change to nitrogen and ammonia discharge limits. However, because a separate sidestream treatment process could be required at some point in the future, Brown and Caldwell evaluated the space requirements for such a system and concluded an area of approximately 43,000 square feet should be reserved, preferably as close to the dewatering facilities or secondary treatment facilities as is feasible.

- **TM 5: Market Feedback.** The City of San José issued a Request for Information in June 2014 soliciting market interest in providing on-site biosolids processing facilities and off-site processing and disposition services. The RFI responses highlighted several issues relevant to this business case evaluation. First, companies providing off-site composting and biosolids disposition services appear willing to enter into relatively short-term (5 year) service contracts; this would give San José the ability to meet a portion of its end product diversification goals in the near term using service providers without locking in long-term contract commitments. Second, responses to the RFI indicate that off-site processing and disposition costs could be higher than indicated in previous market surveys Including those reviewed as part of the work for TM 2. As a result, TM 8 tests the impact of potentially higher disposition costs. Finally, RFI responses revealed a few emerging technologies that are not yet commercially proven in the United States, but that appear to be moving well along in the development process. This suggests an advantage for those biosolids strategies that provide the flexibility to consider these technologies in the future as they mature.
- **TM 6 Heat Recovery.** Brown and Caldwell conducted a technical review of available waste heat from the planned cogeneration facility at the RWF. The review identified the amount of available and suitable waste heat for biosolids drying, potential thermal drying technologies, technical / operational challenges associated with conveying waste heat, and operational issues associated with coordinating waste heat and cogeneration facility operations. The review concluded:
  - The amount of suitable and available waste heat would be insufficient to fully meet the PMP's recommended dryer sizing (20% of the dewatered biosolids). Thus, to implement this PMP recommendation, supplemental natural gas would be required.
  - From a technology perspective, drum drying, which produces a pelletized end product, would not be suitable for use with waste heat recovery because of the high temperatures required for the drum dryer (i.e. above the exhaust temperature for the cogeneration facility). Instead, belt dryers or indirect dryers such as paddle dryers would need to be employed. The TM also suggested siting the dryer as close to the cogeneration facility as possible in order to reduce operational and safety issues associated with conveying waste heat.
- **TM 7: Site Evaluation.** This TM considered four possible alternative sites identified by San José for on-site biosolids processing facilities. The TM also considered whether or not all of the facilities included in a given alternative (as described in Section 3, below) could be accommodated on the alternative sites, the extent to which facilities may impact identified environmental resources and operating facilities, issues potentially affecting the time required for CEQA compliance and environmental permitting, access / traffic, underground utilities, and efficiency of operation in terms of proximity to related facilities. Based on these considerations, two of the four sites were identified as most suitable for biosolids processing facilities. Site A was identified as the preferred location for biosolids processing facilities primarily because it has sufficient space for a number of processes, because development could avoid or would have little impact on environmental resources, and because permitting for dewatering could be streamlined at this location. Development at Site A would, however, require a means for safe transit of plant operations and maintenance staff between the main plant area and the biosolids processing area. Site C was identified as a preferred location for thermal drying unless future design efforts indicate thermal drying could be located immediately adjacent to the planned cogeneration facility; initial analysis conducted in TM 7 suggests this would be unlikely but will depend

on the final selection of dryer technology, dryer sizing, and final footprint considerations. TM 7 did not recommend Site B for dewatering because of existing utility constraints, construction sequencing constraints with other CIP projects, and vehicle access; however, if other more suitable areas could be identified within the RWF, an in-plant location may be preferable for dewatering. The City is considering an in-house evaluation of additional sites within the treatment plant, but in any event, Site A should be reserved for future biosolids processing facilities.

Section 3: Description of Biosolids Processing Alternatives

This section describes the Base Case and three additional biosolids processing alternatives. Each of these alternatives is designed to help address the questions related to biosolids processing outlined in Section 1.

3.1 Facility Sizing Assumptions

3.1.1 Flows and Loads

As discussed in Section 2, the size of facilities was generally based on expected 2030 loading with a future phase to meet forecast 2040 loads. Assumed loads were based on the flows and loads forecast included in the PMP; subsequent adjustments were made to account for the effects of biosolids treatment processes such as the reduction in volatile solids that occurs through the digestion process and the increase in percent solids that results from dewatering.

Table 3-1 summarizes the assumed solids loading following digestion, and the assumed wet tons produced following dewatering.

Table 3-1. Dewatered Cake Loading by Year

Parameter	Day 1, DTPD	2025, DTPD	2030, DTPD	2035, DTPD	2040, DTPD
Mesophilic Digestion Dewatered Cake					
Annual average	100	107	112	117	123
Peak 2-week	139	149	156	163	171
Peak day	149	159	167	175	183
TPAD Dewatered Cake					
Annual average	90	96	101	106	111
Peak 2-week	126	135	142	148	156
Peak day	135	144	152	159	167

1. Assumes dewatering will yield a product that is 25 percent solids. Assumed capture rate of centrifuge is 100 percent.

3.1.2 Other Sizing Assumptions

Each alternative considered in this TM is comprised of a number of processes and facilities. Table 3-2, below, summarizes the sizing assumptions for the various elements incorporated into each of the

alternatives. More detailed descriptions of these elements are included with the capital cost estimates in Attachment A.

Table 3-2. Facility Sizing

	Alternatives					
Process	Base Case	Alt # 1 – TPAD with Dewatering and Drying	Alt #2 - Alt #1 with Accelerated Thermal Drying and Blending	Alt #3: TPAD with Initial Installation of Dewatering Only	Basis of Sizing (Digested Sludge Loads)	Capacity / Redundancy
Rehabilitate Mesophilic Digesters	X	X	X	X	NA	
Modify 4 Mesophilic Digesters to Thermophilic (resulting in TPAD process)		X	X	X	NA	
Digested Sludge Storage – Conversion of 2 Existing Digesters	X	X	X	X	4 days volume; 2040 Average Annual Loads with Imported Materials	4.7 MG / No redundancy
Pumping and Conveyance from Digesters to Dewatering	X	X	X	X	2040 Peak Day with Imported Materials	1200 gpm / No redundancy
Centrifuge Dewatering and Loadout	X	X	X	X	Phase 1: 2030 Peak 2-week load with Imported Materials; 24/5 operation	198 DTPD 4 duty / 1 standby
					Phase 2: 2040 Peak 2-week load with imported materials; 24/5 operation	218 DTPD 4 duty / 1 standby
Dewatered Cake Silo Storage (included in Dewatering and Loadout Facility)	X	X	X	X	48 hours storage based on 2040 Average Annual Load with Imported Materials	2 duty
Thermal Dryer (Paddle)	X	X			20% of 2040 Average Annual Load with Imported Materials; 24/5 operation	31 DTPD 2 duty/0 standby
Thermal Dryer (Paddle) – Reduced Capacity			X		Available and suitable cogeneration waste heat in 2025	22 DTPD 1 duty/0 standby
Dried Biosolids Storage Silos	X	X			24 hours based on 2040 Average Annual Load with Imported Materials	2,000 ft^3 2 duty 0 standby
Dried Biosolids Storage Silos (Reduced Capacity)			X		24 hours based on 2040 Average Annual Load with Imported Materials	1,000 ft^3 2 duty 0 standby
Solar Drying (Greenhouse)	X	X	X		Phase 1: 10% of 2030 Average Annual Load with Imported Materials	10 DTPD 5 Greenhouses / 0 Standby
					Phase 2: 10% of 2040	11 DTPD

Table 3-2. Facility Sizing						
	Alternatives					
Process	Base Case	Alt # 1 – TPAD with Dewatering and Drying	Alt #2 - Alt #1 with Accelerated Thermal Drying and Blending	Alt #3: TPAD with Initial Installation of Dewatering Only	Basis of Sizing (Digested Sludge Loads)	Capacity / Redundancy
					Average Annual Load with Imported Materials	6 Greenhouses / 0 Standby
Batch Tanks				Potential future addition	2040 Peak Day	1.8 MG 6 tanks /see note 1

1. *Assumes 6 tanks operating in series (1 fill, 4 hold, 1 draw. Currently there are no requirements for redundancy in the Class A production of biosolids; however, if 1 tank was out of service, the process temperature could be increased to keep meeting the time-temperature requirements for Class A. (See Digester and Thickening Facilities Upgrade Project TM SO4, August 15, 2014.)*

3.2 Base Case: PMP Recommendations with Mesophilic Digestion

3.2.1 General Description

This alternative continues the overall direction laid out in the PMP with limited modifications and serves as a benchmark against which to evaluate the other alternative strategies. It includes mesophilic digestion, centrifuge dewatering, thermal drying (20% of dewatered biosolids) and solar drying (10% of dewatered biosolids).

The limited PMP modifications that are reflected in the Base Case are summarized in Table 3-3, below.

Table 3-3. Modifications to PMP Incorporated into the Base Case		
PMP Assumption or Recommendation	Modification	Rationale for Change
Timing of facilities	Accelerated to meet requirements to cease lagoon discharge by 2018 and complete lagoon / drying bed decommissioning by 2024	City Council direction
180-days covered lagoon storage for digested sludge	Replaced with 4 peak days storage to provide storage over 3-day weekends with one additional day	Deferred during PMP Validation out of initial 10-year CIP: extensive land requirements and permitting challenges
30-days emergency storage for dewatered biosolids	Two silos provide 24 hours storage each	Standard industry practice is to move material off-site once dewatered Multiple disposition contracts will provide required flexibility if one contract or dispostion method becomes unavailable
Phasing of centrifuge and solar dryer	Modified phasing	PMP called for biosolids facilities being developed in two phases, with the first phase was based on 2/3 of the required 2040 capacity rather than on 100% of the required 2030 capacity. Further analysis indicates that installing a first phase based on 2/3 of the required 2040 capacity would result in facilities that are undersized to meet forecast 2030 loads.
Phasing of thermal dryer	No phasing	Dryer facility sized to meet 2030 loads can also meet 2040 loads

Figure 3-1 illustrates the biosolids processes included in the Base Case.

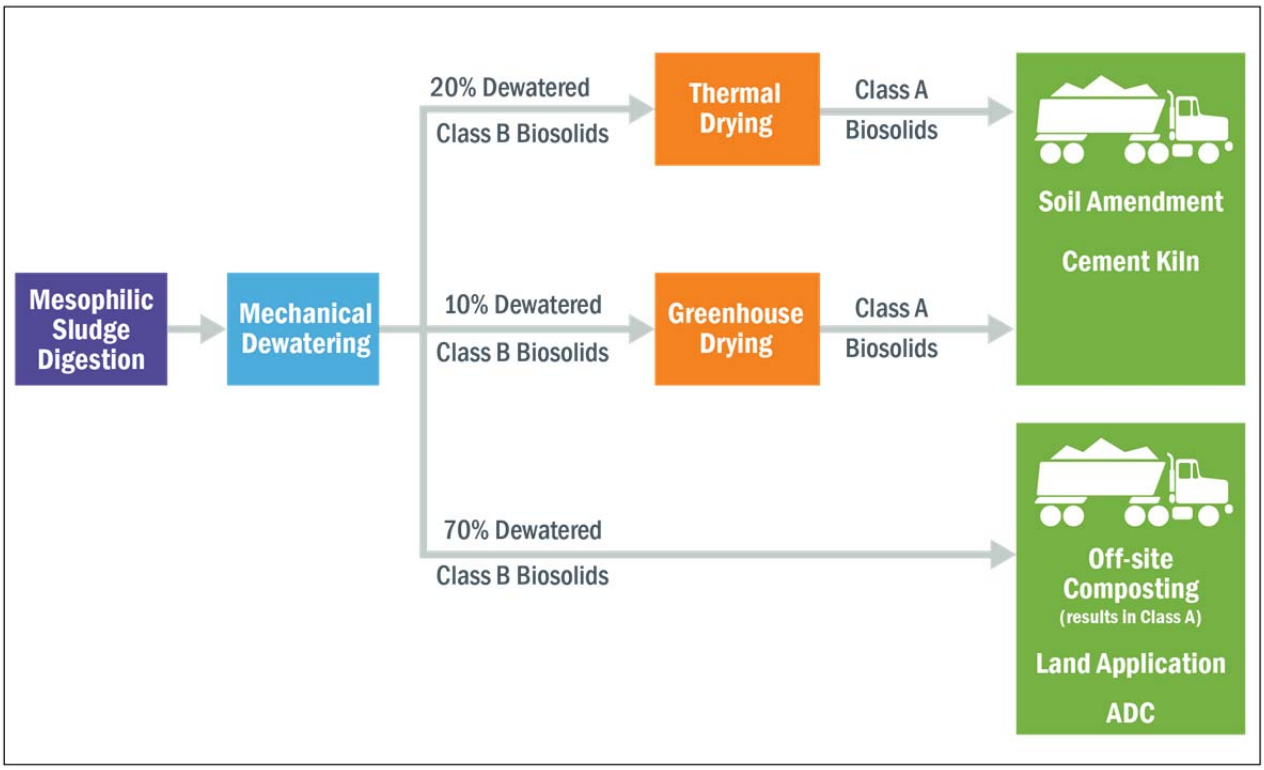

Figure 3-1. Base Case: PMP Recommendations with Mesophilic Digestion

Assumed off-site processing and disposition for the Base Case, before and after completion of drying facilities in 2024, is described Table 3-4, below.

Table 3-4. Off-Site Processing and Disposition included in Base Case

Processing	Assumed Disposition Percentages (% of dewatered biosolids)	
	Before Drying is Operational (Before 2024)	After Drying is Operational (Starting in 2024)
Composting	33%	23%
Land Application (Class B)	33%	23%
Alternative Daily Cover (ADC)	33%	23%
Soil Amendment (Class A)	0%	30%

After the initial installation of facilities (completed between 2018 and 2024), thirty percent of the biosolids produced at the RWF would be Class A (i.e. dried biosolids from thermal and solar drying processes) with additional Class A biosolids being produced via off-site composting. Thus, for the Base Case slightly more than 50 percent of the RWF's biosolids would be processed to meet Class A requirements by 2024.

3.2.2 Base Case Implementation Schedule

Figure 3-2 shows a simplified implementation schedule for initial installation of facilities for the initial Base Case Facilities (dewatering, thermal drying, and solar drying). The schedule assumes traditional design-bid-build delivery, and a significant amount of time required for CEQA compliance and permitting.

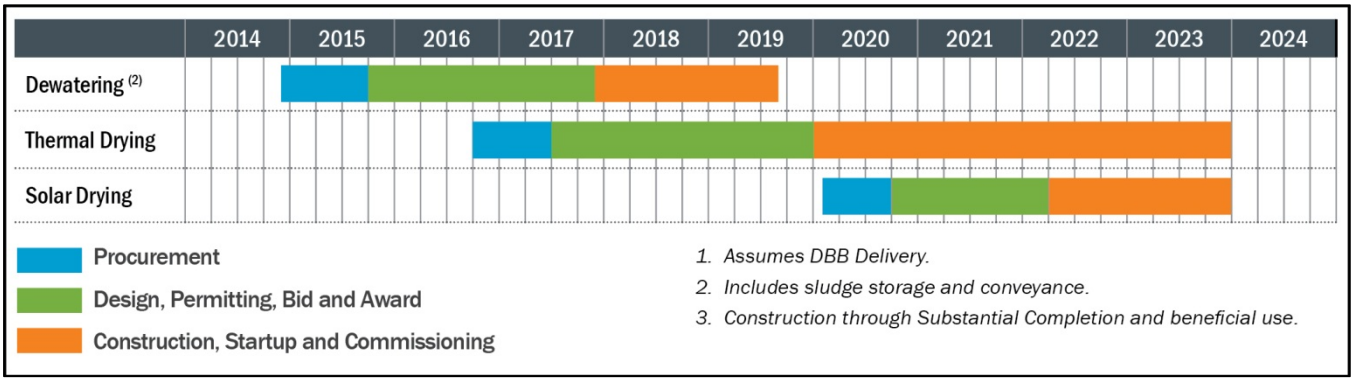

Figure 3-2. Base Case Implementation Schedule

3.2.3 Preliminary Footprint: Base Case

Table 3-5 summarizes the assumed footprint requirements for the Base Case facilities, excluding digestion and digested sludge storage, which would occur within the footprint of some of the existing digesters.

Table 3-5. Preliminary Footprint Requirements for the Base Case

Unit Process	Footprint of Required Structures	Overall Footprint with Associated Infrastructure[1]
Dewatering and Loadout	30,000 sf	45,000 sf
Thermal Drying Facility[2]	38,000 sf	66,000 sf
Solar Drying (Greenhouse) [3]	6 modular greenhouses 75,000 sf	130,000 sf
TOTAL	**143,000 sf**	**241,000 sf**

1. Related infrastructure includes driving roadways, vehicle parking, buffer from other structures, space for electrical transformers, space needed for maneuvering vehicles, etc.

2. Although the thermal drying technology has not been selected, for preliminary space planning purposes, belt drying is assumed. Belt drying requires more area than paddle drying.

3. Overall footprint includes space for staging trucks and vehicle movement

3.2.4 Staff Requirements: Base Case

Initial staffing plans for all alternatives are based on estimated full-time equivalents required for key operations and maintenance functions. For each alternative, additional staff will be required to manage the overall biosolids program and would include overall management and supervisory staff as well as staff dedicated to monitoring, testing, and regulatory compliance; coordination and oversight of disposition contracts; and ongoing planning functions such as monitoring future market conditions and regulatory

changes. Overall management, planning and oversight staffing requirements are summarized in Table 3-6 and are assumed to be the same for all alternatives.

Table 3-6. Management, Planning and Oversight Functions (Applicable to All Alternatives)

	FTEs
Manager	1
Sampling & Testing	2
Regulatory Compliance	1
Coordination and Oversight of Disposition Contracts & Planning Support	1
TOTAL	**5**

Table 3-7 summarizes the preliminary estimated staffing requirements for operations and maintenance of the facilities included in the Base Case. (See also Appendix B for estimates of O&M FTEs required for each facility included in the Base Case.)

Table 3-7. Preliminary O&M Staffing Requirements for the Base Case

	FTEs	
	Before Drying is Operational (Before 2024)	After Drying is Operational (Starting in 2024)
Operations - Operator	11.3	16.5
Operations – Laborer / Support	0	3.5
Maintenance - Mechanic	1.4	3.5
Maintenance – I&C Technician	0.8	1.8
TOTAL	**13.6**	**25.3**

1. *After drying (thermal and solar) is operational, additional staff would be required for operating the thermal drying facility, the solar drying facility, and the steam heat recovery and conveyance system,*
2. *A portion of the operations staff (after drying is operational) are assumed to have the appropriate credentials for operating a steam heat conveyance system.*

3.3 Alternative #1: Modified Base Case with TPAD

3.3.1 General Description

As shown in Figure 3-3, this alternative would be the same as the Base Case with one exception: mesophilic digesters would be upgraded with thermophilic digesters resulting in a TPAD process wherein solids first undergo a thermophilic digestion, followed by mesophilic digestion. The PMP (TM 5.2, Biosolids Treatment Alternatives, Table B-1, August 2011) contemplated further evaluation of digestion technologies including TPAD.

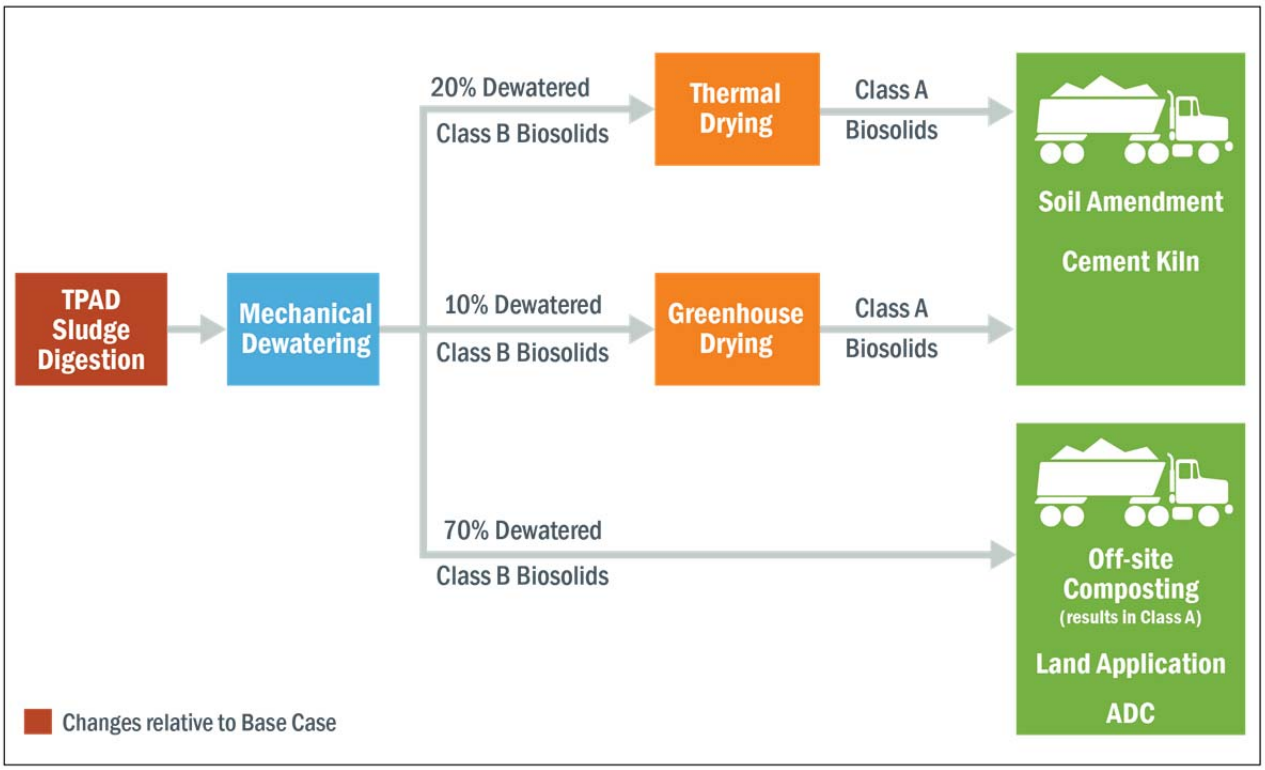

Figure 3-3. Alternative 1: Modified Base Case with TPAD

The preliminary implementation schedule, facility footprints, and staffing requirements would be the same the same as for the Base Case (refer to Figure 3-2 and Tables 3-5 through 3-7).

3.4 Alternative #2: Base Case with a Blending Operation

3.4.1 General Description

Relative to the Base Case (and Alternative 1), Alternative 2 accelerates the timing for installation of thermal and solar drying facilities in order to take advantage of the relatively inexpensive disposition cost associated with the Newby Island Landfill. In addition, a blending operation is included so that dried biosolids can be combined with a portion of the remaining dewatered cake to further maximize use of Newby Island landfill. Finally, the thermal dryer is sized based on available and suitable waste heat from the planned cogeneration facility in the year 2025[3] resulting in a thermal drying facility with about 50 percent of the capacity of the Base Case.

Figure 3-4 illustrates the configuration for this alternative. Note that following closure of Newby Island Landfill, the overall configuration for this alternative would be the same as Alternative 1, except that the thermal dryer would be smaller.

[3] 2025 is the current year that the Newby Island Landfill is scheduled to close.

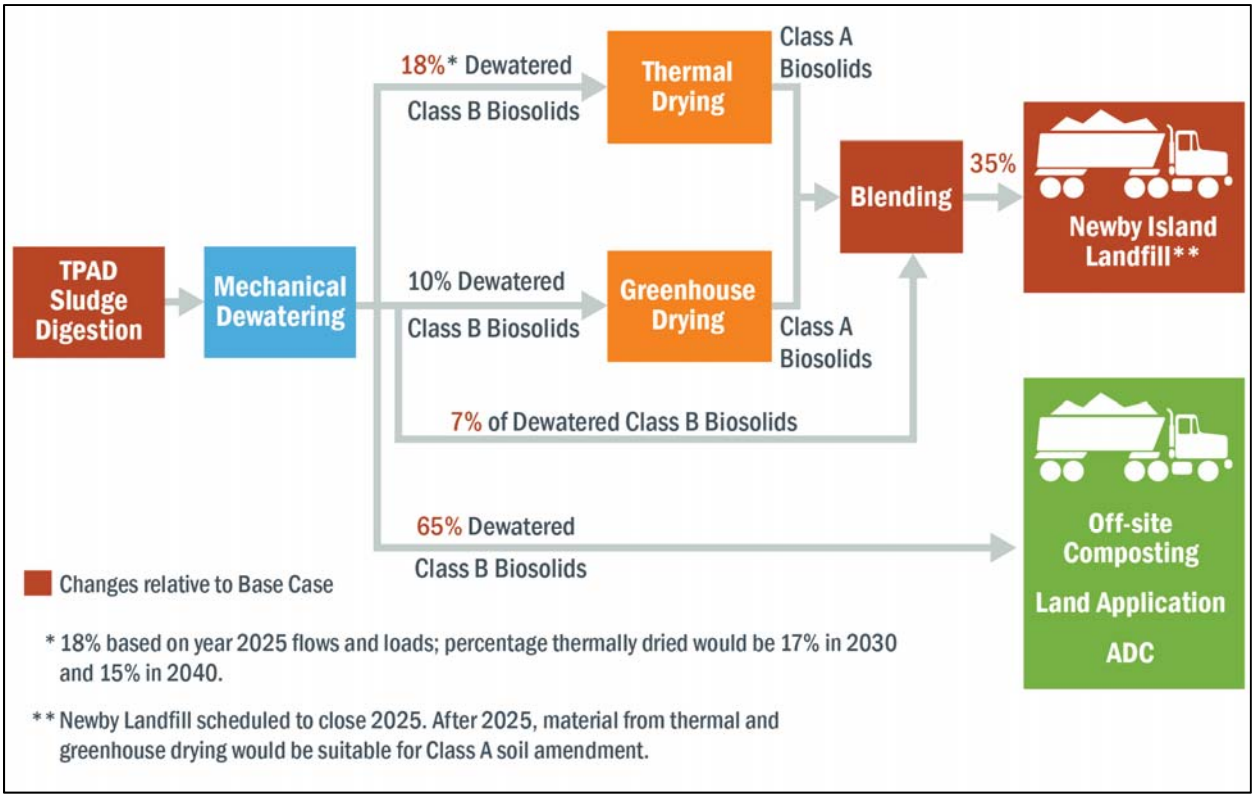

Figure 3-4. Alternative 2: Base Case with a Blending Operation

Table 3-8 illustrates off-site disposition assumptions for Alternative 2 before and after the closure of Newby Island Landfill.

Table 3-8. Assumed off-Site Processing and Disposition for Alternative 2

Processing	Assumed Disposition Percentages (% of dewatered biosolids)	
	Before Newby Island Closure (2025)	After Newby Island Closure [1]
ADC at Newby Island	35%	0%
Composting	22%	24%-25%
Land Application (Class B)	22%	24%-25%
Alternative Daily Cover (ADC) at other landfills	22%	24%-25%
Soil Amendment (Class A)	0%	25%-28%

1. *After Newby Island closure, the amount of biosolids produced by the facility continues to increase while the capacity of the thermal drying facility is fixed. Therefore, the disposition percentage for dried solids varies from year to year.*

3.4.2 Implementation Schedule: Alternative 2

Figure 3-5 shows a simplified implementation schedule for initial installation for this alternative assuming traditional design-bid-build delivery, and a significant amount of time required for CEQA compliance and permitting.

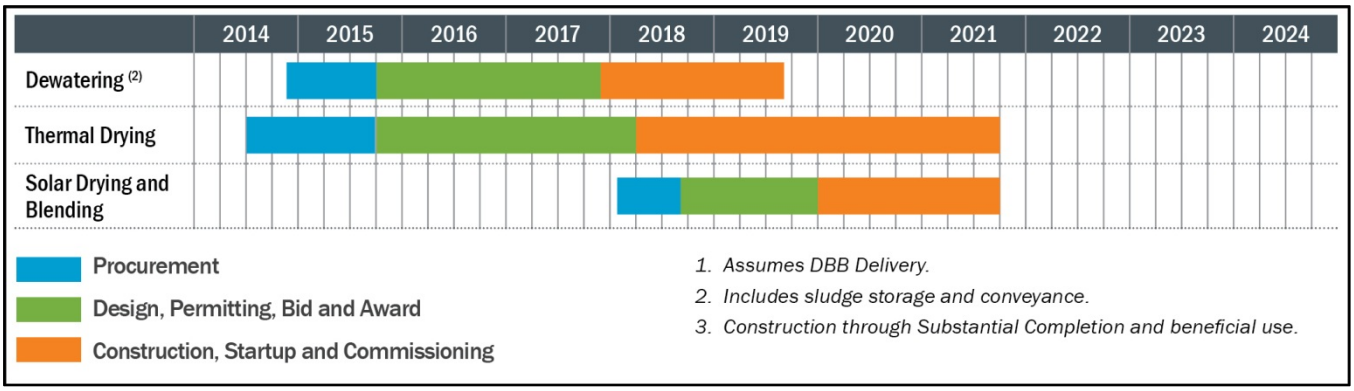

Figure 3-5. Alternative 2: Implementation Schedule

3.4.3 Preliminary Footprint: Alternative 2

Table 3-9 summarizes the assumed footprint requirements for the Alternative 2 facilities, excluding digestion and digested sludge storage, would occur within the footprint of some of the existing digesters.

Table 3-9. Preliminary Footprint Requirements for Alternative 2

Unit Process	Footprint of Required Structures	Overall Footprint with Associated Infrastructure[1]
Dewatering and Loadout	30,000 sf	45,000 sf
Thermal Drying Facility[2]	38,000 sf	66,000 sf
Solar Drying (Greenhouse) [3]	6 modular greenhouses 75,000 sf	130,000 sf
Blending Facility	30,000 sf	140,000 sf
TOTAL	**173,000 sf**	**381,000 sf**

1. *Related infrastructure includes driving roadways, vehicle parking, buffer from other structures, space for electrical transformers, space needed for maneuvering vehicles, etc.*
2. *Although the thermal drying technology has not been selected, for preliminary space planning purposes, belt drying is assumed. Belt drying requires more area than paddle drying.*
3. *Overall footprint includes space for staging trucks and vehicle movement*

3.4.4 Staff Requirements: Alternative #2

Table 3-10 summarizes the preliminary estimated staffing requirements for operations and maintenance of the facilities included in Alternative 2. (See also Appendix B for estimates of O&M FTEs required for each facility included in this alternative.) Overall management, planning and oversight staffing requirements are the same as for the Base Case and are summarized in Table 3-6, above.

Table 3-10. Preliminary O&M Staffing Requirements for Alternative #2	
	FTEs
Operations - Operator	16.5
Operations – Laborer / Support	4.7
Maintenance - Mechanic	3.8
Maintenance – I&C Technician	1.8
TOTAL	**26.8**

1. *Alternative 2 includes drying (thermal and solar) and blending facility. Staff would be required for operating the thermal drying facility, the solar drying facility, the steam heat recovery and conveyance system, and the blending facility.*
2. *A portion of the operations staff are assumed to have the appropriate credentials for operating a steam heat conveyance system.*

3.5 Alternative #3: TPAD with Future Batch Tanks

With this alternative, initial biosolids processing facilities (downstream of TPAD) would be limited to dewatering. Figure 3-6 illustrates the initial configuration for this alternative.

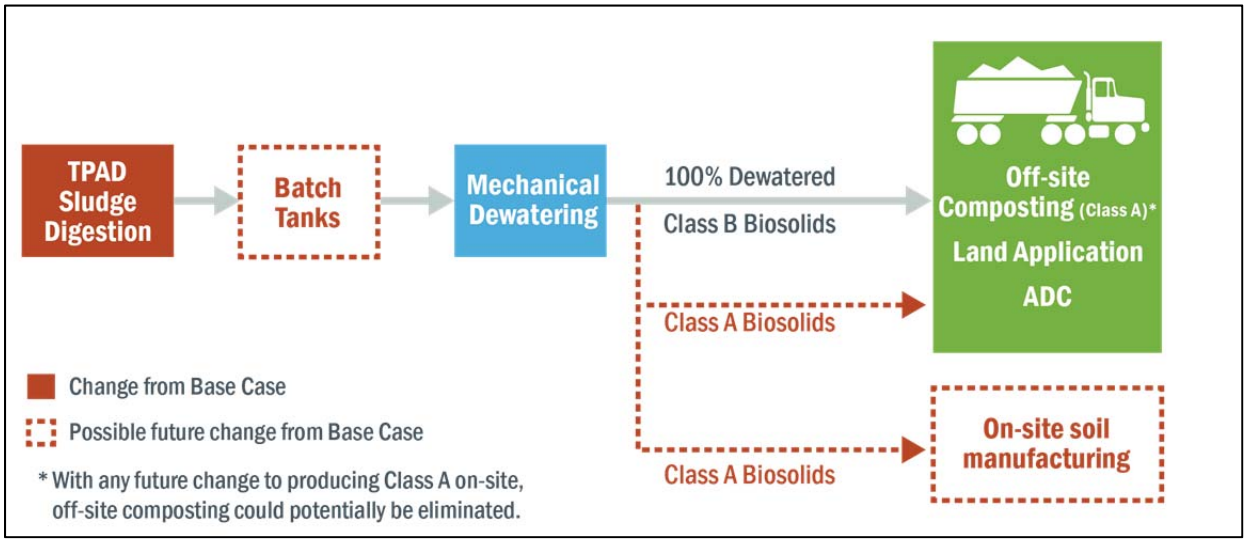

Figure 3-6. TPAD with Future Batch Tanks

As illustrated above, Alternative 3 defers the installation of drying technologies. Dewatered biosolids would then be processed/disposed of off-site with one-third of the material being composted, one-third land applied, and one-third used as alternative daily cover. Thus, while on-site processing will only produce Class B biosolids, since some of the dewatered cake would be sent to an off-site composting facility(ies), this alternative would achieve about 33% Class A material.

Although there appears to be no imminent trigger to produce Class A biosolids in northern California, different types of events, such as local bans and restrictions and / or state or federal regulatory changes, could trigger the need to produce more Class A biosolids at some point in the future. With the change to TPAD, this can be accomplished through the future addition of batch tanks, which would allow 100% of the RWF's biosolids to be processed to Class A standards.

Another "possible future" for this alternative might include a decision to develop an on-site soil manufacturing facility similar to the TAGRO facility at the City of Tacoma's Central Treatment Plant at the time batch tanks are installed. This type of soil manufacturing facility would take Class A biosolids and blend them with other materials, such as sand and sawdust, to create a top soil product.

3.5.1 Implementation Schedule

Figure 3-7 shows a simplified implementation schedule for initial installation for Alternative 3 assuming traditional design-bid-build delivery, and a significant amount of time required for CEQA compliance and permitting.

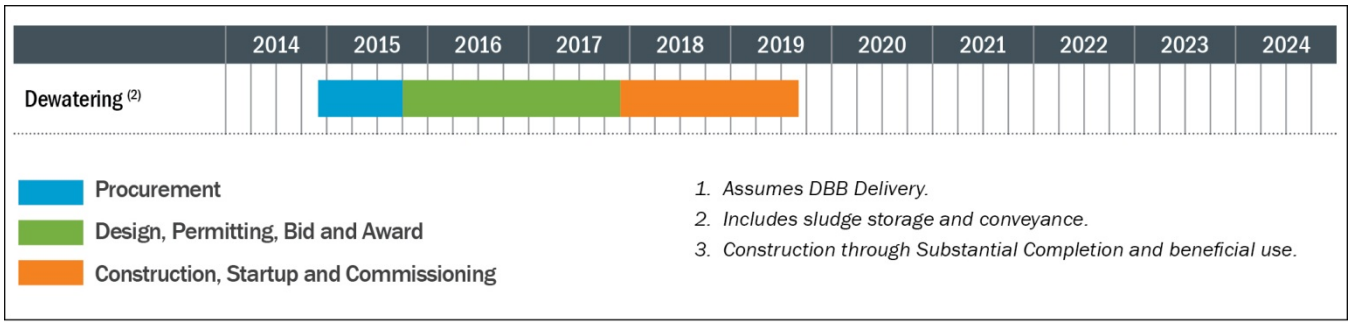

Figure 3-7. Alternative 3: Implementation Schedule

3.5.2 Preliminary Footprint: Alternative 3

Table 3-11 summarizes the assumed footprint requirements for the initial Alternative 3 facilities, excluding digestion and digested sludge storage, would occur within the footprint of some of the existing digesters. If implemented in the future, soil manufacturing, depending on size, could require up to an additional 14 acres and the new batch tanks up to 10.000 square feet; however, it is assumed these would be located within the existing treatment plant footprint where existing Digesters 4 is located.

Table 3-11. Preliminary Footprint Requirements for Alternative 3

Unit Process	Footprint of Required Structures	Overall Footprint with Associated Infrastructure[1]
Dewatering and Loadout	30,000 sf	45,000 sf
TOTAL	30,000 sf	45,000 sf

1. *Related infrastructure includes driving roadways, vehicle parking, buffer from other structures, space for electrical transformers, space needed for maneuvering vehicles, etc.*
2. *Although the thermal drying technology has not been selected, for preliminary space planning purposes, belt drying is assumed. Belt drying requires more area than paddle drying.*
3. *Overall footprint includes space for staging trucks and vehicle movement*

3.5.3 Staff Requirements: Alternative #3

Table 3-12 summarizes the preliminary estimated staffing requirements for operations and maintenance of the facilities included in Alternative 3. (See also Appendix B for estimates of O&M FTEs required for each facility included in this alternative.) Overall management, planning and oversight staffing requirements are the same as for the Base Case and are summarized in Table 3-6, above. Note that this does not include staffing required for possible future batch tanks.

Table 3-12. Preliminary O&M Staffing Requirements for Alternative #3

	FTEs
Operations - Operator	11.3
Operations – Laborer / Support	0
Maintenance - Mechanic	1.4
Maintenance – I&C Technician	0.8
TOTAL	13.5

Section 4: Capital, and O&M Cost Estimates

4.1 Capital Cost Estimates

Attachment A includes detailed capital cost estimates (Class V) for each element (facility or future phase expansion of a facility) included. These capital cost estimates were prepared by Brown and Caldwell ($2014 without contractor markups; contingencies; or allowance for engineering, legal, and administration). Percentages for those items were provided by San José (see Table 4-1) to be consistent with other projects being evaluated as part of the overall RWF program. These markups do not include an allocation for program management costs. Note that capital cost estimates for mesophilic digestion and TPAD (initial phase work) were based on information developed for the digester and thickener facility upgrade project. Note also that Alternatives 1 and 2 include capital costs to produce some Class A biosolids while Alternative 3 defers these capital costs. (As discussed in Section 5.4.3, the addition of batch tanks at some point in the future would result in an additional $15.8 M in capital costs ($2014) for Alternative 3).

Table 4-1. Assumed Capital Cost Markups

Item	Markup
General Conditions	8%
Bonds and Insurance	2%
Contractor Overhead and Profit	15%
Estimate Contingency	30%
Scope Contingency	25%
Engineering, Legal and Administration	30%

Marked-up capital cost estimates for each element were then combined to develop overall capital costs for each alternative. Tables 4-2 through 4-5 summarize capital costs for each alternative.

Table 4-2. Base Case Capital Costs ($2014)

Cost Element	Phase 1 On-line Dates		Phase 2 On-line Date
	2019[1]	2024	2030
Mesophilic Digestion	$41.46M	0	0
Sludge Storage (rehab of 2 existing digesters)	$4.42M	0	0
Pumping and Conveyance from Sludge Storage to Dewatering and from Centrate to RWF[1]	$6.65M	0	0
Dewatering Facility	$74.53M	0	$4.83M
Thermal Drying Facility including waste conveyance	0	$74.49M	0
Solar Drying Facility	0	$22.44M	$3.66M

1. *Note that pumping and conveyance costs were estimated assuming facilities (except digestion and sludge storage) are located at Site A; this provides and upper bound on conveyance costs.*
2. *Note that capital costs associated with waste heat recovery for thermal drying of biosolids are assumed to be included in the CHP facility costs and are not duplicated here.*

Table 4-3. Alternative 1 Capital Costs ($2014)

Cost Element	Phase 1 On-line Dates		Phase 2 On-line Date
	2019[1]	2024	2030
TPAD	$49.96M	0	0
Sludge Storage	$4.42M	0	0
Pumping and Conveyance from Sludge Storing to Dewatering	$6.65M	0	0
Dewatering Facility	$74.53M	0	$4.83M
Thermal Drying Facility	0	$74.49M	0
Solar Drying Facility	0	$22.44M	$3.66M

1. *Note that pumping and conveyance costs were estimated assuming facilities (except digestion and sludge storage) are located at Site A; this provides and upper bound on conveyance costs.*
2. *Note that capital costs associated with waste heat recovery for thermal drying of biosolids are assumed to be included in the CHP facility costs and are not duplicated here.*

Table 4-4. Alternative 2 Capital Costs ($2014)

Cost Element	Phase 1 On-line Dates		Phase 2 On-line Date
	2019[1,2]	2024	2030
TPAD	$49.96M	0	0
Sludge Storage	$4.42M	0	0
Pumping and Conveyance from Sludge Storing to Dewatering	$6.65M	0	0
Dewatering Facility	$74.53M	0	$4.83M
Thermal Drying Facility	$40.65M	0	0
Solar Drying Facility	$22.44M	0	$3.66M
Blending Facility	$11.42M	0	0

1. *Note that pumping and conveyance costs were estimated assuming facilities (except digestion and sludge storage) are located at Site A; this provides and upper bound on conveyance costs.*
2. *Note that capital costs associated with waste heat recovery for thermal drying of biosolids are assumed to be included in the CHP facility costs and are not duplicated here.*
3. *Thermal drying likely to be online 2020 due to greater time required for permitting and startup/commissioning.*

Table 4-5. Alternative 3 Capital Costs ($2014)			
	Phase 1 On-line Dates		Phase 2 On-line Date
Cost Element	2019[1]	2024	2030
TPAD	$49.96M	0	0
Sludge Storage	$4.42M	0	0
Pumping and Conveyance from Sludge Storage to Dewatering	$6.65M	0	0
Dewatering Facility	$74.53M	0	$4.83M

1. *Note that pumping and conveyance costs were estimated assuming facilities (except digestion and sludge storage) are located at Site A; this provides and upper bound on conveyance costs.*
2. *Alternative 3 results in only Class B Biosolids until such time as batch tanks are added in the future (see Section 5.4.3).*

4.2 Operations & Maintenance Cost Estimates

Attachment B includes estimates of certain operations and maintenance (O&M) costs for each biosolids program element. Costs include O&M labor, electricity, natural gas, chemical costs, materials, routine vendor services associated with preventative maintenance, and major equipment renewals. O&M cost estimates for each element were then combined to develop estimated overall O&M costs for each alternative.

Costs for management and oversight staff are not included since these would be the same or similar for all alternatives. Electricity, natural gas, and chemical costs were based on unit pricing provided by San José (see Table 5-1) and consumption quantities estimated using the SWET model for a single year; these quantities were then adjusted to account for changes in annual loadings. Diesel consumption and costs were estimated by Brown and Caldwell using unit pricing from the U.S. Energy Information Administration. Tables 4-6 through 4-9 summarize O&M costs for each alternative.

Table 4-6. Base Case Annual O&M Costs ($2014) [1]	
Cost Element	Once All Facilities On-line
Electricity	$3.3M
Natural Gas	$0.3M
Chemical (Polymer)	$1.1M
Diesel	$0.0M
Labor and Materials	$5.3M
Disposition	$4.4M
TOTAL	**$14.5M**

1. *Note that all annual costs are shown in terms of requirements for 2024 loads. Annual O&M costs in NPV cost file are scaled in relation to 2024 loads.*

Table 4-7. Alternative 1 Annual O&M Costs ($2014) (1)	
Cost Element	Once All Facilities On-Line
Electricity	$3.4M
Natural Gas	$0.1M
Chemical (Polymer)	$1.1M
Diesel	$0.0M
Labor and Materials	$5.3M
Disposition	$4.1M
TOTAL	**$14.1M**

1. *Note that all annual costs are shown in terms of requirements for 2024 loads. Annual O&M costs in NPV cost file are scaled in relation to 2024 loads.*
2. *Disposition costs reduced from the Base Case due to reduction in solids by converting from mesophilic to TPAD; natural gas consumption is reduced compared to the base case due to the additional digester gas produced by TPAD; electricity costs are slightly higher than the Base Case due to increased electrical demand from the TPAD process.*

Table 4-8. Alternative 2 Annual O&M Costs ($2014) (1)	
Cost Element	Once All Facilities On-Line
Electricity	$3.4M
Natural Gas	-
Chemical (Polymer)	$1.1M
Diesel	$0.0M
Labor and Materials	$5.3M
Disposition	$4.2M
TOTAL	**$14.1M**

1. *Note that all annual costs are shown in terms of requirements for 2024 loads. Annual O&M costs in NPV cost file are scaled in relation to 2024 loads.*
2. *Thermal drying likely to be online 2020 due to greater time required for permitting and startup/commissioning.*
3. *Disposition costs reduced from the Base Case due to use of Newby Island Landfill; No natural gas is assumed to be required since the thermal dryer is sized to available waste heat, electricity costs are slightly higher than the Base Case due to increased electrical demand from the TPAD process.*

Table 4-9. Alternative 3 Annual O&M Costs ($2014) [1]	
Cost Element	Once All Facilities On-Line
Electricity	$2.5M
Natural Gas	$0
Chemical (Polymer)	$1.1M
Diesel	$0
Labor and Materials	$3.2M
Disposition	$5.5M
TOTAL	**$12.3M**

1. *Note that all annual costs are shown in terms of requirements for 2024 loads. Annual O&M costs in NPV cost file are scaled in relation to 2024 loads.*
2. *Alternative 3 results in only Class B Biosolids until such time as batch tanks are added in the future. Therefore, O&M costs in Table 4-9 do not reflect O&M costs for possible future batch tanks (see Section 5.4.3 for a discussion of additional costs to achieve Class A biosolids with batch tanks).*
3. *Disposition costs are higher than the Base Case reflecting no volume reduction from drying and due to a portion of the biosolids going to an off-site composting facility (higher disposition cost), Alternative 3 does not include thermal drying and therefore has no natural gas costs and substantially lower electricity costs than the Base Case.*

4.3 Assumed Transport and Disposition Unit Costs

Table 4-10 summarizes assumed disposition methods and costs ($2014) for various types of off-site processing and disposition.

Table 4-10. Disposition Methods and Assumed Costs		
Disposition Method	Description	Disposition Cost ($/wet ton)[1]
Land Application	Application to agricultural land for beneficial use. Class B biosolids limited to non-food crops. Class A biosolids have more flexible options for land application use.	$35.00
Alternative Daily Cover (ADC)	Beneficial use that displaces use of topsoil in the management of active landfill disposal cells. Class B biosolids usually the threshold quality level.	Newby Island: $23.00 (50% dry min) Other Landfills: $35.00
Composting	Additional aerobic stabilization of biosolids to produce a Class A product suitable for flexible beneficial use.	$51.00
Landfilling	Non-beneficial disposal of biosolids in active cells of municipal solid waste landfills or dedicated sludge mono-fills.	$36.00

1. *Assuming 25% solids.*

Section 5: Comparison of Alternatives

5.1 Methods and Assumptions

5.1.1 Overview

This section discusses the relative pros and cons of each alternative when compared to the Base Case. Each comparison considers:

- Economics (Present Value Life Cycle Cost plus Sensitivity Analyses)
- Triple Bottom Line Plus Evaluation
- Other Issues

5.1.2 Economic Analysis

Present-value life cycle costs (PVLCC) were calculated for the Base Case and each alternative for a period from 2014 through 2040 (the design horizon for facilities). Attachment C summarizes the PVLCC analysis for the Base Case and each alternative as well as for a number of sensitivity cases.

Table 5-1 lists commodity cost and financial assumptions used in the present value cost calculations. These assumptions were provided by San José with the exception of diesel costs and diesel cost inflation rates which were based on data published by the United States Energy Information Administration.

Table 5-1. Present Value Life-Cycle Assumptions

Assumptions	Value
Year of Analysis	2014
Capital Cost Inflation	3.1%
Natural Gas Cost Inflation	4.0%
Electricity Cost Inflation	2.5%
Diesel Cost Inflation	1.0%
O&M Cost Inflation	2.0%
Discount Rate	5.0%
Natural Gas Cost	$0.46/therm
Electricity Cost	$0.13/kW-hr
Diesel Cost	$4.00/gal

5.1.3 Triple-Bottom Line+ Assumptions and Methods

Triple-Bottom Line Plus (TBL+) is a form of quantitative analysis that accounts for non-economic factors in addition to economic factors. For example, environmental factors such as amount of habitat impacted can be accounted for in a TBL+ type assessment.

Attachment D includes the completed TBL+ analysis comparing each alternative to the Base Case. The analysis assigns scores on a 1 to 10 scale (1=worst; 10 = best) to individual criteria within the following four general categories:

- Operations, Maintenance and Safety
- Social
- Economic
- Environmental

Overall weightings for these categories were provided by the program. The TBL+ evaluation results in two scores: 1) a TBL+ Performance Score and 2) a Value Score. The TBL+ Performance Score is calculating by applying the weightings for each criterion to each 1 to 10 score and then adding together all of the weighted scores. The Value Score is calculated by adding all of the unweighted scores together (except for the PVLCC score) and dividing the sum by the calculated PVLCC.

Table 5-2 summarizes the criteria and weightings provided by San José.

Table 5-2. Criteria & Ratings Provided by San José

Criteria	Weight
Process Reliability	10%
Flexibility and Simplicity	5%
Safety	10%
Regulatory Risk / Adaptability	5%
Visual, Noise and Odor Impacts	10%
Public Acceptability & Policy	10%
PV Life Cycle Costs	20%
Rate Impact	10%
Cost / Schedule Uncertainty	5%
Environmental Footprint & Sustainability	10%
Beneficial Use: In-Plant, Energy, or End Products	5%

5.2 Alternative 1 Compared to the Base Case

5.2.1 Costs and Sensitivity Analyses

Alternative 1 would result in only one change from the Base Case: changing from mesophllic digestion to TPAD. Table 5-3 shows PV life cycle costs for Alternative 1 compared to the Base Case. As shown in this table, Alternative #1 and the Base Case are equivalent in terms of PVLCC.

Table 5-3. Base Case v. Alternative 1 Cost Comparisons			
Consideration	Base Case	Alt 1	Difference
Capital Costs (including R&R)	$298M	$306M	$8M
Annual O&M Costs (once all facilities are online)	$14.5M	$14.1M	($0.4M)
PVLCC	$520M	$520M	none

1. *All costs in $2014.*
2. Positive cost difference = additional cost; negative difference = cost savings.

Table 5-4 shows how PVLCC of the Base Case and Alternative 1 change when various changes are made to certain assumption used in the analysis. Only one of these sensitivity cases, (increasing capital costs by 10%) results a change in relative ranking with the Base Case having a somewhat lower PVLCC than Alternative 1.

Table 5-4. Base Case v. Alternative 1 Sensitivity Analyses				
Scenario	Description	PV LCC		
		Base Case	Alt 1	Impact
Baseline		$520M	$520M	-
Defer thermal dryer installation	Defer installation of the thermal dryer recommended by the PMP by five years	$480M	$480M	No change in ranking
Reduced cost for electricity	Reduce the cost of electricity from $0.13/kWh to $0.05/kWh (estimated cost of electricity produced by the CHP facility)	$490M	$490M	No change in ranking
Alternate disposition costs	Change disposition costs to: Composting - $62/WT (from $51/WT) Land Application (Class B) - $44/WT (from $35/WT) ADC - $50/WT (from $35/WT) Soil Amendment (Class A) - $44/WT (from $23/WT)	$550M	$550M	No change in ranking
Increased capital costs	Increase capital costs by 10% above estimates	$540M	$550M	Changes Base Case to rank higher than Alt 1

1. *All costs in $2014.*

5.2.2 TBL+ Evaluation

Table 5-5 summarizes the results of the TBL+ comparison of Alternative 1 to the Base Case. As shown in this table, Alternative 1 is also essentially equivalent to the Base Case in terms of the TBL+ analysis.

Table 5-5. Base Case v. Alternative 1 TBL Plus Comparisons				
Category	Criteria	Weight	Unweighted Score	
			Base Case	Alt 1
Operations, Maintenance, and Safety	Process reliability	10%	7	6
	Flexibility and simplicity	5%	5	4
	Safety	10%	4	3
	Regulatory risk/adaptability	5%	9	10
Social	Reduce visual, noise, and odor impacts	10%	9	8
	Political accceptability and policy	10%	9	9
Economic	PV life cycle costs	20%	1	1
	Rate impacts	10%	1	4
	Cost/schedule uncertainty	5%	5	5
Environmental	Environmental footprint and sustainability	10%	7	8
	Beneficial re-use: in-plant, energy, or end products	5%	8	9
TBL+ Performance Score (Weighted Score; out of 10 pts)			**5.3**	**5.4**
Value Score			**0.12**	**0.13**

1. *Higher TBL+ and Value Scores are better.*
2. *Value Score is (Unweighted Scores except PV Cost Score)/PV Cost.*

5.2.3 Other Issues

In terms of PVLCC, TBL+ Performance Score and Value Score, Alternative 1 is essentially equivalent to the Base Case. However, changing to a TPAD process would have other benefits including greater solids stabilization, solids destruction, and biogas production. In addition, shifting to TPAD allows a relatively inexpensive path to producing 100 percent biosolids via the future addition of batch tanks (See comparison of Alternative 3 with the Base Case, below).

5.3 Alternative 2 compared to the Base Case

5.3.1 Costs and Sensitivity Analyses

Alternative 2 would result in several changes from the Base Case including: 1) TPAD instead of mesophilic digestion; 2) smaller thermal drying facility sized to meet 2025 loads and to available / suitable waste heat from cogeneration; 3) accelerated timelines for completing drying facilities; and 4) addition of a blending facility.

Table 5-6 shows PVLCC for Alternative 2 compared to the Base Case. As shown in this table, Alternative 2 would result in savings (about 6%) relative to the Base Case in terms of PVLCC.

Table 5-6. Base Case v. Alternative 2 Cost Comparisons			
Consideration	Base Case	Alt 2	Difference
Capital Costs (including R&R)	$298M	$270M	($28M)
Annual O&M Costs (once all facilities are online)	$14.5M	$14.1M	($0.4M)
PVLCC	$520M	$490M	($30M)

1. *All costs in $2014.*
2. *Positive cost difference = additional cost; negative difference = cost savings.*

Table 5-7 shows how PVLCC of the Base Case and Alternative 2 change when various changes are made to certain assumption used in the analysis. One case to note is the impact of deferring the thermal dryer by 5 years. In that case, the savings from Alternative 2 are substantially reduced. This reflects the fact that the benefits of Alternative 2 are highly time dependent since the benefits of maximizing the use of Newby Island Landfill end with the landfill's closure.

Table 5-7. Base Case v. Alternative 2 Sensitivity Analyses				
Scenario	Description	PV LCC		
		Base Case	Alt 2	Impact
Baseline		$520M	$490M	-
Newby Island Landfill closure delayed	Newby Island Landfill closure delayed until 2030	$520M	$490M	No change in ranking
Defer thermal dryer installation	Defer installation of the thermal dryer recommended by the PMP by five years (Base Case Only)	$480M	$490M	Changes Base Case to rank higher than Alt 2
Reduced cost for electricity	Reduce the cost of electricity from $0.13 to $0.05 (estimated cost of producing electricity by the CHP facility)	$490M	$450M	No change in ranking
Alternate disposition costs	Change disposition costs to: Composting - $62/WT (from $51/WT) Land Application (Class B) - $44/WT (from $35/WT) ADC - $50/WT (from $35/WT) Soil Amendment (Class A) - $44/WT (from $23/WT)	$550M	$510M	No change in ranking
Increased capital costs	Increase capital costs by 10% above estimates	$540M	$510M	No change in ranking

1. *All costs in $2014.*

5.3.2 TBL+ Evaluation

Table 5-8 summarizes the results of the TBL+ comparison of Alternative 2 to the Base Case. As shown in this table, Alternative 2 has higher TBL+ Performance and Value scores relative to the Base Case.

Table 5-8. Base Case v. Alternative 2 TBL Plus Comparisons				
Category	Criteria	Weight	Unweighted Score	
			Base Case	Alt 2
Operations, Maintenance, and Safety	Process reliability	10%	7	6
	Flexibility and simplicity	5%	5	4
	Safety	10%	4	4
	Regulatory risk/adaptability	5%	9	10
Social	Reduce visual, noise, and odor impacts	10%	9	10
	Political accceptability and policy	10%	9	9
Economic	PV life cycle costs	20%	1	3
	Rate impacts	10%	1	4
	Cost/schedule uncertainty	5%	5	4
Environmental	Environmental footprint and sustainability	10%	7	10
	Beneficial re-use: in-plant, energy, or end products	5%	8	10
TBL+ Performance Score (Weighted Score; out of 10 pts)			**5.3**	**6.3**
Value Score			**0.12**	**0.14**

1. *Higher TBL+ and Value Scores are better.*
2. *Value score is (Unweighted Scores except PV Cost Score)/PV Cost.*

5.3.3 Other Issues

While Alternative 2 shows benefit relative to the Base Case in terms of both PVLCC and the TBL+ evaluation, these benefits are highly dependent on being able to successfully accelerate the timing of the thermal and solar dryer facilities. Any slippage in this accelerated schedule would substantially reduce these benefits. This is a substantial risk for this alternative considering the complexities associated with managing the parallel development of dewatering, thermal drying, solar drying, and blending facilities, and the potential for schedule slippage associated with CEQA compliance and obtaining certain environmental permits.

5.4 Alternative 3 compared to the Base Case

5.4.1 Costs and Sensitivity Analyses

Alternative 3 would defer several facilities included in the Base Case resulting in the initial installation of TPAD and dewatering facilities. Table 5-9 shows PVLCC for Alternative 3 compared to the Base Case assuming a limiting case where the drying facilities are indefinitely deferred. As shown in this table, Alternative 3 would result in substantial savings (about 27% or $140 M) relative to the Base Case in terms of PVLCC. This assumes thermal and solar drying are indefinitely deferred and that no Class A biosolids are produced (but the potential to produce them is available with TPAD through the future addition of batch tanks). If solar and thermal drying were deferred for a shorter period and / or downsized instead, the savings would be reduced.

Table 5-9. Base Case v. Alternative 3 Cost Comparisons			
Consideration	Base Case	Alt 3	Difference
Capital Costs (including R&R)	$298M	$166M	($132M)
Annual O&M Costs (once all facilities are online)	$14.5M	$12.3M	($2.2M)
PV Costs	$520M	$380M	($140M)

1. *All costs in $2014.*
2. *Positive cost difference = additional cost; negative difference = cost savings.*

Table 5-10 shows how PVLCC of the Base Case and Alternative 3 change when various changes are made to certain assumption used in the analysis. Under all of these sensitivity cases, Alternative 3 results in PVLCC savings relative to the Base Case although the magnitude of savings varies somewhat.

Table 5-10. Base Case v. Alternative 3 Sensitivity Analyses				
Scenario	Description	PV LCC		Impact
		Base Case	Alt 3	
Baseline		$520M	$380M	-
Defer thermal dryer installation	Defer installation of the thermal dryer recommended by the PMP by five years	$480M	$380M	No change in ranking
Reduced cost for electricity	Reduce the cost of electricity from $0.13 to $0.05 (estimated cost of producing electricity by the CHP facility)	$490M	$350M	No change in ranking
Alternate disposition costs	Change disposition costs to: Composting - $62/WT (from $51/WT) Land Application (Class B) - $44/WT (from $35/WT) ADC - $50/WT (from $35/WT) Soil Amendment (Class A) - $44/WT (from $23/WT)	$550M	$410M	No change in ranking
Increased capital costs	Increase capital costs by 10% above estimates	$540M	$390M	No change in ranking
Include solar drying	Add a solar drying facilty to Alternative 3	$520M	$400M	No change in ranking

1. *All costs in $2014.*

5.4.2 TBL Plus

Table 5-11 summarizes the results of the TBL+ comparison of Alternative 3 to the Base Case. As shown in this table, Alternative 3 has substantially higher TBL+ Performance and Value scores relative to the Base Case. Note that Alternative 3 scores lower than the Base Case with respect to social and environmental criteria, in part reflecting Alternative 3's deferral of producing Class A biosolids on-site. Alternative 3 does, however, result in some Class A biosolids produced via off-site composting.

Table 5-11. Base Case v. Alternative 3 TBL Plus Comparisons				
Category	Criteria	Weight	Unweighted Score	
			Base Case	Alt 3
Operations, Maintenance, and Safety	Process reliability	10%	7	9
	Flexibility and simplicity	5%	5	10
	Safety	10%	4	9
	Regulatory risk/adaptability	5%	9	8
Social	Reduce visual, noise, and odor impacts	10%	9	8
	Political accceptability and policy	10%	9	7
Economic	PV life cycle costs	20%	1	10
	Rate impacts	10%	1	10
	Cost/schedule uncertainty	5%	5	10
Environmental	Environmental footprint and sustainability	10%	7	5
	Beneficial re-use: in-plant, energy, or end products	5%	8	5
TBL+ Performance Score (Weighted Score; out of 10 pts)			**5.3**	**8.5**
Value Score			**0.12**	**0.21**

1. *Higher TBL+ and Value Scores are better.*
2. *Value score is (Unweighted Scores except PV Cost Score)/PV Cost.*

5.4.3 Other Issues

As discussed in Section 3.5, Alternative 3 creates a potential "path" to producing Class A biosolids at the RWF via the future addition of batch tanks. Present value costs for Alternative 3 do not include addition of batch tanks. The addition of batch tanks at some point would result in an additional $11.4M in capital costs but would not affect the PVLCC of Alternative 3. Table 5-12 summarizes the economic impact of adding batch tanks at some future date (in $2014).

The production of Class A biosolids via the future addition of batch tanks would also create the opportunity to produce manufactured soil or perhaps other biosolids products on site. Table 5-12 also shows the potential economic impact of adding batch tanks and soil manufacturing to Alternative 3 (in $2014).

Costs assume soil manufacturing would process about 30% of the biosolids (for comparison with drying which would also process 30%) and assumes that manufactured soil could be sold at about the same price currently obtained by the City of Tacoma, WA for sales from their TAGRO facility. These assumptions would need to be verified through future market research to establish the local market for manufactured soil products, the size of the facility, and likely sales price. For example, assuming that manufactured soil would be given away, the PVLCC of Alternative 3 with Soil Manufacturing would increase from about $380M to about $400 M.

Table 5-12. Alternative 3 Cost Comparison with Batch Tanks and Soil Manufacturing				
Consideration	Base Case	Alt 3	Alt 3 with Batch Tanks	Alt 3 with Batch Tanks and Soil Manufacturing
Capital Costs (including R&R)	$298M	$166M	$177M	$204M
Annual O&M Costs (once all facilities are online)	$14.5M	$12.3M	$11.9M	$10.5M
PV Costs	$520M	$380M	$380M	$380M

1. *All costs in $2014.*
2. *Positive cost difference = additional cost; negative difference = cost savings.*

One risk associated with manufacturing soils is the risk of pathogen regrowth. Such regrowth has been observed at some wastewater treatment facilities with TPAD followed by centrifuge dewatering. In some cases, the cause of regrowth has been shown to be recontamination, but in other cases the causes have not been definitively determined. Research so far suggests, but does not definitively demonstrate (due to small number of facilities), that only series thermophilic digestion or thermal hydrolysis can entirely prevent regrowth when centrifuge dewatering is used. Some hypothesize that the high shear stresses associated with centrifuge dewatering account for this regrowth potential. Note that from a regulatory perspective, biosolids produced via TPAD with batch tanks are considered Class A. But product testing may fail to meet standards for fecal coliform.

The risk of regrowth increases with time, and can be managed by land applying material and incorporating it into soil quickly; the City of Los Angeles takes this approach by land applying and incorporating material within 24 hours. However, the time required for soil manufacturing, product distribution, and application would likely increase the risk of regrowth. While the need for changing dewatering technology with the addition of soil manufacturing is somewhat uncertain, estimating this potential additional cost provides one means for quantifying the risk of regrowth. If for example, belt filter presses were added to dewatering for that portion of biosolids diverted to soil manufacturing, the PVLCC would increase to about $420 million.

Section 6: Ability to Meet 2018 Date for Ceasing Discharge to the Lagoons

6.1 Overview

As shown in Figures 3-3, 3-5, and 3-7 current project schedules indicate that a permanent dewatering facility (which would allow discharge of digested biosolids to the lagoons to cease) is expected to occur in 2019 assuming traditional design-bid-build delivery. This section explores the potential for mobile dewatering and / or design-build (DB) project delivery to accelerate the schedule to meet the 2018 target date established by the City Council for ceasing discharge to the lagoons.

6.2 Mobile Dewatering

6.2.1 Cost Analysis

To evaluate the potential costs, risks, and benefits of employing mobile dewatering, three potential vendors of mobile dewatering services were contacted.

6.2.1.1 Vendor Costs

Vendors indicated that depending on the scale and duration of a mobile dewatering operation, costs typically range from $200 to $400 per dry ton. For a relatively large facility, such as the RWF, and based on conversations with these vendors, it is likely that service fees for mobile dewatering would be on the lower end of this range.

6.2.1.2 Support Facility Costs

In addition to service fees to a mobile dewatering vendor, to implement mobile dewatering, San José would need to provide temporary facilities to support the trailer-mounted mobile dewatering units. At a minimum, this will likely require: 1) piping for digested sludge and centrate; 2) power; and 3) site preparation. These support facilities could add another $20 / dry ton assuming the cost is amortized over a 2 year period.

6.2.1.3 Disposition Costs

Mobile dewatering will produce dewatered cake with a solids concentration in the range of 20 to 25%. This material will be too wet to allow for disposition at Newby Island Landfill, which requires a minimum of 50% solids for use as Alternative Daily Cover. Transport and disposition of dewatered material would incrementally add about $5.3 M per year above the costs of disposition at Newby Island Landfill.

6.2.1.4 Total Potential Costs of Mobile Dewatering

Table 6-1 shows the two-year cost of mobile dewatering assuming the mobile dewatering is dedicated to dewatering sludge from the digestion process and is not also used to dewater material from the stabilization lagoons.

Table 6-1. Potential Two-Year Costs for Mobile Dewatering

Category	Two-Year Cost
Vendor Dewatering Service Fees (1)	$16.4 M
Support Facilities (2)	$1.3 M
Energy	$ 0.5 M
Disposition (3)	$10.6 M
TOTAL	$28.8 M for 2 Years

1. *Assuming $250/dry ton*
2. *Assuming costs are amortized over 2 years*
3. *Assuming a combination of composting, landfill, and land application*

Bringing mobile dewatering on-line prior to 2018 or increasing level of dredging / removal efforts could provide additional assurance that work will be complete by 2024, but would also increase costs.

6.2.2 Implementation Issues

6.2.2.1 Time to Procure / Mobilize: Allow 2 to 3 years

If San José elects to procure mobile dewatering services, two to three years should be allowed for the procurement process and for design / installation of support facilities. Specific activities that would be required include:

- RFP development (6 months)
- Procurement process (6-9 months)

- Permitting (potentially 1+ years depending on location)
- Power / piping / site preparation (6 months)
- Mobilization (3 to 6 months)

6.2.2.2 Odor Sources

Unlike a permanent dewatering facility, mobile dewatering would utilize trailer-mounted dewatering units and would occur outdoors and without odor control. Such a process would add to the current odor sources at the RWF for the period of time that mobile dewatering remained operational.

6.3 Use of Design – Build Project Delivery

One other option that could potentially be used to meet the 2018 target date is to use some form of design-build project delivery for the dewatering facility. Figures 7-1 and 7-2 illustrate the contractual differences between traditional design-bid-build delivery and design-build, respectively.

As shown in Figure 6-1, in traditional delivery, the owner typically holds two contracts: one for engineering and another for construction. Sometimes a third contract is held with a construction manager, or the construction management responsibilities may fall to the owner and/or engineer. In the traditional project delivery model, the engineer prepares a detailed design and specifications with potential contractors bidding on the specified design. In essence, the selection of the contractor involves a one-dimensional competition (price) with all other factors (design, materials specifications, and sometimes minimum qualifications) being fixed. If disputes involving the engineer and contractor ensue during construction (for example over the intent of the design), the owner is typically involved in resolution of these disputes.

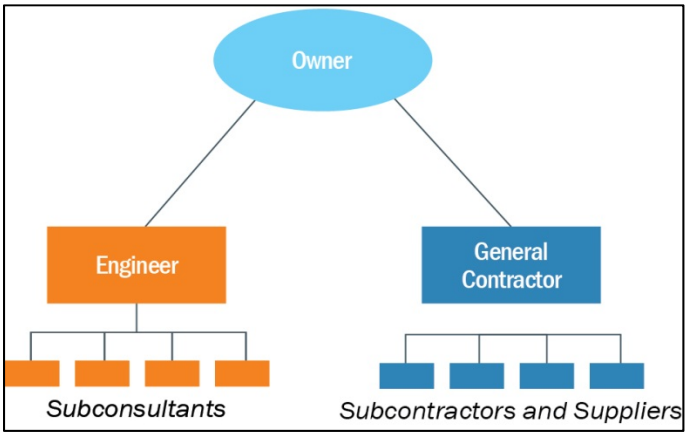

Figure 6-1. Contractual Relationships: Traditional Design-Bid-Build (DBB) Project Delivery

In contrast, Design-Build (DB) delivery involves a single contract between the owner and the design-builder (see Figure 6-2). Procurement of a design-builder occurs early in the project development process. . Unlike traditional delivery, design-build procurement typically involves competition across several dimensions including qualifications and experience, management capabilities, design concepts and innovations, and price factors. While there may be disputes between the designer and contractor during execution, these disputes typically do not involve the owner as they are internal to the design-build team.

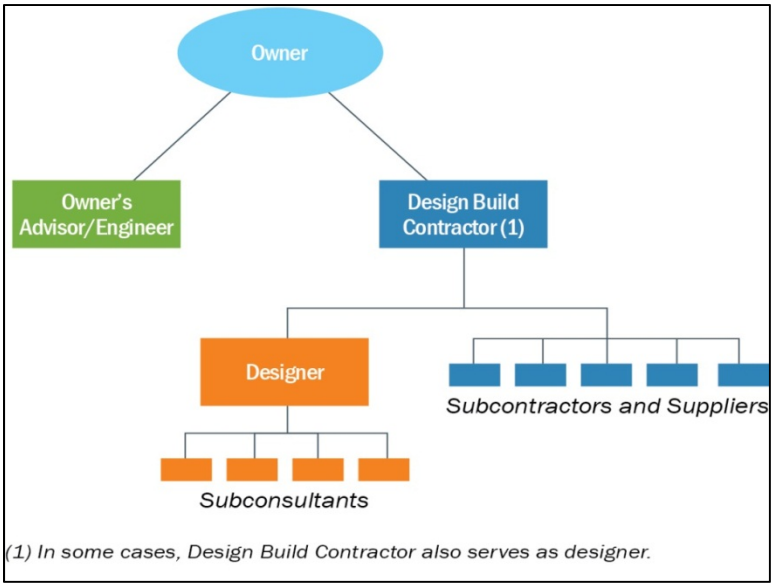

Figure 6-2. Contractual Relationships: Design- Build (DB) Project Delivery

For the purpose of this TM, we considered two variations of DB delivery: fixed price DB and progressive DB. In a fixed price DB project, the owner typically works with an advisor to develop project requirements prior to procuring the design-builder. In some cases, the owner develops a specific concept design while in others project requirements are defined in terms of performance and quality specifications. The DB procurement process then typically involves a "best value" selection process wherein the owner determines which proposal (design concept, fixed price, team) best meets its requirements. The selected design-builder then proceeds to complete the design and construction for its proposed fixed price.

In a progressive DB process, the procurement is more focused on qualifications and experience and the degree of project definition is typically less than for a fixed price DB process. The selected design builder then works closely with the owner to progress the design to some specified level. At that point, a guaranteed maximum price or fixed price is negotiated with the owner. If the owner and design builder are unable to reach an agreement on a negotiated price, then owner can elect to have the design builder complete the bid documents and can convert the project back to a traditional DBB process.

Owners often select to use DB delivery for a number of reasons including the ability to consider factors other than price in selecting a contractor, lower potential for disputes involving the owner, earlier cost predictability and potential for cost savings, better risk allocation, and schedule.

However, these theoretical advantages can be highly project specific. Table 6-2 summarizes the pros and cons of fixed price DB, progressive DB, and traditional delivery with respect to the dewatering facility.

Table 6-2. Comparison of Project Delivery Methods			
Consideration	DBB	Fixed Price DB	Progressive DB
Consider factors other than low bid in contractor selection	-	+	+
Reduces disputes involving owner	-	+	+
Staff inexperience with O&M for Dewatering	-	-	-
Potential to accelerate rel. to DBB		?	?
Early Cost Predictability / Cost Savings	-	++	+
Owner control over design details	++	-	+

Although accelerating the schedule is one potential benefit of DB, based on currently available schedule information developed by the program, DB appears unlikely to accelerate the on-line date for a permanent dewatering facility (see Figure 6-3). While a final decision on project delivery will occur during conceptual design, further schedule analysis should consider selecting a design builder at an earlier stage (as would be possible with progressive DB). Early procurement of equipment and paralleling design and construction should also be considered with DB delivery.

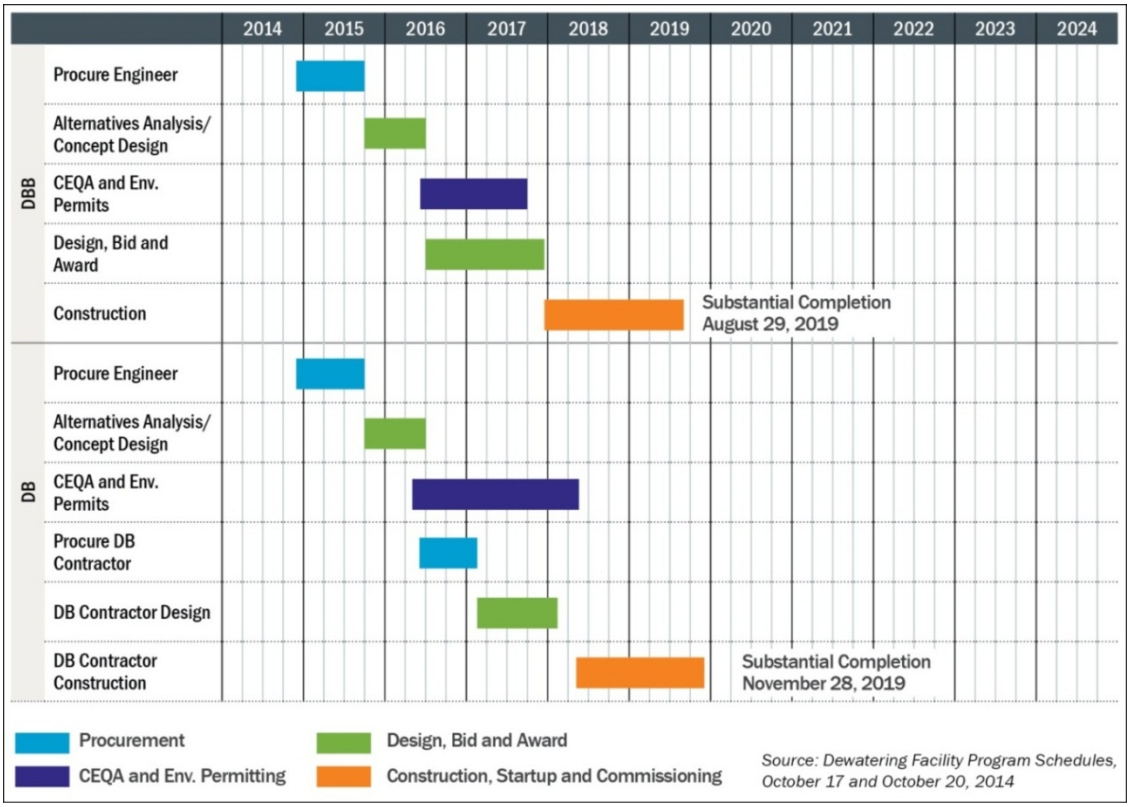

Figure 6-3. Dewatering Facility: DBB vs DB Delivery

Section 7: Conclusions and Recommendations

This section summarizes overall conclusions and recommendations related to the Biosolids Transition. In some cases, conclusions and recommendations are related to work from some of the previous TMs.

7.1 Conclusions

- Current program schedule (Oct. 2, 2014) indicates dewatering most likely to come on line in 2019 in part due to CEQA and potential permitting requirements:
  - Mobile dewatering could potentially be used to meet 2018 schedule but could also face permitting challenges due to need for temporary power / pipeline facilities, would come at a relatively high cost, and would create an additional odor source at the RWF.
  - Current program schedule indicates that design-build is unlikely to accelerate the on-line date for the dewatering facility.
- RFI responses and other research indicate there is currently no immediate driver for Class A or thermally dried product (see TM 5).
- RFI responses also indicate some emerging technologies are moving toward commercial feasibility (i.e. VitAg, Lystek) and regional biosolids management initiatives (i.e. BABE2) continue to progress (see TM 5).
- Deferring thermal drying results in substantial cost savings but reduces end product diversification; however, some end product diversification can be achieved via off-site composting.
- TPAD provides a cost effective alternative path to Class A biosolids through the future addition of batch tanks.
- Of the new sites evaluated, Site A provides the greatest flexibility for future biosolids facilities relative to the other sites evaluated. Site C would have advantages for thermal drying due to its proximity to the planned cogeneration facility but entails significant permitting uncertainty. Site D would also entail a substantial period of time for environmental permitting, and is best reserved for side stream treatment if needed in the future (see TM 7).

7.2 Recommended Biosolids Transition Strategy (Near Term Improvements)

- Proceed with TPAD anaerobic digestion followed by mechanical dewatering at this time (Alternative 3) since there is no imminent driver for Class A biosolids.
- Further evaluate the potential for DB delivery to accelerate the dewatering on-line date specifically considering the potential to select the DB contractor at an earlier date, procure equipment earlier, and parallel design and construction activities.
- Consider provisions for 1-year O&M training and support for the biosolids dewatering facility.
- Locate dewatering facility at Site A unless further evaluation during conceptual design identifies a suitable location within the plant fence line:
  - Reserve Site A for future biosolids processing facilities
  - Provide a safe means for O&M staff to access a mobile dewatering facility at Site A if a suitable site within the fence line is not identified during conceptual design
  - Reserve Site C for any future thermal drying facility
  - Initiate resolution of jurisdictional issues at Site C

- Investigate environmental and permitting issues associated with support facilities for mobile dewatering so that it can be used as a backup strategy in the event of significant delays in bringing a permanent dewatering facility on-line
- Establish biosolids management team (BMT) to begin developing and negotiating a diverse portfolio of disposition contracts in terms of end uses, qualified service providers, contract terms, and procurement.

7.3 Biosolids Transition Strategy: Long-Term Recommendations

- Implement an adaptive management approach with the BMT:
  - Tracking changing industry, regulatory, market and land use conditions, and conducts market research
  - Conducting market research to better determine local demand and price for end products such as manufactured soil and dried biosolids
- Implement additional future on-site processing facilities considering conditions at the time:
  - Start small with pilots, demonstrations, and phasing
- Potentially participate in regional facilities and emerging technologies
- Through the BMT or designated biosolids contract manager, proactively oversee contract operations to ensure regulatory and contract compliance

Section 8: Implementation Plan

A preliminary checklist identifying activities required to implement the recommendations of TM 8 and relevant recommendations from other TMs is included in Table 8-1.

	Table 8-1 Preliminary Implementation Checklist	
Number	Description	Time Frame / Priority
Dewatering		
1	Identify additional potential sites internal to Plant for dewatering	1
	Obtain odor study results to develop Basis of Design for dewatering odor control system	
3	Procure and select dewatering engineering consultant	1
4	Conduct final dewatering site evaluation (i.e. internal sites vs. Site A) incorporating odor study results	1
5	Finalize dewatering site selection	1
6	Conduct dewatering alternatives analysis including technology selection	1
7	Conduct dewatering conceptual design including preferred layout	1
8	Conduct CEQA review for dewatering facility at selected site	1
9	Obtain environmental permits for dewatering facility if impacts to wetlands and other sensitive areas cannot be avoided	1
10	Conduct final dewatering facility delivery analysis /select delivery method	1
11	Procure and select Design-Builder (if DB delivery selected)	1
12	Complete 30/60/90% design	1

Table 8-1 Preliminary Implementation Checklist		
Number	Description	Time Frame / Priority
13	Obtain required utility connections	1
14	Obtain required building permits	1
15	Complete 100% design / issue bid documents / select contractor (if traditional delivery)	1
16	Construct facility	1
17	Perform Startup and Commissioning	2
18	Train dewatering staff (O&M)	2
19	Provide ongoing technical support to dewatering O&M staff (1year)	2
Site Development (longer term)		
1	Obtain determination of state jurisdiction over potential wetland areas on Site A	1
2	Obtain determination of state jurisdiction over potential wetland areas on Site C	2
Staffing		
1	Develop initial staffing plan (# and type of positions over time)	1
2	Develop job descriptions, salary ranges for initial staffing (assumed to be biosolids manager, disposition contract manager, XXX, and O&M staff for dewatering	1
3	Obtain required City approvals for new positions	1
4	Advertise / recruit new staff	1
5	Hire / Integrate new staff	1/2
Disposition Contracts		
1	Conduct informational interviews /follow-up / outreach to potential disposition contractors	1
2	Procure /select required technical and legal support	1
3	Develop initial disposition program description: objectives, quantities of biosolids (range based on projected range of quantities and potential range of solids content taking into account short-term "emergency" conditions that could significantly increase or decrease quantities), desired portfolio of contracts (i.e. mix of disposition methods, number of service providers, mix of shorter-term vs. longer-term service contracts)	1
4	Develop overall procurement strategy (i.e. RFQ/RFP or combined process; single or multiple procurements; approach to negotiations)	1
5	Determine City's preferred approach to critical issues (contract term, required backup service, responsibility for transport, notice and time frame requirements for emergency service, required financial strength of service providers etc.)	1
6	Develop term sheets / draft disposition contracts	1
7	Develop disposition procurement documents	1
8	Conduct disposition procurement	1
9	Select disposition contractors / negotiate contracts	2
10	Develop tracking system for monitoring and managing disposition contracts	2

Table 8-1 Preliminary Implementation Checklist		
Number	Description	Time Frame / Priority
Emerging technologies and market conditions		
1	Contact Fairfield Suisan Sewer District to obtain details on planned regional Lystek facility pilot	1
2	Determine potential City interest in participating in regional facility	1
3	If there is potential City interest, conduct due diligence and field inspections of Lystek facilities in Canada	1
4	Negotiate agreement (if City interest is confirmed) for participation in regional facility	1
5	Monitor progress of development of commercial-scale VitAg facility in Florida	4
6	Identify target conference attendance / journals to keep track of emerging industry and market trends and technologies	1
7	Monitor biosolids regulations and local ordinances esp. in disposition contract locations	2/4
8	Investigate site and permit requirements for mobile dewatering so that it could be more quickly implemented if needed	1
9	Develop pilot test plans for solar and thermal drying	3
10	Develop market research plan for investigating local demand and pricing for manufactured soil	3

1. *Time Frame / Priority: 1= Initiate in next 1-3 years; 2 = Initiate in next 3-5 years; 3 = Initiate later than 5 years; 4 = ongoing*

Attachment A: Estimated Capital Costs of Potential Biosolids Program Elements

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Mesophilic Digestion**		
		BCE Alt	**Base Case**		
Estimate By	Estimate is taken directly from the digester design project, cost mark-ups are applied as used for all BCE modules.	*Date*	Nov-14	*Element Cost*	**$41,459,374**
Estimate Assumptions	From Digester Design (SO#4)				
Sizing Assumptions	From Digester Design (SO#4)				

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
	Demolition						$842,666
	Dedicated Digester Feed Piping						$141,426
	Concrete Fixed Cover						$9,056,552
	Mixers						$2,283,193
	Electrical and Instrumentation						$2,500,000
	Digester Overflow						$77,093
	Digester Sludge Recirculation Pumps						$96,656
	New Electrical Building						$397,031
	Thickened Sludge EQ Tanks & Feed System						$1,228,666
	Building 40 Independent Loop						$188,214
	Digester Loop PS @ DAFT						$160,726
	Modifications to SBB						$391,072
	New Heat Exchangers						$432,389
	Revised Existing 2 pipe system						$132,694
	Batch Tanks						
	New Cooling PS and Effuent Piping Dig 9 -16						
	New Digester Heating System Dig 5 - 8						
	One-Pipe Heat Loop Dig 5 & 6						
	Revise existing digesters 9-16						
	Strainpress Addition						
	Thermophilic Digester						
					SUBTOTAL		**$17,928,378**
	Contractor mark-ups						
	General Conditions	8	percent				$1,434,270
	Bonds & Insurances	2	percent				$358,568
	Overhead & Profit	15	percent				$2,689,257
					SUBTOTAL		**$22,410,473**
	Project Adjustments						
	Estimate Contingency	30	percent				$6,723,142
	Scope Contingency	25	percent				$5,602,618
	Engineering, Legal, and Administrative	30	percent				$6,723,142
					TOTAL ESTIMATED COST FOR MODULE		**$41,459,374**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Thermophilic Digestion**		
		BCE Alt	**1, 2, 3**		
Estimate By	Estimate is taken directly from the digester design project, cost mark-ups are applied as used for all BCE modules.	*Date*	Nov-14	*Element Cost*	**$49,962,825**
Estimate Assumptions	From Digester Design (SO#4)				
Sizing Assumptions	From Digester Design (SO#4)				

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
	Demolition						$842,666
	Dedicated Digester Feed Piping						$141,426
	Concrete Fixed Cover						$9,056,552
	Mixers						$2,283,193
	Electrical and Instrumentation						$2,500,000
	Digester Overflow						$77,093
	Digester Sludge Recirculation Pumps						$96,656
	New Electrical Building						$397,031
	Thickened Sludge EQ Tanks & Feed System						$1,228,666
	Building 40 Independent Loop						$101,032
	Digester Loop PS @ DAFT						
	Modifications to SBB						$131,959
	New Heat Exchangers						
	Revised Existing 2 pipe system						
	Batch Tanks						
	New Cooling PS and Effuent Piping Dig 9 -16						$873,439
	New Digester Heating System Dig 5 - 8						$1,844,529
	One-Pipe Heat Loop Dig 5 & 6						$444,271
	Revise existing digesters 9-16						$40,101
	Strainpress Addition						
	Thermophilic Digester						$1,546,932
					SUBTOTAL		**$21,605,546**
	Contractor mark-ups						
	General Conditions	8	percent				$1,728,444
	Bonds & Insurances	2	percent				$432,111
	Overhead & Profit	15	percent				$3,240,832
					SUBTOTAL		**$27,006,933**
	Project Adjustments						
	Estimate Contingency	30	percent				$8,102,080
	Scope Contingency	25	percent				$6,751,733
	Engineering, Legal, and Administrative	30	percent				$8,102,080
					TOTAL ESTIMATED COST FOR MODULE		**$49,962,825**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Sludge Storage (Rehab 2 Existing Digesters)**
		BCE Alt	**All**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
Element Cost	**$4,422,518**		
Estimate Assumptions	This is an alternative to constructing a new digested sludge storage facility. Escalation will be accounted for in the BCE.		
Sizing Assumptions	4 days at peak 2-week 2040 loading		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Demolition and Rehabilitation						
	Remove contents and clean digester	1	LS	$40,000		$40,000	$40,000
	Demo gas collection system	1	LS	$25,000		$25,000	$25,000
	Remove existing cover and dispose off site	1	LS	$35,000		$35,000	$35,000
	Demo misc equipment in Control Bldg	1	LS	$25,000		$25,000	$25,000
	Crack repair - digester walls	1	LS	$50,000		$50,000	$50,000
	Coat interior walls and slab of tank						
	Bottom slab	7850	SF	$8			$62,800
	Inerior walls	10990	SF	$8			$87,920
	Add walkway at top of tank	1	LS	$75,000			$75,000
					SUBTOTAL PER DIGESTER		$400,720
					SUBTOTAL FOR 2 DIGESTERS		$801,440
2	Replace Digester Recirculation Pumping System and Transfer Pumps + Piping						
	In-line sludge feed grinders (1 per pump)	2	EA	$40,000	$80,000	$60,000	$140,000
	Recirculation pumps - centrifugal, constant speed, 2 per storage tar	2	EA	$25,000	$50,000	$25,000	$75,000
	Piping, Valves and Appurtenances	1	LS	$75,000		$75,000	$75,000
	Transfer pumps (2) to pump stored sludge to "day" tank in dewater	2	EA	$30,000	$60,000	$30,000	$90,000
	Piping, valves and appurtenances (not including conveyance)	1	LS	$100,000		$100,000	$100,000
					SUBTOTAL ITEM 2		$480,000
3	Miscellaneous Allowances						
	Miscellaneous piping systems, valving, etc. within building	1	LS	$25,000			$25,000
	Site improvements - pavement replacement, grading, landscaping, parking areas, stormwater drainage, etc.	1	LS	$30,000			$30,000
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. from remote locations to this facility	1	LS	$80,000			$80,000
	Upgrade / Replace Electrical and I&C	35	percent				$496,000
					SUBTOTAL ITEM 3		$631,000
						MODULE SUBTOTAL	**$1,912,440**
	Contractor mark-ups						
	General Conditions	8	percent				$152,995
	Bonds & Insurances	2	percent				$38,249
	Overhead & Profit	15	percent				$286,866
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$2,390,550**
	Project Adjustments						
	Estimate Contingency	30	percent				$717,165
	Scope Contingency	25	percent				$597,638
	Engineering, Legal, and Administrative	30	percent				$717,165
						TOTAL ESTIMATED COST FOR MODULE	**$4,422,518**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Dewatering Facility - Centrifuge (2019)**
		BCE Alt	**All**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
Estimate Assumptions	No escalation (will be accounted for in BCE)		
Sizing Assumptions	2018 2-week peak, 24/5 operation, building sized for 2040 requirements (5 centrifuges)		

Element Cost **$74,531,297**

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Sludge Dewatering Building (Centrifuge)						
	New concrete building, 2 story (ground level, second floor) with partial basement (100'x100') and integral truck loading bay. Space for 5 centrifuges. Includes electrical room and mechanical room, operations/control room, sample collection/operators "lab" room for routine testing, and men's & women's restroom/shower rooms. Total footprint is 150' x 200' x 40' high above grade (includes truck loading area). Stairwells, building sump, centrate sump in basement, digested sludge sump in basement, steel framed roof with membrane roofing system, skylights or equipment shaft for equipment removal.						
	Below Grade Structure	10,000	SF	$125		$1,250,000	$1,250,000
	Above Grade Structure	60,000	SF	$200		$12,000,000	$12,000,000
	Centrate wet well (concrete wet well in basement)	1	LS			$60,000	$60,000
	Bridge crane in centrifuge area (5 ton) 60'x40'				$75,000	$37,500	$112,500
					SUBTOTAL ITEM 1		$13,422,500
2	Polymer System						
	Neat polymer strorage tanks (2 @ 10,000 gallons, FRP)	2	EA	$30,000	$60,000	$21,000	$81,000
	Polymer dilution and aging tanks (2 @ 10,000 gallons, FRP)	2	EA	$30,000	$60,000	$21,000	$81,000
	Transfer, mixing, and feed pumps (packaged systems, 1 per centrifug	4	EA	$20,000	$80,000	$36,000	$116,000
	Misc supporting infrastructure - piping, valves, containment, etc.	1	LS		$75,000	$93,750	$168,750
					SUBTOTAL ITEM 2		$446,750
3	Digested Sludge Pumping System						
	Digested sludge "day" tanks (2 concrete sumps in basement)	1	LS			$200,000	$200,000
	In-line sludge feed grinders, one per pump	5	EA	$90,000	$450,000	$225,000	$675,000
	Centrifuge sludge feed pumps with VFDs - progressive cavity. 1 pump per centrifuge with 1 redundant unit	5	EA	$85,000	$425,000	$212,500	$637,500
	Piping, Valves and Appurtenances	1	LS		$200,000	$250,000	$450,000
					SUBTOTAL ITEM 3		$1,962,500
4	Dewatering System						
	Centrifuge systems @ 275 gal/min per centrifuge (Andritz D7LL)	4	EA	$800,000	$3,200,000	$1,120,000	$4,320,000
	Centrate pumping system includes 2 centrifugal pumps. Assume centrate is routed to Primary Effluent PS. Cost for centrate piping to the PEPS is included in the Pumping and Conveyance module.	1	LS		$60,000	$30,000	$90,000
	Centrate piping, valves and appurtenances within building (costs for piping outside of building is included in conveyance cost module).	1	LS		$40,000	$30,000	$70,000
	Dewatered sludge transfer conveyor systems (2 [one each per set of centrifuges])-24" Ø x 50'-screw to storage hoppers at truck loading bay. Pneumatic slide gates at discharge points.	100	LF	$2,500	$250,000	$87,500	$337,500
					SUBTOTAL ITEM 4		$4,817,500
5	HVAC Systems						
	Foul air ventilation fans and ducting system	1	LS		$250,000	$312,500	$562,500
	Fresh air ventilation and ducting system - supply and exhaust	2	LS		$200,000	$160,000	$360,000
	Fresh air ventilation and ducting system for occupied spaces (offices,	1	LS		$100,000	$80,000	$180,000
	HVAC system electrical room	1	LS	$30,000	$30,000	$18,000	$48,000
					SUBTOTAL ITEM 5		$1,150,500

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Dewatering Facility - Centrifuge (2019)**
		BCE Alt	**All**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
Element Cost	**$74,531,297**		
Estimate Assumptions	No escalation (will be accounted for in BCE)		
Sizing Assumptions	2018 2-week peak, 24/5 operation, building sized for 2040 requirements (5 centrifuges)		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
6	Dewatered Sludge Storage & Load-Out						
	Truck loading bay (integral with dewatering building, not separate) 75' long x 40' high x 25' wide, roll-up doors, control booth, ventilation, etc.		cost included in building cost				$0
	Truck weight scale package	1	EA		$75,000	$60,000	$135,000
	Sludge storage/load-out tank filling conveyor-24" Ø x 40' long	40	LF	$2,500	$100,000	$75,000	$175,000
	Dewatered Sludge storage/load-out hoppers (2) - 40' Ø x 26' SW and 30° cone bottom with live bottom (24 hrs storage per hopper)	2	LS	$150,000	$300,000	$150,000	$450,000
					SUBTOTAL ITEM 6		$760,000
7	Odor Control - Bio Scrubbers & Carbon Vessel	1	LS		$1,000,000	$500,000	$1,500,000
8	Miscellaneous Allowances						
	Miscellaneous piping systems, valving, etc. within building	1	LS	$800,000			$800,000
	Site civil - pavement, grading, landscaping, parking areas, stormw	1	LS	$750,000			$750,000
	Relocation of existing buried utilities, resolution of conflicts with existing structures, etc.	1	LS	$250,000			$250,000
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. from remote locations to this facility	1	LS	$800,000			$800,000
	Building appurtenances - furniture for lab and offices, coatings, some minor architectural, restroom fixtures, window coverings, etc.	1	LS	$200,000			$200,000
	Electrical and I&C	20	percent				$5,370,000
					SUBTOTAL ITEM 8		$8,170,000
						MODULE SUBTOTAL	**$32,229,750**
	Contractor mark-ups						
	General Conditions	8	percent				$2,578,380
	Bonds & Insurances	2	percent				$644,595
	Overhead & Profit	15	percent				$4,834,463
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$40,287,188**
	Project Adjustments						
	Estimate Contingency	30	percent				$12,086,156
	Scope Contingency	25	percent				$10,071,797
	Engineering, Legal, and Administrative	30	percent				$12,086,156
						TOTAL ESTIMATED COST FOR MODULE	**$74,531,297**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Dewatering Facility - Centrifuge (2030)**
		BCE Alt	**All**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
		Element Cost	**$4,834,859**
Estimate Assumptions	This estimate is for the incremental cost to add another centrifuge to get to 2040 capacity. No escalation (will be accounted for in BCE)		
Sizing Assumptions	2030 2-week peak, 24/5 operation, add one centrifuge for a total of 5 centrifuges		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Sludge Dewatering Building (Centrifuge)						
	New concrete building, 2 story (ground level, second floor) with partial basement (100'x100') and integral truck loading bay. Space for 5 centrifuges. Includes electrical room and mechanical room, operations/control room, sample collection/operators "lab" room for routine testing, and men's & women's restroom/shower rooms. Total footprint is 150' x 200' x 40' high above grade (includes truck loading area). Stairwells, building sump, centrate sump in basement, digested sludge sump in basement, steel framed roof with membrane roofing system, skylights or equipment shaft for equipment removal.						
	Below Grade Structure		SF	$125		$0	$0
	Above Grade Structure		SF	$200		$0	$0
	Centrate wet well (concrete wet well in basement)		LS			$0	$0
	Bridge crane in centrifuge area (5 ton) 60'x40'				$0	$0	$0
					SUBTOTAL ITEM 1		$0
2	Polymer System						
	Neat polymer strorage tanks (2 @ 10,000 gallons, FRP)	0	EA	$30,000	$0	$0	$0
	Polymer dilution and aging tanks (2 @ 10,000 gallons, FRP)	0	EA	$30,000	$0	$0	$0
	Transfer, mixing, and feed pumps (packaged systems, 1 per centrifug	1	EA	$20,000	$20,000	$9,000	$29,000
	Misc supporting infrastructure - piping, valves, containment, etc.	1	LS		$15,000	$18,750	$33,750
					SUBTOTAL ITEM 2		$62,750
3	Digested Sludge Pumping System						
	Digested sludge "day" tanks (2 concrete sumps in basement)	0	LS				$0
	In-line sludge feed grinders, one per pump	1	EA	$90,000	$90,000	$45,000	$135,000
	Centrifuge sludge feed pumps with VFDs - progressive cavity. 1 pump per centrifuge with 1 redundant unit	1	EA	$85,000	$85,000	$42,500	$127,500
	Piping, Valves and Appurtenances	1	LS		$75,000	$93,750	$168,750
					SUBTOTAL ITEM 3		$431,250
4	Dewatering System						
	Centrifuge systems @ 275 gal/min per centrifuge (Andritz D7LL)	1	EA	$800,000	$800,000	$280,000	$1,080,000
	Centrate pumping system includes 2 centrifugal pumps. Assume centrate is routed to Primary Effluent PS. Cost for centrate piping to the PEPS is included in the Pumping and Conveyance module.	0	LS			$0	$0
	Centrate piping, valves and appurtenances within building (costs for piping outside of building is included in conveyance cost module).	0	LS			$0	$0
	Add one dewatered sludge transfer conveyor systems - 24" Ø x 50' to storage hoppers at truck loading bay. Pneumatic slide gates at discharge points.	50	LF	$2,500	$125,000	$43,750	$168,750
					SUBTOTAL ITEM 4		$1,248,750
5	HVAC Systems						
	Foul air ventilation fans and ducting system	0	LS			$0	$0
	Fresh air ventilation and ducting system - supply and exhaust	0	LS			$0	$0
	Fresh air ventilation and ducting system for occupied spaces (offices,	0	LS			$0	$0
	HVAC system electrical room	0	LS			$0	$0
					SUBTOTAL ITEM 5		$0

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Dewatering Facility - Centrifuge (2030)**
		BCE Alt	**All**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
		Element Cost	**$4,834,859**
Estimate Assumptions	This estimate is for the incremental cost to add another centrifuge to get to 2040 capacity. No escalation (will be accounted for in BCE)		
Sizing Assumptions	2030 2-week peak, 24/5 operation, add one centrifuge for a total of 5 centrifuges		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
6	Dewatered Sludge Storage & Load-Out						
	Truck loading bay (integral with dewatering building, not separate) 75' long x 40' high x 25' wide, roll-up doors, control booth, ventilation, etc.		cost included in building cost				$0
	Truck weight scale package	0	EA				$0
	Sludge storage/load-out tank filling conveyor-24" Ø x 40' long	0	LF	$2,500	$0	$0	$0
	Dewatered Sludge storage/load-out hoppers (2) - 40' Ø x 26' SW and 30° cone bottom with live bottom (24 hrs storage per hopper)	0	LS	$150,000	$0	$0	$0
					SUBTOTAL ITEM 6		$0
7	Odor Control - Bio Scrubbers & Carbon Vessel	0	LS			$0	$0
8	Miscellaneous Allowances						
	Miscellaneous piping systems, valving, etc. within building	1	LS	$50,000			$50,000
	Site civil - pavement, grading, landscaping, parking areas, stormw	0	LS	$750,000			$0
	Relocation of existing buried utilities, resolution of conflicts with existing structures, etc.	1	LS	$25,000			$25,000
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. from remote locations to this facility	0	LS	$800,000			$0
	Building appurtenances - furniture for lab and offices, coatings, some minor architectural, restroom fixtures, window coverings,	0	LS	$200,000			$0
	Electrical and I&C	15	percent				$273,000
					SUBTOTAL ITEM 8		$348,000
						MODULE SUBTOTAL	**$2,090,750**
	Contractor mark-ups						
	General Conditions	8	percent				$167,260
	Bonds & Insurances	2	percent				$41,815
	Overhead & Profit	15	percent				$313,613
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$2,613,438**
	Project Adjustments						
	Estimate Contingency	30	percent				$784,031
	Scope Contingency	25	percent				$653,359
	Engineering, Legal, and Administrative	30	percent				$784,031
						TOTAL ESTIMATED COST FOR MODULE	**$4,834,859**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Thermal Drying Facility - PMP**
		BCE Alt	**Base Case, 1**
Estimate By	Humm, McKelvey, Goodburn (QC)	*Date*	Nov-14
Estimate Assumptions	No escalation (will be accounted for in BCE). Belt type dryer is assumed.	*Element Cost*	**$74,492,563**
Sizing Assumptions	Two paddle type thermal dryers will be installed, no redundant standby unit is provided.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Thermal Drying Building						
	2 story building 120'x160' with partial basement (100'x100'). Space for 2 dryers on one level and electrical room, mechanical room, operations/control room on second floor. Building is assumed to use steel framing with precast concrete wall panels. Building footprint includes stairwells to the lower level where cake pumps and building sump are located and to the upper level where electrical room, etc. is located. Steel framed roof with membrane roofing system. Cake storage hoppers and odor treatment equipment are located outside building footprint.	19200	SF	$375		$7,200,000	$7,200,000
	Bridge crane in dryer area (5 ton) 100'x130'				$125,000	$50,000	$175,000
					SUBTOTAL ITEM 1		$7,375,000
2	Dewatered Cake Pumping System						
	Cake Storage Bin (trucks haul dewatered sludge from centrifuge facility to storage bin and discharge load into bin) - assume concrete, below grade bin	1	LS			$200,000	$200,000
	Dewatered sludge feed pumps with VFDs - progressive cavity pumps feed cake into dryer. 2 duty pumps and one redundant	3	EA	$100,000	$300,000	$150,000	$450,000
	Piping, Valves and Appurtenances	1	LS		$60,000	$120,000	$180,000
					SUBTOTAL ITEM 2		$830,000
3	Thermal Drying System						
	Thermal dryer package - Paddle dryer based on proposal from Komline-Sanderson. 2 duty units. All units need to be installed in Phase 1 to meet capacity and redundancy criteria.	1	LS	$7,400,000	$7,400,000	$3,700,000	$11,100,000
	Dried sludge transfer conveyor system (assume helical screw conveyors rather than pneumatic system)						
	Each conveyor is 24" Ø x 200' long to storage hoppers at truck loading bay. One conveyor per dryer.	400	LF	$2,500	$1,000,000	$500,000	$1,500,000
	Pneumatic slide gates at discharge points	2	EA	$20,000	$40,000	$50,000	$90,000
	Estimated cost does not include additional equipment req'd to pelletize material with added cost				SUBTOTAL ITEM 3		$12,690,000
4	HVAC Systems						
	Foul air ventilation fans and ducting system - assume 3 centrifugal fans with FRP ducting	1	LS	$225,000	$225,000	$112,500	$337,500
	Fresh air ventilation and ducting system - supply and exhaust systems for building. Assume 2 supply fans and 2 exhaust fans	2	LS	$75,000	$150,000	$75,000	$225,000
	HVAC system for occupied spaces (heating/cooling)	1	LS	$50,000	$50,000	$30,000	$80,000
	HVAC system electrical room	1	LS	$30,000	$30,000	$18,000	$48,000
					SUBTOTAL ITEM 4		$690,500
5	Dried Sludge Storage & Load-Out						
	Truck weight scale package	1	EA		$75,000	$60,000	$135,000
	Truck loading bay 75' long x 45' high x 25' wide, dried sludge storage/load-out hopper system includes 2 hoppers with pneumatic slide gates at discharge point, short conveyor to distribute loads within the dump truck, structural steel supporting framework, pre-cast concrete wall panels on ground level walls (3 sides, 4th side is the building)	1	LS		$835,000	$417,500	$1,252,500
					SUBTOTAL ITEM 5		$1,387,500

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Thermal Drying Facility - PMP**
		BCE Alt	**Base Case, 1**
Estimate By	Humm, McKelvey, Goodburn (QC)	*Date*	Nov-14
Element Cost	**$74,492,563**		
Estimate Assumptions	No escalation (will be accounted for in BCE). Belt type dryer is assumed.		
Sizing Assumptions	Two paddle type thermal dryers will be installed, no redundant standby unit is provided.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
6	Odor Control - Bio Scrubbers & Carbon Vessel	1	LS		$600,000	$300,000	$900,000
7	Steam Conveyance from Cogen Facility next to Bldg 40 to Thermal Facility on Site A						
	Insulated 10" steam pipeline. Assume high pressure steel pipe with	3000	LF	$400		$1,200,000	$1,200,000
	Add for Zanker Road crossing	1	LS	$30,000		$30,000	$30,000
					SUBTOTAL ITEM 7		$1,230,000
8	Miscellaneous Allowances						
	Miscellaneous piping systems, valving, etc. within building	1	LS	$1,000,000			$1,000,000
	Site civil - pavement, grading, landscaping, parking areas, stormv	1	LS	$800,000			$800,000
	Relocation of existing buried utilities, resolution of conflicts with existing structures, etc.	1	LS	$100,000			$100,000
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. from remote locations to this facility	1	LS	$300,000			$300,000
	Electrical and I&C	18	percent				$4,910,000
					SUBTOTAL ITEM 8		$7,110,000
						MODULE SUBTOTAL	**$32,213,000**
	Contractor mark-ups						
	General Conditions	8	percent				$2,577,040
	Bonds & Insurances	2	percent				$644,260
	Overhead & Profit	15	percent				$4,831,950
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$40,266,250**
	Project Adjustments						
	Estimate Contingency	30	percent				$12,079,875
	Scope Contingency	25	percent				$10,066,563
	Engineering, Legal, and Administrative	30	percent				$12,079,875
						TOTAL ESTIMATED COST FOR MODULE	**$74,492,563**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Thermal Drying Facility - Sized for Waste Heat**
		BCE Alt	**2**
Estimate By	Humm, McKelvey, Goodburn (QC)	*Date*	Nov-14
		Element Cost	**$40,646,813**
Estimate Assumptions	No escalation (will be accounted for in BCE).		
Sizing Assumptions	Two paddle dryer will be installed, sizing and capacity match the available heat produced by the cogen facility.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Thermal Drying Building						
	2 story building 110'x105' with partial basement (100'x100'), space for 2 dryers. Includes electrical room and mechanical room, operations/control room on second floor. Building uses steel framing with precast concrete panels. Building footprint includes stairwells to lower level where cake pumps and building sump are located and stairwell to upper level where electrical room, etc. are located. Steel framed roof with membrane roofing system. Cake unloading station (from dump trucks) and odor treatment equipment are located outside building footprint.	11600	SF	$375		$4,350,000	$4,350,000
	Bridge crane in dryer area (5 ton) 75'x100'				$60,000	$30,000	$90,000
					SUBTOTAL ITEM 1		$4,440,000
2	Dewatered Cake Pumping System						
	Cake Storage Bin (trucks haul dewatered sludge from centrifuge facility to storage bin and discharge load into bin) - assume concrete, below grade bin	1	LS			$200,000	$200,000
	Dewatered sludge feed pumps with VFDs - progressive cavity pumps feed cake into dryer. 2 duty pumps and one redundant standby pump pull from storage bin and pump into dryer.	3	EA	$100,000	$300,000	$150,000	$450,000
	Piping, Valves and Appurtenances	1	LS		$60,000	$120,000	$180,000
					SUBTOTAL ITEM 2		$830,000
3	Thermal Drying System						
	Thermal dryer package - Belt dryer based on proposal from Komline Sanderson	1	LS	$3,500,000	$3,500,000	$1,750,000	$5,250,000
	Dried sludge transfer conveyor - 100-ft long helical screw conveyor	100	LF	$1,800	$180,000	$90,000	$270,000
	Pneumatic slide gates at discharge point	1	EA	$20,000	$20,000	$25,000	$45,000
					SUBTOTAL ITEM 3		$5,565,000
4	HVAC Systems						
	Foul air ventilation fans and ducting system - assume 3 centrifugal fans with FRP ducting	1	LS	$150,000	$150,000	$75,000	$225,000
	Fresh air ventilation and ducting system - supply and exhaust systems for building. Assume 2 supply fans and 2 exhaust fans	2	LS	$40,000	$80,000	$40,000	$120,000
	HVAC system for occupied spaces (heating/cooling)	1	LS	$20,000	$20,000	$12,000	$32,000
	HVAC system electrical room	1	LS	$25,000	$25,000	$15,000	$40,000
					SUBTOTAL ITEM 4		$417,000
5	Dried Sludge Storage & Load-Out						
	Truck weight scale package	1	EA		$75,000	$60,000	$135,000
	Dried Sludge storage/load-out hoppers (2) - total "system" cost	1	LS	$500,000	$500,000	$250,000	$750,000
					SUBTOTAL ITEM 5		$885,000
6	Odor Control - Bio Scrubbers & Carbon Vessel	1	LS		$200,000	$50,000	$250,000
7	Steam Conveyance from Cogen Facility next to Bldg 40 to Thermal Facility on Site A						
	Insulated 10" steam pipeline. Assume high pressure steel pipe with	3000	LF	$400		$1,200,000	$1,200,000
	Add for Zanker Road crossing	1	LS	$30,000		$30,000	$30,000
					SUBTOTAL ITEM 7		$1,230,000

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Thermal Drying Facility - Sized for Waste Heat**
		BCE Alt	**2**
Estimate By	Humm, McKelvey, Goodburn (QC)	*Date*	Nov-14
Element Cost	**$40,646,813**		
Estimate Assumptions	No escalation (will be accounted for in BCE).		
Sizing Assumptions	Two paddle dryer will be installed, sizing and capacity match the available heat produced by the cogen facility.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
8	Miscellaneous Allowances						
	Miscellaneous piping systems, valving, etc. within building	1	LS	$300,000			$300,000
	Site civil - pavement, grading, landscaping, parking areas, stormwater drainage, etc.	1	LS	$600,000			$600,000
	Relocation of existing buried utilities, resolution of conflicts with existing structures, etc.	1	LS	$80,000			$80,000
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. from remote locations to this facility	1	LS	$300,000			$300,000
	Electrical and I&C	18	percent				$2,680,000
						SUBTOTAL ITEM 8	$3,960,000
						MODULE SUBTOTAL	**$17,577,000**
	Contractor mark-ups						
	General Conditions	8	percent				$1,406,160
	Bonds & Insurances	2	percent				$351,540
	Overhead & Profit	15	percent				$2,636,550
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$21,971,250**
	Project Adjustments						
	Estimate Contingency	30	percent				$6,591,375
	Scope Contingency	25	percent				$5,492,813
	Engineering, Legal, and Administrative	30	percent				$6,591,375
						TOTAL ESTIMATED COST FOR MODULE	**$40,646,813**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Solar Drying Facility - Phase 1**
		BCE Alt	**Base Case, 1, 2**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
Estimate Assumptions	No escalation (will be accounted for in BCE)	*Element Cost*	**$22,437,382**
Sizing Assumptions	Base size of Phase 1 facility on receiving 10% of 2030 annual average biosolids production rate of 223,900 ppd.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Solar Drying Greenhouses						
	Grading and site preparation	2.5	Acres	$6,000		$15,152	$15,152
	Concrete slab, assume 12" thick with compacted subbase	417	CY	$600		$250,000	$250,000
	Concrete stem walls					$0	$0
	Footings - short dimension: 6 @ 5' wide by 250' long x 12"	278	CY	$600		$166,667	$166,667
	Footings - long dimension: 2 @ 5' wide by 225' long x 12"	83	CY	$600		$50,000	$50,000
	Stem walls - 6 @ 4' tall x 250' long by 12" deep	222	CY	$600		$133,333	$133,333
	Stem walls - 2 @ 4' tall x 225' long by 12" deep	67	CY	$600		$40,000	$40,000
	Greenhouses @ 45' wide by 250' long	5	EA	$675,000	$3,375,000	$1,012,500	$4,387,500
					SUBTOTAL ITEM 1		$5,042,652
2	Foul Air Collection and Treatment						
	Foul air ventilation fans and ducting system	1	LS		$250,000	$400,000	$650,000
	Odor Control - In-ground biofilter assumed	1	LS			$600,000	$600,000
					SUBTOTAL ITEM 2		$1,250,000
3	Miscellaneous Allowances						
	Site civil - pavement, grading, landscaping, parking areas, stormwat	1	LS	$750,000			$750,000
	Relocation of existing buried utilities, resolution of conflicts with existing structures, etc.	1	LS	$50,000			$50,000
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. from remote locations to this facility	1	LS	$1,000,000			$1,000,000
	Mobile equipment (front end loaders)	1		$150,000			$150,000
	Electrical and I&C	18	percent				$1,460,000
					SUBTOTAL ITEM 3		$3,410,000
						MODULE SUBTOTAL	**$9,702,652**
	Contractor mark-ups						
	General Conditions	8	percent				$776,212
	Bonds & Insurances	2	percent				$194,053
	Overhead & Profit	15	percent				$1,455,398
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$12,128,314**
	Project Adjustments						
	Estimate Contingency	30	percent				$3,638,494
	Scope Contingency	25	percent				$3,032,079
	Engineering, Legal, and Administrative	30	percent				$3,638,494
						TOTAL ESTIMATED COST FOR MODULE	**$22,437,382**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Solar Drying Facility - Phase 2**
		BCE Alt	**Base Case, 1, 2**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
Element Cost	**$3,659,286**		
Estimate Assumptions	No escalation (will be accounted for in BCE)		
Sizing Assumptions	10% of 2040 annual average biosolids production (221,000 ppd) goes to solar dryers. This represents an increase of 2000 ppd over the 2030 loading to the solar dryers and requires less than one new greenhouse. However, assume one new greenhouse is added. Costs shown for this Phase 2 represent only the added cost to incrementally expand by one new greenhouse.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Solar Drying Greenhouses						
	Grading and site preparation	0.3	Acres	$6,000		$1,894	$1,894
	Concrete slab, assume 12" thick with compacted subbase	417	CY	$600		$250,000	$250,000
	Concrete stem walls						
	Footings - short dimension: 2 @ 5' wide by 45' long x 12"	17	CY	$600		$10,000	$10,000
	Footings - long dimension: 2 @ 5' wide by 225' long x 12"	42	CY	$600		$25,000	$25,000
	Stem walls - 2 @ 4' tall x 45' long by 12" deep	13	CY	$600		$8,000	$8,000
	Stem walls - 1 @ 4' tall x 225' long by 12" deep	33	CY	$600		$20,000	$20,000
	Greenhouses @ 45' wide by 250' long	1	EA	$675,000	$675,000	$202,500	$877,500
					SUBTOTAL ITEM 1		$1,192,394
2	Foul Air Collection and Treatment						
	Add one foul air fans and extend ducting to biofilter	1	LS		$40,000	$5,000	$45,000
	Odor Control - assume biofilter is sized for the additional dryer	0	LS				$0
					SUBTOTAL ITEM 2		$45,000
3	Miscellaneous Allowances						
	Site civil - pavement, grading, landscaping, parking areas, stormwat	1	LS			$50,000	$50,000
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. from remote locations to this facility	1	LS	$15,000			$15,000
	Mobile equipment (front end loaders)	1		$150,000			$150,000
	Electrical and I&C	10	percent				$130,000
					SUBTOTAL ITEM 3		$345,000
						MODULE SUBTOTAL	**$1,582,394**
	Contractor mark-ups						
	General Conditions	8	percent				$126,592
	Bonds & Insurances	2	percent				$31,648
	Overhead & Profit	15	percent				$237,359
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$1,977,992**
	Project Adjustments						
	Estimate Contingency	30	percent				$593,398
	Scope Contingency	25	percent				$494,498
	Engineering, Legal, and Administrative	30	percent				$593,398
						TOTAL ESTIMATED COST FOR MODULE	**$3,659,286**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Batch Tanks**		
		BCE Alt	**Alt 3 (sensitivities)**		
Estimate By		*Date*	Nov-14	*Element Cost*	**$11,447,629**

Estimate Assumptions Estimate is taken directly from the digester design project (SO#4), cost mark-ups are applied as used for all BCE modules.

Sizing Assumptions 2040 peak biosolids production rate with one batch tank of service.

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
	Demolition						
	Dedicated Digester Feed Piping						
	Concrete Fixed Cover						
	Mixers						
	Electrical and Instrumentation						
	Digester Overflow						
	Digester Sludge Recirculation Pumps						
	New Electrical Building						
	Thickened Sludge EQ Tanks & Feed System						
	Building 40 Independent Loop						
	Digester Loop PS @ DAFT						
	Modifications to SBB						
	New Heat Exchangers						
	Revised Existing 2 pipe system						
	Batch Tanks						$4,950,326
	New Cooling PS and Effuent Piping Dig 9 -16						
	New Digester Heating System Dig 5 - 8						
	One-Pipe Heat Loop Dig 5 & 6						
	Revise existing digesters 9-16						
	Strainpress Addition						
	Thermophilic Digester						
						MODULE SUBTOTAL	**$4,950,326**
	Contractor mark-ups						
	General Conditions	8	percent				$396,026
	Bonds & Insurances	2	percent				$99,007
	Overhead & Profit	15	percent				$742,549
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$6,187,908**
	Project Adjustments						
	Estimate Contingency	30	percent				$1,856,372
	Scope Contingency	25	percent				$1,546,977
	Engineering, Legal, and Administrative	30	percent				$1,856,372
						TOTAL ESTIMATED COST FOR MODULE	**$11,447,629**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Pumping and Conveyance**
		BCE Alt	**All**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
		Element Cost	**$6,650,750**
Estimate Assumptions	This module is for conveyance costs associated with pumping digested sludge to storage (converted existing digesters) and dewatering at Site A. It also includes conveyance of centrate from the dewatering facility to the existing PEPS. Escalation will be accounted for in the BCE.		
Sizing Assumptions	Conveyance must have capacity for peak flow at Year 2040.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Digested sludge pumping and conveyance to sludge storage - Existing Export PS currently pumps sludge to the storage lagoons. The existing force main (EDS -[Export Digested Sludge]) will be intercepted and new pipe will be added to route digested sludge to the new storage tanks which are converted digesters. Also, a connection is made to the force main at Zanker Road and a new pipe is installed to the dewatering facility at Site A.						
	Connections to existing EDS pipeline located near existing Export Pump Station and at Zanker Rd.	3	LS	$7,000		$21,000	$21,000
	New 14" EDS pipe to storage facility (converted digesters in group 9	1200	LF	$275		$330,000	$330,000
	Extend 14" FM from Zanker Rd to new dewatering at Site A	2400	LF	$275		$660,000	$660,000
	Misc fitting and valves	1	LS	$110,000		$110,000	$110,000
	Adder for Zanker Road crossing (digested sludge and centrate)	1	LS	$20,000		$20,000	$20,000
	Misc cost to cover shutdown, drain contents of pipe, etc.	1	LS	$22,500		$22,500	$22,500
					SUBTOTAL ITEM 1		$1,163,500
2	Centrate pumping and conveyance from the dewatering facility to the existing PEPS. Although a connection can probably be made somewhere within the vicinity of the existing aeration basins, assume a line needs to be installed all the way to the PEPS.						
	Cost for centrate pump station is part of cost for dewatering facility						
	12" Conveyance pipeline Site A to Primary Effluent Pump Station	4100	LF	$250		$1,025,000	$1,025,000
	Misc fitting and valves	1	LS	$117,500		$117,500	$117,500
	Relocation of existing buried utilities, resolution of conflicts with existing structures and utilities, etc.	1	LS	$102,500			$102,500
	Add for tie-in to existing system	1	LS	$15,000			$15,000
					SUBTOTAL ITEM 2		$1,260,000
3	Power Feed to New Facilities - route power to the new dewatering						
	Ductbank from unknown location within the WWTP to Site A	2500	LF	$125		$312,500	$312,500
	Add for transformer	1	LS	$75,000		$75,000	$75,000
					SUBTOTAL ITEM 3		$387,500
6	Miscellaneous Allowances						
	Asphalt replacement	1	LS	$65,000			$65,000
						MODULE SUBTOTAL	**$2,876,000**
	Contractor mark-ups						
	General Conditions	8	percent				$230,080
	Bonds & Insurances	2	percent				$57,520
	Overhead & Profit	15	percent				$431,400
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$3,595,000**
	Project Adjustments						
	Estimate Contingency	30	percent				$1,078,500
	Scope Contingency	25	percent				$898,750
	Engineering, Legal, and Administrative	30	percent				$1,078,500
						TOTAL ESTIMATED COST FOR MODULE	**$6,650,750**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Blending Facility**
		BCE Alt	**2**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
Element Cost	**$11,416,042**		
Estimate Assumptions	No escalation (will be accounted for in BCE)		
Sizing Assumptions	The recipe for blended biosolids is: 22 wet tons per day of dewatered sludge at 25% TS is blended with 23 dry tons per day of dried sludge at 90% TS to produce 48 wet tons per day of blended product at 60% TS. Assume this is accomplished in a batch process, once every 4 days. Thus, the facility needs to store 4 days worth of cake and dried sludge, plus 4 days worth of blended product.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Site Development and Features						
	Grading and site preparation	3	ACRES	$7,000		$21,000	$21,000
	Feedstock Storage and Mixing Area						
	Dewatered biosolids are stored in a concrete bunker, dried biosolids are stored in a silo. Mixing is accomplished in a batch process with a pug mill. Dewatered biosolids are moved from the bunker to the pug mill with front-end odors. A pre-engineered metal building is assumed for odor and dust control.						
	Column Footings - assume columns at 25' spacing (9 per side). Assume 6'x6' footings, 20" deep. Approx 2.5 cy per footing. Assume 12" deep compacted agg base material. Unit cost shown covers excavation, place and compact agg base material, rebar, setting column anchor bolts and placing concrete.	18	EA	$3,500		$63,000	$63,000
	Concrete slab, assume 12" thick with compacted subbase	1,111	CY	$600		$666,667	$666,667
	Abrasive wear surfacing material on vehicle traffic areas with high volume and loading	30,000	SF	$35		$1,050,000	$1,050,000
	Pre-engineered metal building 200' x 150'	30,000	SF	$10.00	$300,000	$195,000	$495,000
	Concrete feedstock bunker for dewatered cake, 30' wide x 20' deep x 10' tall	1	EA	$15,000		$15,000	$45,000
	Pug Mill w/ truck loading and conveyors				$500,000	$400,000	$900,000
	Truck scale	1	EA		$35,000	$21,000	$56,000
	Roadways and parking	1	LS	$400,000		$400,000	$400,000
	Stormwater collection and conveyance system	1	LS	$50,000		$50,000	$50,000
	Stormwater treatment	1	LS	$30,000		$30,000	$30,000
					SUBTOTAL ITEM 1		$3,776,667
2	Miscellaneous Allowances						
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. to and from remote locations to this facility	1	LS				$150,000
	Mobile equipment (front-end loaders)	2		$150,000			$300,000
	Electrical and I&C	18	percent				$710,000
					SUBTOTAL ITEM 2		$1,160,000
						MODULE SUBTOTAL	**$4,936,667**
	Contractor mark-ups						
	General Conditions	8	percent				$394,933
	Bonds & Insurances	2	percent				$98,733
	Overhead & Profit	15	percent				$740,500
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$6,170,833**
	Project Adjustments						
	Estimate Contingency	30	percent				$1,851,250
	Scope Contingency	25	percent				$1,542,708
	Engineering, Legal, and Administrative	30	percent				$1,851,250
						TOTAL ESTIMATED COST FOR MODULE	**$11,416,042**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Soil Manufacturing Facility - Phase 1**
		BCE Alt	**3 (sensitivities)**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
Estimate Assumptions	No escalation (will be accounted for in BCE)	*Element Cost*	**$20,414,056**
Sizing Assumptions	30% of 2030 annual average biosolids production (201,000 ppd) goes to SMF, i.e., 11,000 DTPY. Scale up size of SMF facility based on size of Tacoma WA TAGRO facility (4000 DTPY).		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Site Development and Features						
	Grading and site preparation	14.6	ACRES	$7,000		$102,200	$102,200
	Feedstock Storage and Mixing Area						
	DESCRIPTION: Feedstock is stored in concrete bunkers, mixing is accomplished with front end loaders on a concrete slab on grade. Mixing area is covered with a metal pre-engineered building with open ends. Concrete walls are on either side of the mixing area. The total footprint of the mixing area is 43,800 sf by scaling up from TAGRO facility. This represents a building that is about 150'x300'.						
	Column Footings - assume columns at 25' spacing (13 per side). Assume 6'x6' footings, 20" deep. Approx 2.5 cy per footing. Assume 12" deep compacted agg base material. Unit cost shown covers excavation, place and compact agg base material, rebar, setting column anchor bolts and placing concrete.	26	EA	$3,500		$91,000	$91,000
	Concrete slab, assume 12" thick with compacted subbase	2,257	CY	$600		$1,354,167	$1,354,167
	Abrasive wear surfacing material on mixing area and on vehicle traffic areas with high volume and loading	0	SF	$35		$0	$0
	Pre-engineered metal building	45,000	SF	$20.00		$900,000	$900,000
	Concrete perimeter walls						
	Footing (18" thick)	200	CY	$500		$100,000	$100,000
	Perimeter walls (8 feet high, 12" thick)	178	CY	$750		$133,333	$133,333
	Feedstock bunkers (2 each for sand and sawdust, concrete)	4	EA	$15,000		$60,000	$60,000
	Product Stockpile Area - assumed asphalt pavement, uncovered	100,000	SF	$10.00		$1,000,000	$1,000,000
	Specialty product mixing and storage area (covered)						
	Asphalt pad	60,000	SF	$10.00		$600,000	$600,000
	Fabric covering w/structural supports	40,000	SF	$20.00		$800,000	$800,000
	Operations Building	2500	SF	$350		$875,000	$875,000
	Truck scale	2	EA		$70,000	$42,000	$112,000
	Roadways and parking	1	LS	$500,000		$500,000	$500,000
	Stormwater collection and conveyance system	1	LS	$500,000		$500,000	$500,000
	Stormwater treatment	1	LS	$100,000		$100,000	$100,000
					SUBTOTAL ITEM 1		$7,227,700
2	Miscellaneous Allowances						
	Supporting infrastructure - routing electrical, drainage, piping for support systems, etc. to and from remote locations to this facility	1	LS				$0
	Mobile equipment (front-end loaders)	2		$150,000			$300,000
	Electrical and I&C	18	percent				$1,300,000
					SUBTOTAL ITEM 2		$1,600,000
						MODULE SUBTOTAL	**$8,827,700**
	Contractor mark-ups						
	General Conditions	8	percent				$706,216
	Bonds & Insurances	2	percent				$176,554
	Overhead & Profit	15	percent				$1,324,155
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$11,034,625**
	Project Adjustments						
	Estimate Contingency	30	percent				$3,310,388
	Scope Contingency	25	percent				$2,758,656
	Engineering, Legal, and Administrative	30	percent				$3,310,388
						TOTAL ESTIMATED COST FOR MODULE	**$20,414,056**

Capital Cost Estimate for Biosolids Element

Class 5 Level

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Element Name*	**Soil Manufacturing Facility - Phase 2**
		BCE Alt	**3 (sensitivities)**
Estimate By	Humm, Goodburn (QC)	*Date*	Nov-14
Element Cost	**$1,246,206**		
Estimate Assumptions	No escalation (will be accounted for in BCE)		
Sizing Assumptions	30% of 2040 annual average biosolids production (221,000 ppd) goes to SMF, i.e., 12,100 DTPY. This is an increase in production of 10% and is about 3x larger than the Tacoma TAGRO facility. Costs shown are only the incremental cost to expand the soil manufacturing facility that was constructed under Phase 1; the stormwater treatment facility does not need expansion.		

#	Scope Item Description	Value	Units	Unit Cost	Equipment Cost	Installation or Construction Cost	Total
1	Site Development and Features						
	Grading and site preparation	2	ACRES	$6,000		$12,000	$12,000
2	Feedstock Storage and Mixing Area						
	DESCRIPTION OF EXPANSION: Feedstock bunkers are increased in size by 50%. The mixing area is expanded and the pre-engineered metal building is enlarged by one column bay (about 8000 square feet) such that the total footprint of the mixing area is 48,000 sf.						
	Column Footings - assume one additional column at 25' spacing are needed on each side of the building. Assume 6'x6' footings, 20" deep as before. Approx 2.5 cy per footing. Assume 12" deep compacted agg base material. Unit cost shown covers excavation, place and compact agg base material, rebar, setting column anchor bolts and placing concrete.	2	EA	$3,500		$7,000	$7,000
	Concrete slab, assume 12" thick with compacted subbase	139	CY	$600		$83,300	$83,300
	Abrasive wear surfacing material on mixing area and on vehicle traffic areas with high volume and loading	0	SF	$35		$0	$0
	Expansion of pre-engineered metal building						
	Building cost (unit price increases over Phase 1)	4,000	SF	$22.00		$88,000	$88,000
	Adder for connection to existing structure	1	LS	$40,000		$40,000	$40,000
	Extend concrete perimeter walls						
	Footing (18" thick)	20	CY	$500		$10,000	$10,000
	Perimeter walls (8 feet high, 12" thick)	18	CY	$750		$13,300	$13,300
	Feedstock bunkers (2 each for sand and sawdust, bunkers are cast-in-place concrete)	2	EA	$10,000		$20,000	$20,000
	Expand Product Stockpile Area (asphalt pavement, uncovered)	5,000	SF	$10.00		$50,000	$50,000
	Expand specialty product mixing and storage area (covered)						
	Asphalt pad	3,000	SF	$10.00		$30,000	$30,000
	Fabric covering w/structural supports	3,000	SF	$25.00		$75,000	$75,000
	Roadways and parking (assume no additional roadwork and parking is	0	LS			$0	$0
	Extend stormwater collection and conveyance system	1	LS	$40,000		$40,000	$40,000
					SUBTOTAL ITEM 2		$456,600
3	Miscellaneous Allowances						
	Electrical and I&C (assume lower percentage due to loads being pri	15	percent				$70,300
						MODULE SUBTOTAL	**$538,900**
	Contractor mark-ups						
	General Conditions	8	percent				$43,112
	Bonds & Insurances	2	percent				$10,778
	Overhead & Profit	15	percent				$80,835
						SUBTOTAL W/CONTRACTOR MARK-UPS	**$673,625**
	Project Adjustments						
	Estimate Contingency	30	percent				$202,088
	Scope Contingency	25	percent				$168,406
	Engineering, Legal, and Administrative	30	percent				$202,088
						TOTAL ESTIMATED COST FOR MODULE	**$1,246,206**

Attachment B: Estimated O&M Costs for Potential Biosolids Program Elements

BCE Process O&M Cost Estimate

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Process Name*	**Mesophillic Digestion**
Estimate By	**Simon Watson, Ken Schnaars, Ian McKelvey**	*Date*	
Estimate Assumptions	Information on labor and maintenance is obtained from TM from SO4	*Annual Cost*	**$4,060,494**
Sizing Assumptions		*BCE Alt*	**Base Case**

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]	6.5	FTE/yr	$154,000	$1,001,000
2	Energy				
	Electricity	16,600,200	kW-hr/yr	$0.13	$2,158,026
	Natural Gas (due to less digester gas than TPAD and more solids to dry)	481,800	therms/yr	$0.46	$221,628
	Diesel Fuel	0	gal/yr	$4.00	$0
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
				SUBTOTAL OPERATIONAL COSTS	**$3,380,654**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.45	FTE/yr	$154,000	$69,300
	Electrical/Instrumentation	0.35	FTE/yr	$154,000	$53,900
2	Materials				
	Assumed 0.8% of M/E Capital cost ($7.1M)				$56,640
3	Annual Vendor Services				
	Digester cleaning and valve replacements				$500,000
				SUBTOTAL MAINTENANCE COSTS	**$679,840**
				TOTAL ESTIMATED ANNUAL O&M COST	**$4,060,494**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	None		
		TOTAL ESTIMATED RENEWAL COST	**$0**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays. (1,800hrs)

BCE Process O&M Cost Estimate

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Process Name*	**TPAD**
Estimate By	**Simon Watson, Ken Schnaars, Ian McKelvey**	*Date*	
Estimate Assumptions	Information on labor and maintenance is obtained from TM from SO4	*Annual Cost*	**$3,995,185**
Sizing Assumptions		*BCE Alt*	**1, 2, 3**

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]	6.5	FTE/yr	$154,000	$1,001,000
2	Energy				
	Electricity	17,555,040	kW-hr/yr	$0.13	$2,282,155
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	0	gal/yr	$4.00	$0
3	Chemical				
	Polymer (additional needed by centrifuges compared to meso. digestion)	13194	lb/yr	$1.70	$22,430
				SUBTOTAL OPERATIONAL COSTS	**$3,305,585**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.45	FTE/yr	$154,000	$69,300
	Electrical/Instrumentation	0.35	FTE/yr	$154,000	$53,900
2	Materials				
	Assumed 0.8% of Est Capital cost ($8.3M)				$66,400
3	Annual Vendor Services				
	Digester cleaning and valve replacements				$500,000
				SUBTOTAL MAINTENANCE COSTS	**$689,600**
				TOTAL ESTIMATED ANNUAL O&M COST	**$3,995,185**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	None		
		TOTAL ESTIMATED RENEWAL COST	**$0**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays. (1,800hrs)

BCE Process O&M Cost Estimate

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Process Name*	**TPAD + Batch Tanks**
Estimate By	**Simon Watson, Ken Schnaars, Ian McKelvey**	*Date*	
Estimate Assumptions	Information on labor and maintenance is obtained from TM from SO4	*Annual Cost*	**$4,221,199**
Sizing Assumptions		*BCE Alt*	**3 (sensitivities)**

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]	7.1	FTE/yr	$154,000	$1,093,400
2	Energy				
	Electricity	18,693,840	kW-hr/yr	$0.13	$2,430,199
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	0	gal/yr	$4.00	$0
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
				SUBTOTAL OPERATIONAL COSTS	**$3,523,599**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.45	FTE/yr	$154,000	$69,300
	Electrical/Instrumentation	0.35	FTE/yr	$154,000	$53,900
2	Materials				
	Assumed 0.8% of Est Capital cost ($9.3M)				$74,400
3	Annual Vendor Services				
	Digester cleaning and valve replacements				$500,000
				SUBTOTAL MAINTENANCE COSTS	**$697,600**
				TOTAL ESTIMATED ANNUAL O&M COST	**$4,221,199**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	None		
		TOTAL ESTIMATED RENEWAL COST	**$0**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays. (1,800hrs)

BCE Process O&M Cost Estimate

Client Name	San Jose-Santa Clara Regional WW Facility	*Process Name*	Sludge Storage
Estimate By	Simon Watson, Ken Schnaars, Ian McKelvey	*Date*	
Estimate Assumptions		*Annual Cost*	$123,420
Sizing Assumptions		*BCE Alt*	All

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]	0.43	FTE/yr	$154,000	$66,220
2	Energy				
	Electricity	0	kW-hr/yr	$0.13	$0
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	0	gal/yr	$4.00	$0
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
				SUBTOTAL OPERATIONAL COSTS	**$66,220**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.1	FTE/yr	$154,000	$15,400
	Electrical/Instrumentation	0.2	FTE/yr	$154,000	$30,800
2	Materials				
	Assumed 1% of M/E Capital cost ($1.1M)				$11,000
				SUBTOTAL MAINTENANCE COSTS	**$57,200**
				TOTAL ESTIMATED ANNUAL O&M COST	**$123,420**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	Major overhaul (6% of M/E capital)	5	$66,000
		TOTAL ESTIMATED RENEWAL COST	**$66,000**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays. (1,800hrs)

BCE Process O&M Cost Estimate

Client Name	San Jose-Santa Clara Regional WW Facility	*Process Name*	Pumping and Conveyance
Estimate By	Simon Watson, Ken Schnaars, Ian McKelvey	*Date*	
Estimate Assumptions	Limited to piping; pumping already operated by plant	*Annual Cost*	$238,500
Sizing Assumptions		*BCE Alt*	All

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]	0.05	FTE/yr	$154,000	$7,700
2	Energy				
	Electricity	0	kW-hr/yr	$0.13	$0
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	0	gal/yr	$4.00	$0
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
				SUBTOTAL OPERATIONAL COSTS	**$7,700**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.2	FTE/yr	$154,000	$30,800
	Electrical/Instrumentation		FTE/yr	$154,000	$0
2	Materials				
	None				$0
3	Annual Vendor Services				
	Struvite Removal (LS)				$200,000
				SUBTOTAL MAINTENANCE COSTS	**$230,800**
				TOTAL ESTIMATED ANNUAL O&M COST	**$238,500**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	None		$0
		TOTAL ESTIMATED RENEWAL COST	**$0**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays.

BCE Process O&M Cost Estimate

Client Name	San Jose-Santa Clara Regional WW Facility	*Process Name*	Centrifuge Dewatering
Estimate By	Simon Watson, Ken Schnaars, Ian McKelvey	*Date*	
Estimate Assumptions		*Annual Cost*	$2,481,510
Sizing Assumptions		*BCE Alt*	All

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]	4.3	FTE/yr	$154,000	$654,500
	Assumes 1 person per shift; 3 shifts per day; 5 days per week				
2	Energy				
	Electricity	1,638,120	kW-hr/yr	$0.13	$212,956
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	0	gal/yr	$4.00	$0
3	Chemical				
	Polymer (Mesophilic digestion; see TPAD costs for addtl polymer costs)	643,032	lb/yr	$1.70	$1,093,154
				SUBTOTAL OPERATIONAL COSTS	**$1,960,610**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.6	FTE/yr	$154,000	$92,400
	Electrical/Instrumentation	0.25	FTE/yr	$154,000	$38,500
2	Materials				
	None (covered by vendor services below)				
3	Annual Vendor Services				
	Vendor Preventive Maintenance (4 units each year)	4	EA	$40,000	$160,000
	Odor Control Media		LS		$100,000
	Bowl and Scroll Maintenance (Assume 2 per year at $40,000 per centrifuge)	2	EA	$80,000	$80,000
	Phase 2 additional vendor services				$50,000
				SUBTOTAL MAINTENANCE COSTS	**$520,900**
				TOTAL ESTIMATED ANNUAL O&M COST	**$2,481,510**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	Major overhaul (6% of centrifuge capital costs=$4.3M)	10	$258,000
	Phase 2 Major Overhaul (6% of centrifuge capital cost = $1.1M)	10	$65,000
	Major overhaul odor control (4% of odor control = $1.5M)	10	$60,000
	Mechanical Equipment replacement	20	$24,600,000
		TOTAL ESTIMATED RENEWAL COST	**$24,983,000**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays (1,800).

BCE Process O&M Cost Estimate

Client Name	San Jose-Santa Clara Regional WW Facility	*Process Name*	Thermal Dryer - PMP
Estimate By	Simon Watson, Ken Schnaars, Ian McKelvey	*Date*	
Estimate Assumptions		*Annual Cost*	$2,417,789
Sizing Assumptions		*BCE Alt*	Base Case, 1

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]				
	Operator (1.5 persons per shift; 3 shifts per day; 5 days per week)	5.2	FTE/yr	$154,000	$800,800
	Laborer (2; 1 shift per day; 5 shifts per week)	2.3	FTE/yr	$115,500	$266,933
2	Energy				
	Electricity	3,626,640	kW-hr/yr	$0.13	$471,463
	Natural Gas (assumes TPAD, additional gas for meso. dig. is in meso O&M)	175,200	therms/yr	$0.46	$80,592
	Diesel Fuel	0	gal/yr	$4.00	$0
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
				SUBTOTAL OPERATIONAL COSTS	**$1,619,789**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	2	FTE/yr	$154,000	$308,000
	Electrical/Instrumentation	1	FTE/yr	$154,000	$154,000
2	Materials				
	Assumed 1% of M/E Capital cost ($23.6M)				$236,000
3	Annual Vendor Services				
	Odor Control Media				$100,000
				SUBTOTAL MAINTENANCE COSTS	**$798,000**
				TOTAL ESTIMATED ANNUAL O&M COST	**$2,417,789**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	Major overhaul (6% of Dryer Capital Costs = $12.7m)	10	$762,000
	Major overhaul odor treatment (4% of Capital Cost = $0.9M)	10	$36,000
	Mechanical equipment replacement	20	$38,200,000
		TOTAL ESTIMATED RENEWAL COST	**$38,998,000**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays.

BCE Process O&M Cost Estimate

Client Name	San Jose-Santa Clara Regional WW Facility	*Process Name*	Thermal Dryer - Sized for Waste Heat
Estimate By	Simon Watson, Ken Schnaars, Ian McKelvey	*Date*	
Estimate Assumptions		*Annual Cost*	$2,173,197
Sizing Assumptions		*BCE Alt*	2

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]				
	Operator (1.5 persons per shift; 3 shifts per day; 5 days per week)	5.2	FTE/yr	$154,000	$800,800
	Laborer (2; 1 shift per day; 5 shifts per week)	2.3	FTE/yr	$115,500	$266,933
2	Energy				
	Electricity	3,626,640	kW-hr/yr	$0.13	$471,463
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	0	gal/yr	$4.00	$0
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
4	Other				
	Other item				$0
				SUBTOTAL OPERATIONAL COSTS	**$1,539,197**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	2	FTE/yr	$154,000	$308,000
	Electrical/Instrumentation	1	FTE/yr	$154,000	$154,000
2	Materials				
	Assumed 1% of M/E Capital cost ($12.2M)				$122,000
3	Annual Vendor Services				
	Odor Control Media				$50,000
				SUBTOTAL MAINTENANCE COSTS	**$634,000**
				TOTAL ESTIMATED ANNUAL O&M COST	**$2,173,197**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	Major overhaul (6% of Dryer Capital Costs = $5.6M)	10	$336,000
	Major overhaul odor treatment (4% of Capital Cost = $0.3M)	10	$12,000
	Mechanical equipment replacement	20	$18,300,000
		TOTAL ESTIMATED RENEWAL COST	**$18,648,000**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays.

BCE Process O&M Cost Estimate

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Process Name*	**Solar Drying**
Estimate By	**Simon Watson, Ken Schnaars, Ian McKelvey**	*Date*	
Estimate Assumptions		*Annual Cost*	**$723,899**
Sizing Assumptions		*BCE Alt*	**Base Case, 1, 2**

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]				
	Operator	0	FTE/yr	$154,000	$0
	Laborer (1 person per shift;1 shift per day; 5 days per week)for hauling from dewatering to solar and spreading. Assumes hauling from solar in disposition cost	1.16	FTE/yr	$115,500	$133,467
2	Energy				
	Electricity	3,705,480	kW-hr/yr	$0.13	$481,712
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	3,000	gal/yr	$4.00	$12,000
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
				SUBTOTAL OPERATIONAL COSTS	**$627,179**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.1	FTE/yr	$154,000	$15,400
	Electrical/Instrumentation	0	FTE/yr	$154,000	$0
2	Materials				
	Assumed 0.5% of greenhouse capital cost ($4.4M)				$21,935
	Phase 2 (at 0.5% of capital cost=$0.9M)				$4,385
	Mobile equipment maintenance (per front end loader)				$25,000
3	Annual Vendor Services				
	Odor Control Media Changeout (Biofilter)				$30,000
				SUBTOTAL MAINTENANCE COSTS	**$96,720**
				TOTAL ESTIMATED ANNUAL O&M COST	**$723,899**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	Mobile equipment replacement (per front end loader)	7	$300,000
		TOTAL ESTIMATED RENEWAL COST	**$300,000**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays.

BCE Process O&M Cost Estimate

Client Name	San Jose-Santa Clara Regional WW Facility	*Process Name*	Soil Manufacturing
Estimate By	Simon Watson, Ken Schnaars, Ian McKelvey	*Date*	
Estimate Assumptions		*Annual Cost*	$940,200
Sizing Assumptions		*BCE Alt*	3 (sensitivities)

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]				
	Laborer/Sales (2; 1 shift per day; 5 days per week)	2.3	FTE/yr	$115,500	$266,933
	Laborer -- Mixing Operation (5; 1 shift per week)	1.2	FTE/yr	$115,500	$133,467
2	Energy				
	Electricity	0	kW-hr/yr	$0.13	$0
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	21,000	gal/yr	$4.00	$84,000
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
				SUBTOTAL OPERATIONAL COSTS	**$884,800**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.1	FTE/yr	$154,000	$15,400
	Laborer	0	FTE/yr	$154,000	$0
2	Materials				
	Mobile Equipment maintenance				$40,000
3	Annual Vendor Services				
	None				$0
				SUBTOTAL MAINTENANCE COSTS	**$55,400**
				TOTAL ESTIMATED ANNUAL O&M COST	**$940,200**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	Mobile equipment replacement	7	$700,000
	Topping slab replacement	10	$1,720,000
		TOTAL ESTIMATED RENEWAL COST	**$2,420,000**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays.

BCE Process O&M Cost Estimate

Client Name	San Jose-Santa Clara Regional WW Facility	*Process Name*	Belt Filter Press
Estimate By	Simon Watson, Ken Schnaars, Ian McKelvey	*Date*	
Estimate Assumptions		*Annual Cost*	$389,156
Sizing Assumptions		*BCE Alt*	3 (sensitivities)

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]	1.2	FTE/yr	$154,000	$177,956
	Assumes 1 person per shift; 1 shift per day; 5 days per week				
				SUBTOTAL OPERATIONAL COSTS	**$177,956**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.6	FTE/yr	$154,000	$92,400
	Electrical/Instrumentation	0.2	FTE/yr	$154,000	$30,800
2	Materials				
	1% of M/E Capital Cost ($5.8M)				$58,000
3	Annual Vendor Services				
	Odor control media (biofilter)				$30,000
				SUBTOTAL MAINTENANCE COSTS	**$211,200**
				TOTAL ESTIMATED ANNUAL O&M COST	**$389,156**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	Major overhaul (6% of M/E capital cost)	10	$290,000
		TOTAL ESTIMATED RENEWAL COST	**$290,000**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays.

BCE Process O&M Cost Estimate

Client Name	**San Jose-Santa Clara Regional WW Facility**	*Process Name*	**Blending**
Estimate By	**Simon Watson, Ken Schnaars, Ian McKelvey**	*Date*	
Estimate Assumptions		*Annual Cost*	**$253,667**
Sizing Assumptions		*BCE Alt*	**2**

#	Component	Quantity	Units	Avg Cost per Unit	Total
Operational Costs					
1	Labor [1]				
	Operator	0	FTE/yr	$154,000	$0
	Laborer	1.2	FTE/yr	$115,500	$133,467
2	Energy				
	Electricity	0	kW-hr/yr	$0.13	$0
	Natural Gas	0	therms/yr	$0.46	$0
	Diesel Fuel	8,000	gal/yr	$4.00	$32,000
3	Chemical				
	Polymer	0	lb/yr	$1.70	$0
				SUBTOTAL OPERATIONAL COSTS	**$165,467**
Maintenance Costs					
1	Labor [1]				
	Mechanic/Technician	0.3	FTE/yr	$154,000	$46,200
	Electrical/Instrumentation		FTE/yr	$154,000	$0
2	Materials				
	Assumed 1% of M/E capital cost ($1.7M)				$17,000
	Mobile equipment maintenance				$25,000
3	Annual Vendor Services				
	None				$0
				SUBTOTAL MAINTENANCE COSTS	**$88,200**
				TOTAL ESTIMATED ANNUAL O&M COST	**$253,667**

#	Component	Years Between Renewal	Cost
1	Vendor Services (Major Maintenance Activities and Renewals)		
	Pug mill replacement	20	$2,100,000
	Topping slab replacement	10	$850,000
	Mobile equipment replacement	7	$700,000
		TOTAL ESTIMATED RENEWAL COST	**$3,650,000**

Notes:

1 Estimated FTEs include consideration for operation and maintenance during vacation, sick, and holidays.

Attachment C: Present Value Cost Analysis and Sensitivity Cases

City of San Jose
Biosolids Processing
Life Cycle Alternatives Cost Analysis

		Results	Results	
Agency:	City of San Jose			
Project/Problem:	Biosolids Processing	Capital Cost	PVC	Alt. Rank
Base Case	PMP: Mesophilic Digestion	$230,000,000	$520,000,000	3
Alternative 1	PMP: TPAD	$250,000,000	$520,000,000	3
Alternative 2	Maximize Use of Newby Island Landfill	$220,000,000	$490,000,000	2
Alternative 3	TPAD and Dewatering Only	$140,000,000	$380,000,000	1

Year of analysis:	2014
Capital Cost Inflation:	3.1%
Natural Gas Inflation:	4.0%
Electricity Inflation:	2.5%
Diesel Inflation:	1.0%
O&M Inflation:	2.0%
Discount rate:	5.0%

Select one

- (●) All entries in dollars
- ( ) All entries in thousands of dollars

Disposition	Cost (per WT)	Biosolids Dryness	
ADC (Newby)	$23	60%	
Soil Amendment	$23	84%	This assumes thermal dry material is 90% dry and solar dry material is 75% dry
Land app (Class B)	$35	25%	
ADC (non-Newby)	$35	25%	
Compost	$51	25%	
Soil Manufacturing	($11)	25%	

Year	2020		2021		2022		2023		2024		2025		2026		2027		2028		2029		2030	
DTPD (Meso/TPAD)	98	92	99	93	100	93	101	94	102	95	103	96	104	97	105	98	106	99	107	100	108	101
	% of material	Cost	% of material	Cost	% of material	Cost	% of material	Cost	% of material	Cost	% of material	Cost	% of material	Cost	% of material	Cost	% of material	Cost	% of material	Cost	% of material	Cost
Base Case																						
ADC (Newby)	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Soil Amendment	0%	$0	0%	$0	0%	$0	0%	$0	30%	$304,459	30%	$307,444	30%	$310,428	30%	$313,413	30%	$316,398	30%	$319,383	30%	$322,368
Land app (Class B)	33%	$1,652,574	33%	$1,669,437	33%	$1,686,300	33%	$1,703,163	23%	$1,198,806	23%	$1,210,559	23%	$1,222,312	23%	$1,234,065	23%	$1,245,818	23%	$1,257,571	23%	$1,269,324
ADC (non-Newby)	33%	$1,652,574	33%	$1,669,437	33%	$1,686,300	33%	$1,703,163	23%	$1,198,806	23%	$1,210,559	23%	$1,222,312	23%	$1,234,065	23%	$1,245,818	23%	$1,257,571	23%	$1,269,324
Compost	33%	$2,408,036	33%	$2,432,608	33%	$2,457,180	33%	$2,481,752	23%	$1,746,832	23%	$1,763,957	23%	$1,781,083	23%	$1,798,209	23%	$1,815,335	23%	$1,832,461	23%	$1,849,586
Soil Manufacturing	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Sum	**99%**	**$5,713,184**	**99%**	**$5,771,482**	**99%**	**$5,829,780**	**99%**	**$5,888,078**	**99%**	**$4,448,902**	**99%**	**$4,492,519**	**99%**	**$4,536,136**	**99%**	**$4,579,752**	**99%**	**$4,623,369**	**99%**	**$4,666,986**	**99%**	**$4,710,602**
Alternative 1																						
ADC (Newby)	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Soil Amendment	0%	$0	0%	$0	0%	$0	0%	$0	30%	$283,564	30%	$286,549	30%	$289,534	30%	$292,519	30%	$294,012	30%	$296,996	30%	$299,981
Land app (Class B)	33%	$1,542,965	33%	$1,559,828	33%	$1,568,259	33%	$1,585,122	23%	$1,116,535	23%	$1,128,288	23%	$1,140,041	23%	$1,151,794	23%	$1,157,671	23%	$1,169,424	23%	$1,181,177
ADC (non-Newby)	33%	$1,542,965	33%	$1,559,828	33%	$1,568,259	33%	$1,585,122	23%	$1,116,535	23%	$1,128,288	23%	$1,140,041	23%	$1,151,794	23%	$1,157,671	23%	$1,169,424	23%	$1,181,177
Compost	33%	$2,248,320	33%	$2,272,892	33%	$2,285,177	33%	$2,309,749	23%	$1,626,951	23%	$1,644,077	23%	$1,661,203	23%	$1,678,328	23%	$1,686,891	23%	$1,704,017	23%	$1,721,143
Soil Manufacturing	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Sum	**99%**	**$5,334,249**	**99%**	**$5,392,547**	**99%**	**$5,421,695**	**99%**	**$5,479,993**	**99%**	**$4,143,585**	**99%**	**$4,187,202**	**99%**	**$4,230,819**	**99%**	**$4,274,436**	**99%**	**$4,296,244**	**99%**	**$4,339,861**	**99%**	**$4,383,477**
Alternative 2																						
ADC (Newby)	0%	$0	35%	$452,980	35%	$455,429	35%	$460,326	35%	$465,223	35%	$470,120	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Soil Amendment	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	28%	$270,232	28%	$273,018	27%	$264,610	27%	$267,297	27%	$269,983
Land app (Class B)	33%	$1,542,965	22%	$1,039,885	22%	$1,045,506	22%	$1,056,748	22%	$1,067,990	22%	$1,079,232	24%	$1,189,608	24%	$1,201,872	24%	$1,208,004	24%	$1,220,268	24%	$1,232,532
ADC (non-Newby)	33%	$1,542,965	22%	$1,039,885	22%	$1,045,506	22%	$1,056,748	22%	$1,067,990	22%	$1,079,232	24%	$1,189,608	24%	$1,201,872	24%	$1,208,004	24%	$1,220,268	24%	$1,232,532
Compost	33%	$2,248,320	22%	$1,515,261	22%	$1,523,452	22%	$1,539,833	22%	$1,556,214	22%	$1,572,595	24%	$1,733,429	24%	$1,751,299	24%	$1,760,234	24%	$1,778,105	24%	$1,795,975
Soil Manufacturing	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Sum	**99%**	**$5,334,249**	**101%**	**$4,048,011**	**101%**	**$4,069,892**	**101%**	**$4,113,655**	**101%**	**$4,157,417**	**101%**	**$4,201,179**	**100%**	**$4,382,877**	**100%**	**$4,428,061**	**99%**	**$4,440,853**	**99%**	**$4,485,938**	**99%**	**$4,531,022**
Alternative 3																						
ADC (Newby)	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Soil Amendment	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Land app (Class B)	33%	$1,542,965	33%	$1,559,828	33%	$1,568,259	33%	$1,585,122	33%	$1,601,985	33%	$1,618,848	33%	$1,635,711	33%	$1,652,574	33%	$1,661,006	33%	$1,677,869	33%	$1,694,732
ADC (non-Newby)	33%	$1,542,965	33%	$1,559,828	33%	$1,568,259	33%	$1,585,122	33%	$1,601,985	33%	$1,618,848	33%	$1,635,711	33%	$1,652,574	33%	$1,661,006	33%	$1,677,869	33%	$1,694,732
Compost	33%	$2,248,320	33%	$2,272,892	33%	$2,285,177	33%	$2,309,749	33%	$2,334,321	33%	$2,358,893	33%	$2,383,465	33%	$2,408,036	33%	$2,420,322	33%	$2,444,894	33%	$2,469,466
Soil Manufacturing	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Sum	**99%**	**$5,334,249**	**99%**	**$5,392,547**	**99%**	**$5,421,695**	**99%**	**$5,479,993**	**99%**	**$5,538,291**	**99%**	**$5,596,589**	**99%**	**$5,654,887**	**99%**	**$5,713,184**	**99%**	**$5,742,333**	**99%**	**$5,800,631**	**99%**	**$5,858,929**

Disposition
ADC (Newby)
Soil Amendment
Land app (Class B)
ADC (non-Newby)
Compost
Soil Manufacturing

Year	**2031**		**2032**		**2033**		**2034**		**2035**		**2036**		**2037**		**2038**		**2039**		**2040**	
DTPD (Meso/TPAD)	109	102	110	103	111	104	112	105	113	106	114	107	115	108	116	109	117	110	118	111
	% of material	**Cost**	**% of material**	**Cost**	**% of material**	**Cost**	**% of material**	**Cost**	**% of material**	**Cost**	**% of material**	**Cost**	**% of material**	**Cost**	**% of material**	**Cost**	**% of material**	**Cost**	**% of material**	**Cost**
Base Case																				
ADC (Newby)	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Soil Amendment	30%	$325,353	30%	$328,338	30%	$331,323	30%	$334,308	30%	$337,292	30%	$340,277	30%	$343,262	30%	$346,247	30%	$349,232	30%	$352,217
Land app (Class B)	23%	$1,281,077	23%	$1,292,830	23%	$1,304,583	23%	$1,316,336	23%	$1,328,089	23%	$1,339,842	23%	$1,351,595	23%	$1,363,348	23%	$1,375,101	23%	$1,386,854
ADC (non-Newby)	23%	$1,281,077	23%	$1,292,830	23%	$1,304,583	23%	$1,316,336	23%	$1,328,089	23%	$1,339,842	23%	$1,351,595	23%	$1,363,348	23%	$1,375,101	23%	$1,386,854
Compost	23%	$1,866,712	23%	$1,883,838	23%	$1,900,964	23%	$1,918,090	23%	$1,935,215	23%	$1,952,341	23%	$1,969,467	23%	$1,986,593	23%	$2,003,719	23%	$2,020,844
Soil Manufacturing	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Sum	**99%**	**$4,754,219**	**99%**	**$4,797,836**	**99%**	**$4,841,452**	**99%**	**$4,885,069**	**99%**	**$4,928,686**	**99%**	**$4,972,303**	**99%**	**$5,015,919**	**99%**	**$5,059,536**	**99%**	**$5,103,153**	**99%**	**$5,146,769**
Alternative 1																				
ADC (Newby)	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Soil Amendment	30%	$302,966	30%	$305,951	30%	$308,936	30%	$311,921	30%	$314,906	30%	$317,891	30%	$320,876	30%	$323,860	30%	$326,845	30%	$329,830
Land app (Class B)	23%	$1,192,930	23%	$1,204,683	23%	$1,216,436	23%	$1,228,189	23%	$1,239,942	23%	$1,251,695	23%	$1,263,448	23%	$1,275,201	23%	$1,286,954	23%	$1,298,707
ADC (non-Newby)	23%	$1,192,930	23%	$1,204,683	23%	$1,216,436	23%	$1,228,189	23%	$1,239,942	23%	$1,251,695	23%	$1,263,448	23%	$1,275,201	23%	$1,286,954	23%	$1,298,707
Compost	23%	$1,738,269	23%	$1,755,395	23%	$1,772,520	23%	$1,789,646	23%	$1,806,772	23%	$1,823,898	23%	$1,841,024	23%	$1,858,149	23%	$1,875,275	23%	$1,892,401
Soil Manufacturing	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Sum	**99%**	**$4,427,094**	**99%**	**$4,470,711**	**99%**	**$4,514,327**	**99%**	**$4,557,944**	**99%**	**$4,601,561**	**99%**	**$4,645,177**	**99%**	**$4,688,794**	**99%**	**$4,732,411**	**99%**	**$4,776,027**	**99%**	**$4,819,644**
Alternative 2																				
ADC (Newby)	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Soil Amendment	26%	$262,571	26%	$265,158	26%	$267,745	26%	$270,331	26%	$272,918	26%	$275,505	26%	$278,092	25%	$269,884	25%	$272,371	25%	$274,859
Land app (Class B)	25%	$1,296,663	25%	$1,309,438	25%	$1,322,213	25%	$1,334,988	25%	$1,347,763	25%	$1,360,538	25%	$1,373,313	25%	$1,386,088	25%	$1,398,863	25%	$1,411,638
ADC (non-Newby)	25%	$1,296,663	25%	$1,309,438	25%	$1,322,213	25%	$1,334,988	25%	$1,347,763	25%	$1,360,538	25%	$1,373,313	25%	$1,386,088	25%	$1,398,863	25%	$1,411,638
Compost	25%	$1,889,423	25%	$1,908,038	25%	$1,926,653	25%	$1,945,268	25%	$1,963,883	25%	$1,982,498	25%	$2,001,113	25%	$2,019,728	25%	$2,038,343	25%	$2,056,958
Soil Manufacturing	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Sum	**101%**	**$4,745,318**	**101%**	**$4,792,070**	**101%**	**$4,838,822**	**101%**	**$4,885,574**	**101%**	**$4,932,326**	**101%**	**$4,979,078**	**101%**	**$5,025,830**	**100%**	**$5,061,786**	**100%**	**$5,108,439**	**100%**	**$5,155,091**
Alternative 3																				
ADC (Newby)	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Soil Amendment	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Land app (Class B)	33%	$1,711,595	33%	$1,728,458	33%	$1,745,321	33%	$1,762,184	33%	$1,779,047	33%	$1,795,910	33%	$1,812,773	33%	$1,829,636	33%	$1,846,499	33%	$1,863,362
ADC (non-Newby)	33%	$1,711,595	33%	$1,728,458	33%	$1,745,321	33%	$1,762,184	33%	$1,779,047	33%	$1,795,910	33%	$1,812,773	33%	$1,829,636	33%	$1,846,499	33%	$1,863,362
Compost	33%	$2,494,038	33%	$2,518,610	33%	$2,543,181	33%	$2,567,753	33%	$2,592,325	33%	$2,616,897	33%	$2,641,469	33%	$2,666,040	33%	$2,690,612	33%	$2,715,184
Soil Manufacturing	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0	0%	$0
Sum	**99%**	**$5,917,227**	**99%**	**$5,975,525**	**99%**	**$6,033,822**	**99%**	**$6,092,120**	**99%**	**$6,150,418**	**99%**	**$6,208,716**	**99%**	**$6,267,014**	**99%**	**$6,325,311**	**99%**	**$6,383,609**	**99%**	**$6,441,907**

From Summary Sheet:				Risk adjustments (+/- percent):	
Year of analysis	2014	Electricity Inflation	2.5%	Benefits	
Capital Cost Inflation	3.1%	Diesel Inflation	1.0%	Capital costs	
Natural Gas Inflation	4.0%	O&M Inflation	2.0%	Running costs	
		Discount rate	5.0%		

City of San Jose
Biosolids Processing
Life Cycle Alternative Cost Analysis
Base Case - PMP: Mesophilic Digestion

	Year																										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expressed in 2014 dollars, unescalated -- dollars																											
Capital Outlays																											
Mesophilic Digestion					41,460,000																						
Sludge Storage					4,420,000																						
Centrifuge Dewatering					74,530,000											4,830,000											
Thermal Drying									74,493,000																		
Pumping and Conveyance					6,650,000																						
Solar Drying										22,437,000						3,659,000											
Total capital outlays					**127,060,000**				**74,493,000**	**22,437,000**						**8,489,000**											
Benefits:																											
Benefit 1																											
Benefit 2																											
Benefit 3																											
Total benefits																											
Annual Running Costs:																											
Electricity							2,294,598	2,319,676	2,332,214	2,357,292	3,335,545	3,370,656	3,405,767	3,440,878	3,458,434	3,493,545	3,528,656	3,563,767	3,598,878	3,633,989	3,669,100	3,704,211	3,739,322	3,774,433	3,809,544	3,844,655	3,879,766
Natural Gas							174,651	176,560	177,514	179,423	302,220	305,401	308,583	311,764	313,354	316,536	319,717	322,898	326,079	329,261	332,442	335,623	338,805	341,986	345,167	348,348	351,530
Labor							2,060,000	2,060,000	2,060,000	2,060,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000
Chemical (polymer)							1,052,881	1,064,388	1,070,141	1,081,648	1,093,155	1,104,662	1,116,169	1,127,675	1,133,429	1,144,936	1,156,443	1,167,950	1,179,456	1,190,963	1,202,470	1,213,977	1,225,484	1,236,991	1,248,498	1,260,005	1,271,512
Diesel											12,000	12,126	12,253	12,379	12,442	12,568	12,695	12,821	12,947	13,074	13,200	13,326	13,453	13,579	13,705	13,832	13,958
Materials and Vendor Services							1,107,000	1,107,000	1,107,000	1,107,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,520,000	1,599,000	1,599,000	1,599,000	1,599,000	1,599,000	1,599,000	1,599,000	1,599,000	1,599,000	1,599,000	1,599,000
Disposition							5,713,184	5,771,482	5,829,780	5,888,078	4,448,902	4,492,519	4,536,136	4,579,752	4,623,369	4,666,986	4,710,602	4,754,219	4,797,836	4,841,452	4,885,069	4,928,686	4,972,303	5,015,919	5,059,536	5,103,153	5,146,769
Total running costs							**12,402,314**	**12,499,106**	**12,576,650**	**12,673,441**	**14,451,822**	**14,545,364**	**14,638,907**	**14,732,449**	**14,801,028**	**14,894,570**	**15,067,112**	**15,160,655**	**15,254,197**	**15,347,739**	**15,441,281**	**15,534,823**	**15,628,365**	**15,721,908**	**15,815,450**	**15,908,992**	**16,002,534**
Annual Risk Costs:																											
Risk cost 1																											
Risk cost 2																											
Risk cost 3																											
Risk cost 4																											
Risk cost 5																											
Total risk costs																											
R&R Costs:																											
Major renewals											66,000					384,000				798,000	66,000					131,000	
Centrifuge replacement																										24,600,000	
Dryer replacement																											
Mobile equipment replacement																	300,000						300,000	300,000			
R&R cost 5																											
Total refurbishments											**66,000**					**384,000**	**300,000**			**798,000**	**66,000**		**300,000**	**300,000**		**24,731,000**	
Net Benefit/(cost)					**(127,060,000)**		**(12,402,314)**	**(12,499,106)**	**(87,069,650)**	**(35,110,441)**	**(14,517,822)**	**(14,545,364)**	**(14,638,907)**	**(14,732,449)**	**(14,801,028)**	**(23,767,570)**	**(15,367,112)**	**(15,160,655)**	**(15,254,197)**	**(16,145,739)**	**(15,507,281)**	**(15,534,823)**	**(15,928,365)**	**(16,021,908)**	**(15,815,450)**	**(40,639,992)**	**(16,002,534)**
Expressed in escalated dollars with sensitivity adjustments																											
Capital Outlays																											
Mesophilic Digestion					46,845,077																						
Sludge Storage					4,994,097																						
Centrifuge Dewatering					84,210,410											7,635,318											
Thermal Drying									95,100,935																		
Pumping and Conveyance					7,513,742																						
Solar Drying										29,531,994						5,784,188											
Total capital outlays					**143,563,326**				**95,100,935**	**29,531,994**						**13,419,506**											
Benefits:																											
Benefit 1																											
Benefit 2																											
Benefit 3																											
Total benefits																											
Annual Running Costs:																											
Electricity							2,661,030	2,757,365	2,841,577	2,943,935	4,269,780	4,422,593	4,580,378	4,743,289	4,886,676	5,059,694	5,238,309	5,422,693	5,613,021	5,809,477	6,012,247	6,221,525	6,437,509	6,660,404	6,890,421	7,127,775	7,372,691
Natural Gas							220,990	232,341	242,941	255,375	447,359	470,151	494,051	519,110	542,628	570,063	598,824	628,974	660,577	693,703	728,421	764,808	802,939	842,898	884,768	928,640	974,605
Labor							2,319,895	2,366,292	2,413,618	2,461,891	4,559,039	4,650,220	4,743,224	4,838,089	4,934,851	5,033,548	5,134,219	5,236,903	5,341,641	5,448,474	5,557,443	5,668,592	5,781,964	5,897,603	6,015,555	6,135,866	6,258,584
Chemical (polymer)							1,185,715	1,222,647	1,253,841	1,292,669	1,332,550	1,373,508	1,415,572	1,458,768	1,495,535	1,540,933	1,587,548	1,635,411	1,684,554	1,735,009	1,786,808	1,839,984	1,894,573	1,950,610	2,008,130	2,067,171	2,127,771
Diesel											13,255	13,529	13,807	14,088	14,302	14,592	14,886	15,184	15,487	15,794	16,107	16,423	16,745	17,071	17,402	17,738	18,079
Materials and Vendor Services							1,329,535	1,370,750	1,413,243	1,457,054	2,062,672	2,126,615	2,192,540	2,260,509	2,330,585	2,402,833	2,606,076	2,686,865	2,770,157	2,856,032	2,944,569	3,035,851	3,129,962	3,226,991	3,327,028	3,430,166	3,536,501
Disposition							6,861,676	7,146,576	7,442,545	7,749,997	6,037,255	6,285,434	6,543,197	6,810,902	7,088,917	7,377,623	7,677,416	7,988,707	8,311,920	8,647,495	8,995,888	9,357,571	9,733,033	10,122,781	10,527,340	10,947,254	11,383,086
Total running costs							**14,578,840**	**15,095,972**	**15,607,765**	**16,160,921**	**18,721,911**	**19,342,050**	**19,982,769**	**20,644,755**	**21,293,494**	**21,999,285**	**22,857,278**	**23,614,736**	**24,397,358**	**25,205,983**	**26,041,483**	**26,904,754**	**27,796,726**	**28,718,358**	**29,670,644**	**30,654,610**	**31,671,315**
Annual Risk Costs:																											
Risk cost 1																											
Risk cost 2																											
Risk cost 3																											
Risk cost 4																											
Risk cost 5																											
Total risk costs																											
R&R Costs:																											
Major renewals											89,563					607,031				1,425,337	121,539					281,020	
Centrifuge replacement																										52,771,780	
Dryer replacement																											
Mobile equipment replacement																	488,945						587,235	605,439			
R&R cost 5																											
Total refurbishments											**89,563**					**607,031**	**488,945**			**1,425,337**	**121,539**		**587,235**	**605,439**		**53,052,800**	
Net escalated benefit/(cost)					**(143,563,326)**		**(14,578,840)**	**(15,095,972)**	**(110,708,700)**	**(45,692,915)**	**(18,811,474)**	**(19,342,050)**	**(19,982,769)**	**(20,644,755)**	**(21,293,494)**	**(36,025,822)**	**(23,346,223)**	**(23,614,736)**	**(24,397,358)**	**(26,631,320)**	**(26,163,022)**	**(26,904,754)**	**(28,383,960)**	**(29,323,797)**	**(29,670,644)**	**(83,707,410)**	**(31,671,315)**
Life cycle cost analysis																											
PVs in 2014					(122,718,533)		(11,521,869)	(11,471,698)	(80,893,763)	(32,103,236)	(12,708,358)	(12,564,227)	(12,481,178)	(12,398,705)	(12,296,462)	(20,003,860)	(12,464,739)	(12,123,174)	(12,043,222)	(12,640,354)	(11,940,462)	(11,806,710)	(11,976,765)	(11,897,437)	(11,575,155)	(31,400,056)	(11,423,502)
NPV as of 2014	**(522,375,780)**																										

From Summary Sheet:				Risk adjustments (+/- percent):	
Year of analysis	2014	Electricity Inflation	2.5%	Benefits	
Capital Cost Inflation	3.1%	Diesel Inflation	1.0%	Capital costs	
Natural Gas Inflation	4.0%	O&M Inflation	2.0%	Running costs	
		Discount rate	5.0%		

City of San Jose
Biosolids Processing
Life Cycle Alternative Cost Analysis
Alternative 1 - PMP: TPAD

	Year																										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expressed in 2014 dollars, unescalated -- dollars																											
Capital Outlays																											
TPAD					49,960,000																						
Sludge Storage					4,420,000																						
Centrifuge Dewatering					74,530,000											4,830,000											
Thermal Drying									74,493,000																		
Pumping and Conveyance					6,650,000																						
Solar Drying										22,437,000						3,659,000											
Total capital outlays					**135,560,000**				**74,493,000**	**22,437,000**						**8,489,000**											
Benefits:																											
Benefit 1																											
Benefit 2																											
Benefit 3																											
Total benefits																											
Annual Running Costs:																											
Electricity							2,402,089	2,428,341	2,441,467	2,467,720	3,447,148	3,483,433	3,519,719	3,556,005	3,574,148	3,610,434	3,646,719	3,683,005	3,719,291	3,755,577	3,791,862	3,828,148	3,864,434	3,900,720	3,937,005	3,973,291	4,009,577
Natural Gas											80,592	81,440	82,289	83,137	83,561	84,410	85,258	86,106	86,955	87,803	88,651	89,500	90,348	91,196	92,045	92,893	93,741
Labor							2,060,000	2,060,000	2,060,000	2,060,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000	3,740,000
Chemical (polymer)							1,074,484	1,086,227	1,092,099	1,103,842	1,115,585	1,127,328	1,139,071	1,150,814	1,156,685	1,168,428	1,180,171	1,191,914	1,203,657	1,215,400	1,227,143	1,238,886	1,250,629	1,262,372	1,274,115	1,285,858	1,297,601
Diesel											12,000	12,126	12,253	12,379	12,442	12,568	12,695	12,821	12,947	13,074	13,200	13,326	13,453	13,579	13,705	13,832	13,958
Materials and Vendor Services							1,117,000	1,117,000	1,117,000	1,117,000	1,530,000	1,530,000	1,530,000	1,530,000	1,530,000	1,530,000	1,609,000	1,609,000	1,609,000	1,609,000	1,609,000	1,609,000	1,609,000	1,609,000	1,609,000	1,609,000	1,609,000
Disposition							5,334,249	5,392,547	5,421,695	5,479,993	4,143,585	4,187,202	4,230,819	4,274,436	4,296,244	4,339,861	4,383,477	4,427,094	4,470,711	4,514,327	4,557,944	4,601,561	4,645,177	4,688,794	4,732,411	4,776,027	4,819,644
Total running costs							**11,987,822**	**12,084,115**	**12,132,262**	**12,228,555**	**14,068,910**	**14,161,530**	**14,254,150**	**14,346,770**	**14,393,080**	**14,485,700**	**14,657,320**	**14,749,941**	**14,842,561**	**14,935,181**	**15,027,801**	**15,120,421**	**15,213,041**	**15,305,661**	**15,398,281**	**15,490,901**	**15,583,521**
Annual Risk Costs:																											
Risk cost 1																											
Risk cost 2																											
Risk cost 3																											
Risk cost 4																											
Risk cost 5																											
Total risk costs																											
R&R Costs:																											
Major renewals											66,000					384,000				798,000	66,000					131,000	
Centrifuge replacement																										24,600,000	
Dryer replacement																											
Mobile equipment replacement																	300,000						300,000	300,000			
R&R cost 5																											
Total refurbishments											**66,000**					**384,000**	**300,000**			**798,000**	**66,000**		**300,000**	**300,000**		**24,731,000**	
Net Benefit/(cost)					**(135,560,000)**		**(11,987,822)**	**(12,084,115)**	**(86,625,262)**	**(34,665,555)**	**(14,134,910)**	**(14,161,530)**	**(14,254,150)**	**(14,346,770)**	**(14,393,080)**	**(23,358,700)**	**(14,957,320)**	**(14,749,941)**	**(14,842,561)**	**(15,733,181)**	**(15,093,801)**	**(15,120,421)**	**(15,513,041)**	**(15,605,661)**	**(15,398,281)**	**(40,221,901)**	**(15,583,521)**
Expressed in escalated dollars with sensitivity adjustments																											
Capital Outlays																											
TPAD					56,449,109																						
Sludge Storage					4,994,097																						
Centrifuge Dewatering					84,210,410											7,635,318											
Thermal Drying									95,100,935																		
Pumping and Conveyance					7,513,742																						
Solar Drying										29,531,994						5,784,188											
Total capital outlays					**153,167,358**				**95,100,935**	**29,531,994**						**13,419,506**											
Benefits:																											
Benefit 1																											
Benefit 2																											
Benefit 3																											
Total benefits																											
Annual Running Costs:																											
Electricity							2,785,687	2,886,535	2,974,691	3,081,844	4,412,640	4,570,566	4,733,631	4,901,992	5,050,177	5,228,984	5,413,575	5,604,128	5,800,824	6,003,853	6,213,408	6,429,688	6,652,899	6,883,252	7,120,964	7,366,260	7,619,370
Natural Gas											119,296	125,374	131,747	138,429	144,701	152,017	159,686	167,726	176,154	184,987	194,246	203,949	214,117	224,773	235,938	247,637	259,895
Labor							2,319,895	2,366,292	2,413,618	2,461,891	4,559,039	4,650,220	4,743,224	4,838,089	4,934,851	5,033,548	5,134,219	5,236,903	5,341,641	5,448,474	5,557,443	5,668,592	5,781,964	5,897,603	6,015,555	6,135,866	6,258,584
Chemical (polymer)							1,210,044	1,247,734	1,279,568	1,319,193	1,359,892	1,401,690	1,444,617	1,488,700	1,526,222	1,572,551	1,620,122	1,668,968	1,719,119	1,770,609	1,823,470	1,877,738	1,933,448	1,990,634	2,049,335	2,109,587	2,171,430
Diesel											13,255	13,529	13,807	14,088	14,302	14,592	14,886	15,184	15,487	15,794	16,107	16,423	16,745	17,071	17,402	17,738	18,079
Materials and Vendor Services							1,341,545	1,383,133	1,426,010	1,470,216	2,076,243	2,140,606	2,206,965	2,275,381	2,345,918	2,418,641	2,622,374	2,703,668	2,787,482	2,873,894	2,962,984	3,054,837	3,149,537	3,247,172	3,347,835	3,451,618	3,558,618
Disposition							6,406,565	6,677,356	6,921,567	7,212,868	5,622,934	5,858,268	6,102,790	6,356,842	6,587,342	6,860,500	7,144,262	7,439,025	7,745,198	8,063,205	8,393,484	8,736,493	9,092,702	9,462,600	9,846,693	10,245,507	10,659,584
Total running costs							**14,063,735**	**14,561,050**	**15,015,454**	**15,546,012**	**18,163,299**	**18,760,254**	**19,376,780**	**20,013,522**	**20,603,512**	**21,280,832**	**22,109,125**	**22,835,602**	**23,585,905**	**24,360,816**	**25,161,143**	**25,987,720**	**26,841,410**	**27,723,104**	**28,633,722**	**29,574,213**	**30,545,559**
Annual Risk Costs:																											
Risk cost 1																											
Risk cost 2																											
Risk cost 3																											
Risk cost 4																											
Risk cost 5																											
Total risk costs																											
R&R Costs:																											
Major renewals											89,563					607,031				1,425,337	121,539					281,020	
Centrifuge replacement																										52,771,780	
Dryer replacement																											
Mobile equipment replacement																	488,945						587,235	605,439			
R&R cost 5																											
Total refurbishments											**89,563**					**607,031**	**488,945**			**1,425,337**	**121,539**		**587,235**	**605,439**		**53,052,800**	
Net escalated benefit/(cost)					**(153,167,358)**		**(14,063,735)**	**(14,561,050)**	**(110,116,389)**	**(45,078,006)**	**(18,252,862)**	**(18,760,254)**	**(19,376,780)**	**(20,013,522)**	**(20,603,512)**	**(35,307,369)**	**(22,598,070)**	**(22,835,602)**	**(23,585,905)**	**(25,786,153)**	**(25,282,682)**	**(25,987,720)**	**(27,428,645)**	**(28,328,544)**	**(28,633,722)**	**(82,627,013)**	**(30,545,559)**
Life cycle cost analysis																											
PVs in 2014					(130,928,100)		(11,114,774)	(11,065,201)	(80,460,967)	(31,671,209)	(12,330,980)	(12,186,303)	(12,102,680)	(12,019,602)	(11,898,015)	(19,604,928)	(12,065,294)	(11,723,187)	(11,642,666)	(12,239,202)	(11,538,686)	(11,404,285)	(11,573,665)	(11,493,636)	(11,170,630)	(30,994,781)	(11,017,454)
NPV as of 2014	**(522,168,560)**																										

From Summary Sheet:		Electricity Inflation	2.5%	Risk adjustments (+/- percent):	
Year of analysis	2014	Diesel Inflation	1.0%	Benefits	
Capital Cost Inflation	3.1%	O&M Inflation	2.0%	Capital costs	
Natural Gas Inflation	4.0%	Discount rate	5.0%	Running costs	

City of San Jose
Biosolids Processing
Life Cycle Alternative Cost Analysis
Alternative 2 - Maximize Use of Newby Island Landfill

	Year																										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expressed in 2014 dollars, unescalated -- dollars																											
Capital Outlays																											
TPAD					49,960,000																						
Sludge Storage					4,420,000																						
Centrifuge Dewatering					74,530,000											4,830,000											
Thermal Drying					40,647,000																						
Pumping and Conveyance					6,650,000																						
Solar Drying						22,437,000										3,659,000											
Blending						11,416,000																					
Total capital outlays					**176,207,000**	**33,853,000**										**8,489,000**											
Benefits:																											
Benefit 1																											
Benefit 2																											
Benefit 3																											
Total benefits																											
Annual Running Costs:																											
Electricity							2,402,089	3,356,433	3,374,576	3,410,862	3,447,148	3,483,433	3,519,719	3,556,005	3,574,148	3,610,434	3,646,719	3,683,005	3,719,291	3,755,577	3,791,862	3,828,148	3,864,434	3,900,720	3,937,005	3,973,291	4,009,577
Natural Gas																											
Labor							2,060,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000	3,920,000
Chemical (polymer)							1,074,484	1,086,227	1,092,099	1,103,842	1,115,585	1,127,328	1,139,071	1,150,814	1,156,685	1,168,428	1,180,171	1,191,914	1,203,657	1,215,400	1,227,143	1,238,886	1,250,629	1,262,372	1,274,115	1,285,858	1,297,601
Diesel								42,842	43,074	43,537	44,000	44,463	12,253	12,379	12,442	12,568	12,695	12,821	12,947	13,074	13,200	13,326	13,453	13,579	13,705	13,832	13,958
Materials and Vendor Services							1,117,000	1,408,000	1,408,000	1,408,000	1,408,000	1,408,000	1,408,000	1,408,000	1,408,000	1,408,000	1,487,000	1,487,000	1,487,000	1,487,000	1,487,000	1,487,000	1,487,000	1,487,000	1,487,000	1,487,000	1,487,000
Disposition							5,334,249	4,048,011	4,069,892	4,113,655	4,157,417	4,201,179	4,382,877	4,428,061	4,440,853	4,485,938	4,531,022	4,745,318	4,792,070	4,838,822	4,885,574	4,932,326	4,979,078	5,025,830	5,061,786	5,108,439	5,155,091
Total running costs							**11,987,822**	**13,861,514**	**13,907,641**	**13,999,895**	**14,092,149**	**14,184,404**	**14,381,919**	**14,475,259**	**14,512,128**	**14,605,368**	**14,777,608**	**15,040,059**	**15,134,966**	**15,229,873**	**15,324,780**	**15,419,687**	**15,514,594**	**15,609,501**	**15,693,612**	**15,788,420**	**15,883,227**
Annual Risk Costs:																											
Risk cost 1																											
Risk cost 2																											
Risk cost 3																											
Risk cost 4																											
Risk cost 5																											
Total risk costs																											
R&R Costs:																											
Major renewals											66,000					384,000	348,000				66,000					131,000	
Centrifuge replacement																										24,600,000	
Dryer replacement																											18,300,000
Mobile equipment replacement													1,000,000							1,000,000			300,000				1,000,000
Pug mill replacement																										2,100,000	
Resurfacing for blending pad																850,000										850,000	
Total refurbishments											**66,000**		**1,000,000**			**1,234,000**	**348,000**			**1,000,000**	**66,000**		**300,000**			**27,681,000**	**19,300,000**
Net Benefit/(cost)					**(176,207,000)**	**(33,853,000)**	**(11,987,822)**	**(13,861,514)**	**(13,907,641)**	**(13,999,895)**	**(14,158,149)**	**(14,184,404)**	**(15,381,919)**	**(14,475,259)**	**(14,512,128)**	**(24,328,368)**	**(15,125,608)**	**(15,040,059)**	**(15,134,966)**	**(16,229,873)**	**(15,390,780)**	**(15,419,687)**	**(15,814,594)**	**(15,609,501)**	**(15,693,612)**	**(43,469,420)**	**(35,183,227)**
Expressed in escalated dollars with sensitivity adjustments																											
Capital Outlays																											
TPAD					56,449,109																						
Sludge Storage					4,994,097																						
Centrifuge Dewatering					84,210,410											7,635,318											
Thermal Drying					45,926,480																						
Pumping and Conveyance					7,513,742																						
Solar Drying						26,137,143										5,784,188											
Blending						13,298,642																					
Total capital outlays					**199,093,838**	**39,435,785**										**13,419,506**											
Benefits:																											
Benefit 1																											
Benefit 2																											
Benefit 3																											
Total benefits																											
Annual Running Costs:																											
Electricity							2,785,687	3,989,744	4,111,593	4,259,699	4,412,640	4,570,566	4,733,631	4,901,992	5,050,177	5,228,984	5,413,575	5,604,128	5,800,824	6,003,853	6,213,408	6,429,688	6,652,899	6,883,252	7,120,964	7,366,260	7,619,370
Natural Gas																											
Labor							2,319,895	4,502,848	4,592,905	4,684,763	4,778,458	4,874,027	4,971,508	5,070,938	5,172,357	5,275,804	5,381,320	5,488,946	5,598,725	5,710,700	5,824,914	5,941,412	6,060,240	6,181,445	6,305,074	6,431,175	6,559,799
Chemical (polymer)							1,210,044	1,247,734	1,279,568	1,319,193	1,359,892	1,401,690	1,444,617	1,488,700	1,526,222	1,572,551	1,620,122	1,668,968	1,719,119	1,770,609	1,823,470	1,877,738	1,933,448	1,990,634	2,049,335	2,109,587	2,171,430
Diesel								45,933	46,643	47,616	48,603	49,606	13,807	14,088	14,302	14,592	14,886	15,184	15,487	15,794	16,107	16,423	16,745	17,071	17,402	17,738	18,079
Materials and Vendor Services							1,341,545	1,743,465	1,797,513	1,853,236	1,910,686	1,969,917	2,030,985	2,093,945	2,158,857	2,225,782	2,423,537	2,498,666	2,576,125	2,655,985	2,738,320	2,823,208	2,910,728	3,000,960	3,093,990	3,189,904	3,288,791
Disposition							6,406,565	5,012,477	5,195,798	5,414,468	5,641,703	5,877,823	6,322,127	6,585,310	6,809,068	7,091,420	7,384,734	7,973,751	8,301,931	8,642,797	8,996,817	9,364,481	9,746,295	10,142,781	10,532,022	10,958,593	11,401,491
Total running costs							**14,063,735**	**16,542,200**	**17,024,019**	**17,578,975**	**18,151,983**	**18,743,631**	**19,516,675**	**20,154,974**	**20,730,983**	**21,409,132**	**22,238,174**	**23,249,643**	**24,012,212**	**24,799,738**	**25,613,036**	**26,452,952**	**27,320,354**	**28,216,143**	**29,118,787**	**30,073,257**	**31,058,959**
Annual Risk Costs:																											
Risk cost 1																											
Risk cost 2																											
Risk cost 3																											
Risk cost 4																											
Risk cost 5																											
Total risk costs																											
R&R Costs:																											
Major renewals											89,563					607,031	567,176				121,539					281,020	
Centrifuge replacement																										52,771,780	
Dryer replacement																											40,474,024
Mobile equipment replacement													1,442,461							1,786,136			587,235				2,211,695
Pug mill replacement																										4,504,908	
Resurfacing for blending pad																1,343,689										1,823,415	
Total refurbishments											**89,563**		**1,442,461**			**1,950,721**	**567,176**			**1,786,136**	**121,539**		**587,235**			**59,381,123**	**42,685,720**
Net escalated benefit/(cost)					**(199,093,838)**	**(39,435,785)**	**(14,063,735)**	**(16,542,200)**	**(17,024,019)**	**(17,578,975)**	**(18,241,546)**	**(18,743,631)**	**(20,959,135)**	**(20,154,974)**	**(20,730,983)**	**(36,779,359)**	**(22,805,350)**	**(23,249,643)**	**(24,012,212)**	**(26,585,874)**	**(25,734,576)**	**(26,452,952)**	**(27,907,589)**	**(28,216,143)**	**(29,118,787)**	**(89,454,381)**	**(73,744,678)**
Life cycle cost analysis																											
PVs in 2014					(170,186,247)	(32,413,340)	(11,114,774)	(12,570,713)	(12,439,284)	(12,350,754)	(12,323,335)		(13,091,014)	(12,104,555)	(11,971,626)	(20,422,272)	(12,175,963)	(11,935,745)	(11,853,103)	(12,618,784)	(11,744,924)	(11,608,444)	(11,775,758)	(11,448,032)	(11,359,864)	(33,555,841)	(26,598,912)
NPV as of 2014	**(487,896,446)**																										

From Summary Sheet:				Risk adjustments (+/- percent):	
Year of analysis	2014	Electricity Inflation	2.5%	Benefits	
Capital Cost Inflation	3.1%	Diesel Inflation	1.0%	Capital costs	
Natural Gas Inflation	4.0%	O&M Inflation	2.0%	Running costs	
		Discount rate	5.0%		

City of San Jose
Biosolids Processing
Life Cycle Alternative Cost Analysis
Alternative 3 - TPAD and Dewatering Only

	Year																										
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Expressed in 2014 dollars, unescalated -- dollars																											
Capital Outlays																											
TPAD					49,960,000																						
Batch Tanks																											
Sludge Storage					4,420,000																						
Centrifuge Dewatering					74,530,000											4,830,000											
Pumping and Conveyance					6,650,000																						
Total capital outlays					**135,560,000**											**4,830,000**											
Benefits:																											
Benefit 1																											
Benefit 2																											
Benefit 3																											
Total benefits																											
Annual Running Costs:																											
Electricity							2,402,089	2,428,341	2,441,467	2,467,720	2,493,972	2,520,224	2,546,477	2,572,729	2,585,855	2,612,108	2,638,360	2,664,612	2,690,865	2,717,117	2,743,369	2,769,622	2,795,874	2,822,126	2,848,379	2,874,631	2,900,883
Natural Gas																											
Labor							2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000	2,060,000
Chemical (polymer)							1,074,484	1,086,227	1,092,099	1,103,842	1,115,585	1,127,328	1,139,071	1,150,814	1,156,685	1,168,428	1,180,171	1,191,914	1,203,657	1,215,400	1,227,143	1,238,886	1,250,629	1,262,372	1,274,115	1,285,858	1,297,601
Diesel																											
Materials and Vendor Services							1,117,000	1,117,000	1,117,000	1,117,000	1,117,000	1,117,000	1,117,000	1,117,000	1,117,000	1,117,000	1,167,000	1,167,000	1,167,000	1,167,000	1,167,000	1,167,000	1,167,000	1,167,000	1,167,000	1,167,000	1,167,000
Disposition							5,334,249	5,392,547	5,421,695	5,479,993	5,538,291	5,596,589	5,654,887	5,713,184	5,742,333	5,800,631	5,858,929	5,917,227	5,975,525	6,033,822	6,092,120	6,150,418	6,208,716	6,267,014	6,325,311	6,383,609	6,441,907
Total running costs							**11,987,822**	**12,084,115**	**12,132,262**	**12,228,555**	**12,324,848**	**12,421,141**	**12,517,434**	**12,613,727**	**12,661,874**	**12,758,167**	**12,904,460**	**13,000,753**	**13,097,046**	**13,193,339**	**13,289,633**	**13,385,926**	**13,482,219**	**13,578,512**	**13,674,805**	**13,771,098**	**13,867,391**
Annual Risk Costs:																											
Risk cost 1																											
Risk cost 2																											
Risk cost 3																											
Risk cost 4																											
Risk cost 5																											
Total risk costs																											
R&R Costs:																											
Major renewals											66,000					384,000					66,000					131,000	
Centrifuge replacement																										24,600,000	
R&R cost 3																											
R&R cost 4																											
R&R cost 5																											
Total refurbishments											**66,000**					**384,000**					**66,000**					**24,731,000**	
Net Benefit/(cost)					**(135,560,000)**		**(11,987,822)**	**(12,084,115)**	**(12,132,262)**	**(12,228,555)**	**(12,390,848)**	**(12,421,141)**	**(12,517,434)**	**(12,613,727)**	**(12,661,874)**	**(17,972,167)**	**(12,904,460)**	**(13,000,753)**	**(13,097,046)**	**(13,193,339)**	**(13,355,633)**	**(13,385,926)**	**(13,482,219)**	**(13,578,512)**	**(13,674,805)**	**(38,502,098)**	**(13,867,391)**
Expressed in escalated dollars with sensitivity adjustments																											
Capital Outlays																											
TPAD					56,449,109																						
Batch Tanks																											
Sludge Storage					4,994,097																						
Centrifuge Dewatering					84,210,410											7,635,318											
Pumping and Conveyance					7,513,742																						
Total capital outlays					**153,167,358**											**7,635,318**											
Benefits:																											
Benefit 1																											
Benefit 2																											
Benefit 3																											
Total benefits																											
Annual Running Costs:																											
Electricity							2,785,687	2,886,535	2,974,691	3,081,844	3,192,495	3,306,753	3,424,728	3,546,535	3,653,746	3,783,111	3,916,660	4,054,523	4,196,830	4,343,719	4,495,330	4,651,806	4,813,296	4,979,954	5,151,936	5,329,405	5,512,527
Natural Gas																											
Labor							2,319,895	2,366,292	2,413,618	2,461,891	2,511,129	2,561,351	2,612,578	2,664,830	2,718,126	2,772,489	2,827,939	2,884,497	2,942,187	3,001,031	3,061,052	3,122,273	3,184,718	3,248,412	3,313,381	3,379,648	3,447,241
Chemical (polymer)							1,210,044	1,247,734	1,279,568	1,319,193	1,359,892	1,401,690	1,444,617	1,488,700	1,526,222	1,572,551	1,620,122	1,668,968	1,719,119	1,770,609	1,823,470	1,877,738	1,933,448	1,990,634	2,049,335	2,109,587	2,171,430
Diesel																											
Materials and Vendor Services							1,341,545	1,383,133	1,426,010	1,470,216	1,515,793	1,562,782	1,611,229	1,661,177	1,712,673	1,765,766	1,901,996	1,960,957	2,021,747	2,084,421	2,149,038	2,215,659	2,284,344	2,355,159	2,428,169	2,503,442	2,581,048
Disposition							6,406,565	6,677,356	6,921,567	7,212,868	7,515,579	7,830,125	8,156,952	8,496,516	8,804,602	9,169,702	9,548,978	9,942,956	10,352,185	10,777,230	11,218,680	11,677,143	12,153,249	12,647,653	13,161,030	13,694,082	14,247,535
Total running costs							**14,063,735**	**14,561,050**	**15,015,454**	**15,546,012**	**16,094,887**	**16,662,702**	**17,250,104**	**17,857,758**	**18,415,368**	**19,063,618**	**19,815,694**	**20,511,901**	**21,232,068**	**21,977,011**	**22,747,570**	**23,544,618**	**24,369,055**	**25,221,812**	**26,103,850**	**27,016,164**	**27,959,782**
Annual Risk Costs:																											
Risk cost 1																											
Risk cost 2																											
Risk cost 3																											
Risk cost 4																											
Risk cost 5																											
Total risk costs																											
R&R Costs:																											
Major renewals											89,563					607,031					121,539					281,020	
Centrifuge replacement																										52,771,780	
R&R cost 3																											
R&R cost 4																											
R&R cost 5																											
Total refurbishments											**89,563**					**607,031**					**121,539**					**53,052,800**	
Net escalated benefit/(cost)					**(153,167,358)**		**(14,063,735)**	**(14,561,050)**	**(15,015,454)**	**(15,546,012)**	**(16,184,450)**	**(16,662,702)**	**(17,250,104)**	**(17,857,758)**	**(18,415,368)**	**(27,305,967)**	**(19,815,694)**	**(20,511,901)**	**(21,232,068)**	**(21,977,011)**	**(22,869,110)**	**(23,544,618)**	**(24,369,055)**	**(25,221,812)**	**(26,103,850)**	**(80,068,964)**	**(27,959,782)**
Life cycle cost analysis																											
PVs in 2014					(130,928,100)		(11,114,774)	(11,065,201)	(10,971,645)	(10,922,422)	(10,933,635)	(10,823,773)	(10,774,364)	(10,724,907)	(10,634,416)	(15,162,034)	(10,579,761)	(10,530,261)	(10,480,746)	(10,431,222)	(10,437,163)	(10,332,170)	(10,282,654)	(10,233,153)	(10,183,672)	(30,035,214)	(10,084,792)
NPV as of 2014	**(377,666,079)**																										

Attachment D: Triple-Bottom-Line-Plus

BIOSOLIDS PROGRAM TBL+

BASE CASE vs. ALT 1 (PMP with TPAD)

10-30-2014 rev 01

Evaluation Criteria	*Definition*	*Elements of Scoring Assessment*	*Ranking Characteristics*	*Weight (must add to 100) 100)*	*Alternative Scoring (1 - 10)*			*Comments*
					BASE CASE	*ALT 1*	*NOT USED*	
Operations, Maintenance & Safety (30%)					**180**	**160**	**0**	
Process Reliability	Ability to ensure consistent process outcomes. Proven track record for process and equipment.	Redundancy Interruptability Track Record End product quality and consistency Impact of influent on the process Warranty	10 - Process has a proven track record, and remains operational during fluctuations in inputs. Quality end product and consistency. 1 - Process is unproven. Process is easily upset and can disrupt ability to meet regulations/ operations requirements.	**10**	7	6		Base Case -- Mesophilic digestion commercially proven and most common industry practice. Dewatering commercially proven, reliable with consistent end product quality; thermal dryer (paddle) commercially proven but product quality can be variable (i.e. product can be "clumpy"). (Belt dryer commercially proven but just entering US market and would be more expensive). Solar drying is more of an emerging technology, labor intensive, with highly variable end product. The combination of all of these processes could compromise reliability because of the number of different processes operating simultaneously on the site. Alt 1 – Same as above except for TPAD digestion. TPAD is commerically proven but newer to the market than mesophilic digestion. TPAD is more challenging to operate and therefore can be more prone to upset.
Flexibility & Simplicity	Provides options for operators to optimize in response to changing conditions and needs. Includes compatibility with existing systems and ability to accommodate future additions to capacity or capabilities. Process principles and intuitive to understand by CIP and O&M staff. Easy to operate.	Interruptability and ease of maintenance Operational Options Footprint Minimize points of failure Process is simple to operate, communicate & learn Staff skill level Support/ancillary processes required	10 - Flexible and interruptable operations; modular system with minimal effort to integrate future expansions. Few points of failure. 1 - Difficult to adjust to meet operational needs; necessary and prescriptive operation that requires constant expert attention.	**5**	5	4		Base Case -- Mesophilic digestion is known to San Jose operators, controllable and relatively simple processes. Dewatering is controllable and relatively simple but not know to San Jose operators. Thermal drying is more complex and not know to San Jose operators. Solar drying is relatively simple but not known to San Jose operators. Combination of solar plus thermal drying provides some flexibility to produce a dried product. Themal drying requires signficant captial investment which would be less flexible than entering into a shorter term disposition contract. Alt 1 – Same as above, except TPAD is more complex to operate.
Safety	Provides a safe enviroment in which to operate and maintain the equipment.	Traffic Flow Employee safety	10 - Does not pose a safety hazard, or any potential safety issues can be easily mitigated. 1 - Poses a safety hazard that is difficult to mitigate.	**10**	4	3		Base Case -- Dewatering and thermal drying require operation of complex mechanical equipment and solar drying requires operation of heavy equipment -- all of which create potential safety hazards. Conveyance of waste heat (for thermal drying) creates safety hazards associated with steam, hot oil, or hot pressurized water. Thermal drying also creates potential for explosive dust. Alt 1 – Same as above.
Regulatory Risk / Adaptability	Provides protection against current and future regulations.	Meets current regulation. Ability to make modifications in order to meet changes in future regulations/ trends. Space to accommodate future expansion. Cost to implement future processes in order to meet regulations.	10 - Meets current regulations. Has the ability to respond to changes in future regulations and expansion. 1 - The ability to respond to future regulations and need for expansion would be challenging.	**5**	9	10		Base Case -- Solar drying will require testing to prove Class A. Thermal drying will provide presumptive Class A. Altogether Base Case will be adaptive to local regulatory changes mandating Class A because of drying. Alt 1 – Generally the same as the base case, but TPAD digestion would be more adaptive to regulatory changes mandating Class A product because Class A could be achieved with the addition of batch tanks for 100% of product.
Social (20%)								
Reduce Visual, Noise, and Odor Impacts	Visual, noise and odor impacts to the surrounding communities, employees, and visitors to the RWF that result from operation of facilities.	Buffer zone to minimize visual, noise and odor impacts. Aesthetics Odor generation/ Odor Control Noise during construction and operation	10 - Large buffer zone. Visual, noise and odor impacts are minimal. Odor Control is implemented. 1 - Visual, noise and odor impacts are likely to result in many complaints.	**10**	9	8		Base Case -- Relatively large commitment to construction and associated construction traffic / noise impacts. Volume reduction due to drying is a benefit in terms of reducing offsite traffic impacts. Digestion within current site footprint, providing significant buffer. Dewatering and drying processes add to odor sources but can be provided with odor control. Note dewatering is common to all alternatives. Alt 1 -- Generally same as Base Case but greater biosolids volume reduction due to TPAD will further reduce off-site traffic impacts.

BIOSOLIDS PROGRAM TBL+

BASE CASE vs. ALT 1 (PMP with TPAD)

10-30-2014 rev 01

Evaluation Criteria	*Definition*	*Elements of Scoring Assessment*	*Ranking Characteristics*	*Weight (must add to 100) 100)*	*Alternative Scoring (1 - 10)*			*Comments*
					BASE CASE	*ALT 1*	*NOT USED*	
Public Acceptability & Policy	Acceptable to the adjacent communities and tributary agencies. Aligns with City and Tributary Agency Policies.	Acceptable to adjacent Communities Acceptable to tributary agencies: West Valley, Burbank, Santa Clara County, Milpitas, Saratoga, Monte Sereno. Aligns with Council adopted policies.	10 - Alternative will be highly favorable when presented to TPAC, TAC and the public at large and aligns with adopted policies. 1 - Significant resistance from public at large. Does not align with adopted policies.	**10**	9	9		Base Case -- End product diversification; consistent with PMP. Alt 1 -- Same as Base Case.
Economic (35%)								
Life Cycle Costs	Based on the net present value (NPV) of all costs over a thirty (30) year span, including upfront capital, re-occurring capital, O&M costs, opportunity costs and salvage value at the end of the 30 year study period.	Capital Costs O&M Cost Opportunity Costs Salvage Value	10 - Lowest NPV 1 - Highest NPV	**20**	1	1		Same NPV, but lowest NPV among all alts therefore given score of 1
Rate Impact	As proxy for rate increase	O&M Cost	10 - Lowest Rate Impact 1 - Highest Rate Impact	**10**	1	4		Rate impacts (proxy of O&M costs) vary less than 2%.
Cost/Schedule Uncertainty	Uncertainty in future commodity, equipment, schedule and/or labor costs. Availability of parts and local supplier.	Electricity costs Natural gas costs Labor costs Availability of parts and service Seasonality of supply Schedule impact	10 - Known or fixed costs and schedule. 1 - Highly variable schedule and cost trend forecasts, large variable costs due to slight variations in markets, limited suppliers.	**5**	5	5		Base Case: Relatively high level of schedule and cost uncertainty due number of on-site capital facilities requiring development. Alt 1: Same as Base Case
Environmental (15%)								
Environmental Footprint & Sustainability	Potential impacts to water quality, greenhouse gas emissions, loss of habitat. Relative degree of sustainability incorporated into the project. Includes power and other consumable consumption, as well as greenhouse gas emissions.	TDS TOC Nutrients Trace contaminants Greenhouse gas emissions Loss of habitat Carbon Footprint	10 - Significantly reduces environmental footprint from current facility 1 - Significantly increases the environmental footprint from current facility	**10**	7	8		Base Case: Reduces environmental footprint relative to current facility. Solar dryer uses and produces renewable resource. Thermal dryer uses waste heat from cogen. Multiple new facilities increases liklihood of impacts to sensitive habitats. Alt 1: Same as Base Case but TPAD provides some additional volume reduction and reduces amount of fossil fuel required for transport.
Beneficial Use: In-Plant, Energy or End Products	Multiple diversified end products &/or uses that are beneficially reused within the community, energy requirements are reasonable and on-site energy inputs are utilized.	End product diversification Reuse of end product in the community Beneficial use of end product End product market stability and maturity Energy requirements/efficiency Use of waste heat / biogas Any resource recovery, including: Ammonia Phosphorus	10 - Diversification and beneficial use of end product, utilizes on-site energy sources, promotes additional resource recovery that achieves a tangible impact on Facility operations. 1 - Lack of diversification and beneficial use of end product, significantly increases the demand from external public utilities and eliminates the recovery of a resource that the facility is currently recovering.	**5**	8	9		Base Case: Uses waste heat and solar drying (beneficial reuse); produces thermally dried Class A product for a portion of the biosolids (end product diversification / beneficial reuse) with additional diversification / beneficial re-use via composting and other off-site disposition. Alt 1: Same as Base Case but requires less imported natural gas.
			Total:	**100**				
			TBL+ Performance Score (weighted)		**5.3**	**5.4**	**0.0**	
			TBL+ Performance Score Rank:		**2**	**1**	**3**	
			Net Present Value ($M)		**$520**	**$520**	**$0**	
			Value Score		**0.12**	**0.13**		
			Value Rank:		**2**	**1**	**#N/A**	

BIOSOLIDS PROGRAM TBL+

BASE CASE vs. ALT 2 (Blending to Maximize Use of Newby Island LF)

10-30-2014 REV 01

Evaluation Criteria	*Definition*	*Elements of Scoring Assessment*	*Ranking Characteristics*	*Weight (must add to 100)*	*Alternative Scoring (1-10) (1 - 10)*			*Comments*
					BASE CASE	*ALT 2*	*NOT USED*	
Operations, Maintenance & Safety (30%)					**180**	**170**	**0**	
Process Reliability	Ability to ensure consistent process outcomes. Proven track record for process and equipment.	Redundancy Interruptability Track Record End product quality and consistency Impact of influent on the process Warranty	10 - Process has a proven track record, and remains operational during fluctuations in inputs. Quality end product and consistency. 1 - Process is unproven. Process is easily upset and can disrupt ability to meet regulations/ operations requirements.	**10**	7	6		Base Case -- Mesophilic digestion commercially proven and most common industry practice. Dewatering commercially proven, reliable with consistent end product quality; thermal dryer (paddle) commercially proven but product quality can be variable (i.e. product can be "clumpy"). Belt dryer commercially proven but just entering US market and would be more expensive). Heat recovery adds to thermal drying complexity. Solar drying is more of an emerging technology, labor intensive, with highly variable end product. The combination of all of these processes could compromise reliability because of the number of different processes operating simultaneously on the site. Alt 2 -- Somewhat less reliable than Base Case because that several complex processes be brought on-line under an accelerated schedule. Accelerated schedule reduces ability to modify course of action without "paying penalty" in terms of $ or time. In addition, mesophilic digestion (Base Case) would be somewhat more reliable.
Flexibility & Simplicity	Provides options for operators to optimize in response to changing conditions and needs. Includes compatibility with existing systems and ability to accommodate future additions to capacity or capabilities. Process principles and intuitive to understand by CIP and O&M staff. Easy to operate.	Interruptability and ease of maintenance Operational Options Footprint Minimize points of failure Process is simple to operate, communicate & learn Staff skill level Support/ancillary processes required	10 - Flexible and interruptable operations; modular system with minimal effort to integrate future expansions. Few points of failure. 1 - Difficult to adjust to meet operational needs; necessary and prescriptive operation that requires constant expert attention.	**5**	5	4		Base Case -- Mesophilic digestion is known to San Jose operators, controllable and relatively simple processes. Dewatering is controllable and relatively simple but not know to San Jose operators. Thermal drying is more complex and not know to San Jose operators. Solar drying is relatively simple but not known to San Jose operators. Combination of solar plus thermal drying provides some flexibility to produce a dried product. Themal drying requires signficant captial investment which would be less flexible than entering into a shorter term disposition contract. Alt 2 -- In addition, TPAD is more complex to operate.
Safety	Provides a safe enviroment in which to operate and maintain the equipment.	Traffic Flow Employee safety	10 - Does not pose a safety hazard, or any potential safety issues can be easily mitigated. 1 - Poses a safety hazard that is difficult to mitigate.	**10**	4	4		Base Case -- Dewatering and thermal drying require operation of complex mechanical equipment and solar drying requires operation of heavy equipment -- all of which create potential safety hazards. Conveyance of waste heat (for thermal drying) creates safety hazards associated with steam, hot oil, or hot pressurized water. Thermal drying also creates potential for explosive dust. Alt 2 -- Same as above but also adds operation of mechanical / heavy equipment for blending operation
Regulatory Risk / Adaptability	Provides protection against current and future regulations.	Meets current regulation. Ability to make modifications in order to meet changes in future regulations/ trends. Space to accommodate future expansion. Cost to implement future processes in order to meet regulations.	10 - Meets current regulations. Has the ability to respond to changes in future regulations and expansion. 1 - The ability to respond to future regulations and need for expansion would be challenging.	**5**	9	10		Base Case -- Solar drying will require testing to prove Class A. Thermal drying will provide presumptive Class A. Altogether Base Case will be adaptive to local regulatory changes mandating Class A because of drying. Alt 2 -- TPAD digestion would be more adaptive to regulatory changes mandating Class A product because Class A could be achieved with the addition of batch tanks for 100% of product.
Social (20%)								
Reduce Visual, Noise, and Odor Impacts	Visual, noise and odor impacts to the surrounding communities, employees, and visitors to the RWF that result from operation of facilities.	Buffer zone to minimize visual, noise and odor impacts. Aesthetics Odor generation/ Odor Control Noise during construction and operation	10 - Large buffer zone. Visual, noise and odor impacts are minimal. Odor Control is implemented. 1 - Visual, noise and odor impacts are likely to result in many complaints.	**10**	9	10		Base Case -- Relatively large commitment to construction and associated traffic / noise impacts. Volume reduction due to drying is a benefit in terms of reducing offsite traffic impacts. Digestion within current site footprint, providing significant buffer. Dewatering and drying processes add to odor sources but can be provided with odor control. Note dewatering is common to all alternatives. Alt 2 -- Generally same as Base Case but greater volume reduction due to TPAD will further reduce off-site traffic impacts. Use of Newby Island Landfill will reduce time / distance truck traffic is on public roads until the landfill closes.

BIOSOLIDS PROGRAM TBL+

BASE CASE vs. ALT 2 (Blending to Maximize Use of Newby Island LF)

10-30-2014 REV 01

Evaluation Criteria	*Definition*	*Elements of Scoring Assessment*	*Ranking Characteristics*	*Weight (must add to 100)*	*Alternative Scoring (1-10) (1 - 10)*			*Comments*
					BASE CASE	*ALT 2*	*NOT USED*	
Public Acceptability & Policy	Acceptable to the adjacent communities and tributary agencies. Aligns with City and Tributary Agency Policies.	Acceptable to adjacent Communities Acceptable to tributary agencies: West Valley, Burbank, Santa Clara County, Milpitas, Saratoga, Monte Sereno. Aligns with Council adopted policies.	10 - Alternative will be highly favorable when presented to TPAC, TAC and the public at large and aligns with adopted policies. 1 - Significant resistance from public at large. Does not align with adopted policies.	**10**	9	9		Base Case -- End product diversification; consistent with PMP. Alt 2 -- Same as Base Case except for a few years due to use of Newby Island for disposition.
Economic (35%)								
Life Cycle Costs	Based on the net present value (NPV) of all costs over a thirty (30) year span, including upfront capital, re-occurring capital, O&M costs, opportunity costs and salvage value at the end of the 30 year study period.	Capital Costs O&M Cost Opportunity Costs Salvage Value	10 - Lowest NPV 1 - Highest NPV	**20**	1	3		Alt 2 has lowest NPV compared to BC. Score of 3 is proportional when Alt 3 is considered and given a 10 (ie highest NPV)
Rate Impact	As proxy for rate increase	O&M Cost	10 - Lowest Rate Impact 1 - Highest Rate Impact	**10**	1	4		Alt 2 O&M (proxy for rate impacts same as Alt 1.
Cost/Schedule Uncertainty	Uncertainty in future commodity, equipment, schedule and/or labor costs. Availability of parts and local supplier.	Electricity costs Natural gas costs Labor costs Availability of parts and service Seasonality of supply Schedule impact	10 - Known or fixed costs and schedule. 1 - Highly variable schedule and cost trend forecasts, large variable costs due to slight variations in markets, limited suppliers.	**5**	5	4		Base Case: Relatively high level of schedule and cost uncertainty due number of on-site capital facilities requiring development. Alt 2: Accelerated schedule for thermal and solar drying adds to cost and schedule uncertainty relative to Base Case.
Environmental (15%)								
Environmental Footprint & Sustainability	Potential impacts to water quality, greenhouse gas emissions, loss of habitat. Relative degree of sustainability incorporated into the project. Includes power and other consumable consumption, as well as greenhouse gas emissions.	TDS TOC Nutrients Trace contaminants Greenhouse gas emissions Loss of habitat Carbon Footprint	10 - Significantly reduces environmental footprint from current facility 1 - Significantly increases the environmental footprint from current facility	**10**	7	10		Base Case: Reduces environmental footprint relative to current facility. Solar dryer uses and produces renewable resource. Thermal dryer uses waste heat from cogen. Multiple new facilities increases liklihood of impacts to sensitive habitats. Alt 2: Similar to Base Case but TPAD provides some additional volume reduction and reduces amount of fossil fuel required for transport. Prior to Newby Island landfill closure, distances are significantly reduced further reducing amount of fossible fuel required for transport.
Beneficial Use: In-Plant, Energy or End Products	Multiple diversified end products &/or uses that are beneficially reused within the community, energy requirements are reasonable and on-site energy inputs are utilized.	End product diversification Reuse of end product in the community Beneficial use of end product End product market stability and maturity Energy requirements/efficiency Use of waste heat / biogas Any resource recovery, including: Ammonia Phosphorus	10 - Diversification and beneficial use of end product, utilizes on-site energy sources, promotes additional resource recovery that achieves a tangible impact on Facility operations. 1 - Lack of diversification and beneficial use of end product, significantly increases the demand from external public utilities and eliminates the recovery of a resource that the facility is currently recovering.	**5**	8	10		Base Case: Uses waste heat and solar drying (beneficial reuse); produces thermally dried Class A product for a portion of the biosolids (end product diversification / beneficial reuse) with additional diversification / beneficial re-use via composting and other off-site disposition. Alt 2: Similar to Base Case but does not require as much imported natural gas.
			Total:	**100**				
			TBL+ Performance Score (weighted)		**5.3**	**6.3**	**0.0**	
			TBL+ Performance Score Rank:		**2**	**1**	**3**	
			Net Present Value ($M)		**$520**	**$490**	**$1**	
			Value Score		**0.12**	**0.14**	**0.00**	
			Value Rank:		**2**	**1**	**3**	

BIOSOLIDS PROGRAM TBL+

BASE CASE vs. ALT 3 (TPAD with Dewatering Only)

Oct 30 2014 rev 01

Evaluation Criteria	*Definition*	*Elements of Scoring Assessment*	*Ranking Characteristics*	*Weight (must add to 100)*	*Alternative Scoring (1-10) (1 - 10)*			*Comments*
					BASE CASE	*ALT 3*	*NOT USED*	
Operations, Maintenance & Safety (30%)					**180**	**270**	**0**	
Process Reliability	Ability to ensure consistent process outcomes. Proven track record for process and equipment.	Redundancy Interruptability Track Record End product quality and consistency Impact of influent on the process Warranty	10 - Process has a proven track record, and remains operational during fluctuations in inputs. Quality end product and consistency. 1 - Process is unproven. Process is easily upset and can disrupt ability to meet regulations/ operations requirements.	**10**	7	9		Base Case -- Mesophilic digestion commercially proven and most common industry practice. Dewatering commercially proven, reliable with consistent end product quality; thermal dryer (paddle) commercially proven but product quality can be variable (i.e. product can be "clumpy"). (Belt dryer commercially proven but just entering US market and would be more expensive). Solar drying is more of an emerging technology, labor intensive, with highly variable end product. The combination of all of these processes could compromise reliability because of the number of different processes operating simultaneously on the site. Alt 3 -- Eliminates thermal and solar drying and associated complexity and process issues. TPAD digestion somewhat more complex to operate than mesophilic digestion. Fewer processes will tend to increase reliability.
Flexibility & Simplicity	Provides options for operators to optimize in response to changing conditions and needs. Includes compatibility with existing systems and ability to accommodate future additions to capacity or capabilities. Process principles and intuitive to understand by CIP and O&M staff. Easy to operate.	Interruptability and ease of maintenance Operational Options Footprint Minimize points of failure Process is simple to operate, communicate & learn Staff skill level Support/ancillary processes required	10 - Flexible and interruptable operations; modular system with minimal effort to integrate future expansions. Few points of failure. 1 - Difficult to adjust to meet operational needs; necessary and prescriptive operation that requires constant expert attention.	**5**	5	10		Base Case -- Mesophilic digestion is known to San Jose operators, controllable and relatively simple processes. Dewatering is controllable and relatively simple but not know to San Jose operators. Thermal drying is more complex and not know to San Jose operators. Solar drying is relatively simple but not known to San Jose operators. Combination of solar plus thermal drying provides some flexibility to produce a dried product. Themal drying requires signficant captial investment which would be less flexible than entering into a shorter term disposition contract. Alt 3 -- Overall simplified relative to Base Case due to fewer processes. Also more flexible because commited capital investment is lower.
Safety	Provides a safe enviroment in which to operate and maintain the equipment.	Traffic Flow Employee safety	10 - Does not pose a safety hazard, or any potential safety issues can be easily mitigated. 1 - Poses a safety hazard that is difficult to mitigate.	**10**	4	9		Base Case -- Dewatering and thermal drying require operation of complex mechanical equipment and solar drying requires operation of heavy equipment -- all of which create potential safety hazards. Conveyance of waste heat (for thermal drying) creates safety hazards associated with steam, hot oil, or hot pressurized water. Thermal drying also creates potential for explosive dust. Alt 3 -- Lower safety risks since reduces amount of mechanical and heavy equipment operated onsite. Avoids safety hazards associated with conveyance of waste heat. Some issues with greater ammonia.
Regulatory Risk / Adaptability	Provides protection against current and future regulations.	Meets current regulation. Ability to make modifications in order to meet changes in future regulations/ trends. Space to accommodate future expansion. Cost to implement future processes in order to meet regulations.	10 - Meets current regulations. Has the ability to respond to changes in future regulations and expansion. 1 - The ability to respond to future regulations and need for expansion would be challenging.	**5**	9	8		Base Case -- Solar drying will require testing to prove Class A. Thermal drying will provide presumptive Class A. Altogether Base Case will be adaptive to local regulatory changes mandating Class A because of drying. Alt 3 -- Does not produce Class A but provides pathway to Class A via addition of batch tanks.
Social (20%)								
Reduce Visual, Noise, and Odor Impacts	Visual, noise and odor impacts to the surrounding communities, employees, and visitors to the RWF that result from operation of facilities.	Buffer zone to minimize visual, noise and odor impacts. Aesthetics Odor generation/ Odor Control Noise during construction and operation	10 - Large buffer zone. Visual, noise and odor impacts are minimal. Odor Control is implemented. 1 - Visual, noise and odor impacts are likely to result in many complaints.	**10**	9	8		Base Case -- Relatively large commitment to construction and associated traffic / noise impacts. Volume reduction due to drying is a benefit in terms of reducing offsite traffic impacts. Digestion within current site footprint, providing significant buffer. Dewatering and drying processes add to odor sources but can be provided with odor control. Note dewatering is common to all alternatives. Alt 3 -- Greater amount of dewatered biosolids requiring transportation (visual / noise impacts) since no thermal or solar drying. Avoids additional odor sources associated with drying.

BIOSOLIDS PROGRAM TBL+

BASE CASE vs. ALT 3 (TPAD with Dewatering Only)

Oct 30 2014 rev 01

Evaluation Criteria	*Definition*	*Elements of Scoring Assessment*	*Ranking Characteristics*	*Weight (must add to 100)*	*Alternative Scoring (1-10) (1 - 10)*			*Comments*
					BASE CASE	*ALT 3*	*NOT USED*	
Public Acceptability & Policy	Acceptable to the adjacent communities and tributary agencies. Aligns with City and Tributary Agency Policies.	Acceptable to adjacent Communities Acceptable to tributary agencies: West Valley, Burbank, Santa Clara County, Milpitas, Saratoga, Monte Sereno. Aligns with Council adopted policies.	10 - Alternative will be highly favorable when presented to TPAC, TAC and the public at large and aligns with adopted policies. 1 - Significant resistance from public at large. Does not align with adopted policies.	**10**	9	7		Base Case -- End product diversification; consistent with PMP. Alt 3 -- Change from PMP in that drying technologies recommended to be deferred or downsized; process and diversification provided solely via contracts with of-site service providers. Significant cost reduction may be perceived as benefit by tributary agencies.
Economic (35%)								
Life Cycle Costs	Based on the net present value (NPV) of all costs over a thirty (30) year span, including upfront capital, re-occurring capital, O&M costs, opportunity costs and salvage value at the end of the 30 year study period.	Capital Costs O&M Cost Opportunity Costs Salvage Value	10 - Lowest NPV 1 - Highest NPV	**20**	1	10		Alt 3 has the lowest NPV.
Rate Impact	As proxy for rate increase	O&M Cost	10 - Lowest Rate Impact 1 - Highest Rate Impact	**10**	1	10		Alt 3 O&M costs are lowest.
Cost/Schedule Uncertainty	Uncertainty in future commodity, equipment, schedule and/or labor costs. Availability of parts and local supplier.	Electricity costs Natural gas costs Labor costs Availability of parts and service Seasonality of supply Schedule impact	10 - Known or fixed costs and schedule. 1 - Highly variable schedule and cost trend forecasts, large variable costs due to slight variations in markets, limited suppliers.	**5**	5	10		Base Case: Relatively high level of schedule and cost uncertainty due number of on-site capital facilities requiring development. Alt 3: Lowest cost and schedule uncertainty because: 1) only one on-site post digestion process is being constructed; and 2) disposition contracts can provide cost predictability.
Environmental (15%)								
Environmental Footprint & Sustainability	Potential impacts to water quality, greenhouse gas emissions, loss of habitat. Relative degree of sustainability incorporated into the project. Includes power and other consumable consumption, as well as greenhouse gas emissions.	TDS TOC Nutrients Trace contaminants Greenhouse gas emissions Loss of habitat Carbon Footprint	10 - Significantly reduces environmental footprint from current facility 1 - Significantly increases the environmental footprint from current facility	**10**	7	5		Base Case: Reduces environmental footprint relative to current facility. Solar dryer uses and produces renewable resource. Thermal dryer uses waste heat from cogen. Multiple new facilities increases liklihood of impacts to sensitive habitats. Alt 3: No benefit from drying in terms of transport of biosolids; fewer onsite facilities reduces footprint and potential for impacts to sensitive habitats.
Beneficial Use: In-Plant, Energy or End Products	Multiple diversified end products &/or uses that are beneficially reused within the community, energy requirements are reasonable and on-site energy inputs are utilized.	End product diversification Reuse of end product in the community Beneficial use of end product End product market stability and maturity Energy requirements/efficiency Use of waste heat / biogas Any resource recovery, including: Ammonia Phosphorus	10 - Diversification and beneficial use of end product, utilizes on-site energy sources, promotes additional resource recovery that achieves a tangible impact on Facility operations. 1 - Lack of diversification and beneficial use of end product, significantly increases the demand from external public utilities and eliminates the recovery of a resource that the facility is currently recovering.	**5**	8	5		Base Case: Uses waste heat and solar drying (beneficial reuse); produces thermally dried Class A product for a portion of the biosolids (end product diversification / beneficial reuse) with additional diversification / beneficial re-use via composting and other off-site disposition. Alt 3: Does not take advantage of solar heat / waste heat recovery. Diversification achieved through service contracts.
			Total:	**100**				
			TBL+ Performance Score (weighted)		**5.3**	**8.5**	**0.0**	
			TBL+ Performance Score Rank:		**2**	**1**	**3**	
			Net Present Value ($M)		**$520**	**$380**	**$560**	
			Value Score		**0.12**	**0.21**	**0.00**	
			Value Rank:		**2**	**1**	**3**	