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DAF Co-Thickening Alternatives Business Case Evaluation

Prepared for: San Jose/Santa Clara Water Pollution Control Plant

Project Title: FOG Evaluation, Digester Rehabilitation and Gas Line Replacement

Project No: 136242-007

Technical Memorandum 7.1

Subject: DAF Co-Thickening Alternatives Business Case Evaluation

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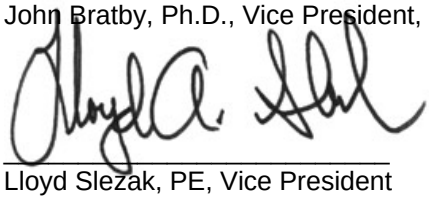

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1. EXECUTIVE SUMMARY

The primary purpose of this technical memorandum (TM) is to evaluate the opportunity of upgrading the existing dissolved air flotation thickening (DAFT) system operation through the use of polymer and through simultaneously co-thickening both primary and secondary sludge, and to recommend alternatives for the DAFT system using a business case evaluation (BCE) process.

Based on pilot testing conducted by the WPCP staff and operations from across the industry, Brown and Caldwell recommends assuming an average co-thickening DAFT solids loading rate of 50 pounds per day per square foot (ppd/sq ft) for this evaluation. This loading rate is viewed as being conservative, given the higher, more aggressive range of loadings than traditional that are now being discussed and tested in the industry. Testing and future experience may allow taking advantage of even higher loading rates. Current peak day conditions can be accommodated with just 5 tanks under this loading criterion.

The alternatives in this BCE are as follows:

- Alternative 1 – Thickening status-quo. No upgrades or changes to the thickening facilities are included in this alternative. There is no reduction in required digester volume.
- Alternative 2 – Status-quo with polymer. No modifications to primary sludge thickening facilities are included but polymer facilities are added to the DAFT area. There is some reduction in required digester volume due the improvements in waste activated sludge (WAS) thickening performance.
- Alternative 3 – Co-thickening without odor control - Modifications to the DAFT area are included to allow for co-thickening. There is a reduction in required digester volume due the improvement in thickening performance.
- Alternative 4 – Co-thickening with odor control - Modifications to the DAFT area are included to allow for co-thickening and odor containment and treatment. There is a reduction in required digester volume due the improvement in thickening performance. There are two sub alternatives in Alternative 4.
  - Alternative 4a includes odor containment and stack discharge only.
  - Alternative 4b includes odor containment and treatment.

In all alternatives, digester upgrades are necessary at the level required to support associated 15-day hydraulic retention time (HRT) for maximum two-week flows. By improved thickening, the number of required digesters requiring modification is reduced and this results in a net cost benefit to the City. The life cycle cost analysis is summarized in Table 1-1.

Table 1-1. Life Cycle Cost Analysis Results

Alternative	15 yr NPV Benefit	30 yr NPV Benefit
1 – Thickening Status Quo	(700,000)	(1,100,000)
2 – Status Quo with Polymer	11,700,000	16,000,000
3 – Co-Thickening without Odor Control	18,600,000	27,100,000
4a – Co-Thickening with Odor Containment	17,100,000	25,600,000
4b – Co-Thickening with Odor Containment and Treatment	16,600,000	25,100,000

The results from the life cycle cost analysis show that there is significant economic benefit to improvements in thickening. By simply adding polymer to existing WAS thickening, multiple digesters can be eliminated from service. Further upgrading the system to co-thickening brings additional benefit in cost savings. Within the three co-thickening alternatives, the one with no odor control brings the highest benefit. However, this alternative also bears the highest odor risk. Based on the results of the BCE, Brown and Caldwell recommends Alterative 4b. This alternative maximizes the cost savings while minimizing the odor risk.

In addition, pilot testing is recommended to confirm DAFT solids loading, air-to-solids ratio, polymer dose, inlet baffles, nitrogen purge, and skimmer speed. Pilot testing is also recommended to confirm performance of the optimized saturation system concept discussed in Section 6.1.

2. INTRODUCTION

This TM is one in a series of TMs to be provided under Service Order No. 1for the WPCP Fats, Oils, and Grease (FOG) Program Evaluation and Enhancement Study, Pre-design Study of Digester Rehabilitation, Modifications and Gas Line Replacement, and Implementation Plan. This TM represents work under Task 7 of that Service Order Number 1, authorized by Amendment on July 20, 2010. The primary goal of Service Order No. 1 is to evaluate the 16 existing digesters and develop an implementation plan for digester modifications that rehabilitates digesters needed for reliable service through the 2030 planning period in a way that will not limit long-term options for future digestion processes that may be used at the WPCP.

The primary purpose of this TM 7.1 is to evaluate the opportunity of upgrading the existing DAFT system operation through the use of polymer and through simultaneously co-thickening both primary and secondary sludge, and to recommend alternatives for the DAFT system using a BCE process. Currently, primary sludge is thickened in primary sedimentation tanks and waste activated sludge is thickened in dissolved air flotation thickeners without the use of polymers. Historically, this practice has resulted in digester process combined sludge feed at solids concentrations in the range of 3 to 4 percent. Industry experience with co-thickening of primary and waste activated sludge has shown that thickened sludge feed solids concentrations in the range of 5 to 7 percent are achievable with a DAFT. Many aspects of anaerobic digester operations are optimized with the thickening of feed sludge. Lower digester volume requirements, reduced heating energy, and reduced sludge pumping and mixing costs are among the benefits that can be realized through thicker digester feedstocks.

For details of digester design criteria to be used for analysis in Task 7 of Service Order No. 1, TM 3.3, Design Criteria for Digester Modifications and Gas System Improvements should be referenced.

2.1 Purpose and Scope of TM 7.1

The scope of this TM is to evaluate and compare alternatives for DAFT thickening. Alternatives defined in the scope of work include polymer enhanced thickening and co-thickening. The purpose of this TM is to define and compare alternatives that improve thickened digester feed with reduced anaerobic digestion facilities requirements against the status-quo alternative of improving anaerobic digestion facilities with capacities sufficient to process the thinner digester feed sludge produced from the existing thickening practices.

3. EXISTING SYSTEM AND DESIGN CRITERIA

This section presents an overview of the existing system and the design criteria used in the evaluation of the DAFT system.

3.1 Existing System

Primary sludge and WAS are thickened prior to being pumped to the anaerobic digester. The primary sludge is thickened in the primary clarifiers to approximately 3.5 percent. The WAS is thickened in the DAFT tanks to approximately 3.5 percent. No polymer is used in the thickening process. A schematic of the existing system is shown in Figure 3-1. The major components of the DAFT system are summarized in Table 3-1.

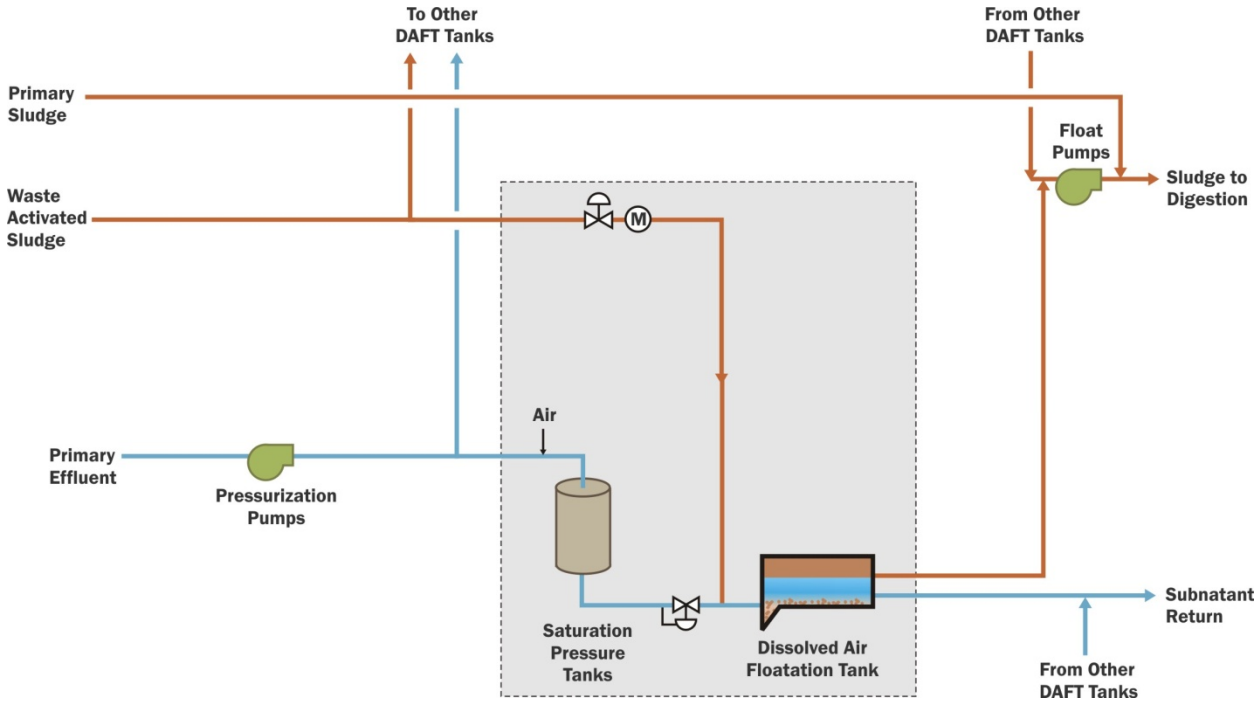

Figure 3-1. Schematic of existing sludge thickening prior to digestion.

Table 3-1. DAFT System Components

Parameter	Unit	Data
Number of DAF tanks		16
Surface area, each	sf	1640
Number of saturation pressure tanks		16
Capacity, each	cu ft	190
Operating pressure	psi	45
Number of pressurization pumps		4
Type		Centrifugal
Capacity, each	gpm	2 @ 7000 1 @ 4000 1 @ 2000
Number of float pumps		6
Type		Progressing Cavity
Capacity, each	gpm	3 @ 700 3 @ 400

Note: Not all equipment is in service currently.

3.2 Design Criteria

Traditionally, thickening DAFTs have been designed with conservative, low solids loading rates. Typical design values for average annual conditions range from 25 ppd/ sq ft to 30 ppd/sq ft. The upper loading in peak conditions is around 40 ppd/sq ft. However, in recent years, plant staff and design engineers have been able to achieve excellent thickening performance while loading DAFTs at rates two to three times these traditional loading rates.

Loading rate values for selected plants are shown in Figure 3-2 (for WAS only thickening) and Figure 3-3 (for co-thickening). Comparison of the two figures shows better thickening performance with co-thickening systems. It should be noted that in recent bench scale pilot testing, the San Jose DAFTs continued to perform at loading rates as high as 94 to 174 ppd/sq ft. A recent co-thickening design for Tacoma, Washington is based on a loading rate of 90 ppd/sq ft for peak day at 5 percent TS and 46 ppd/sq ft under average loading.

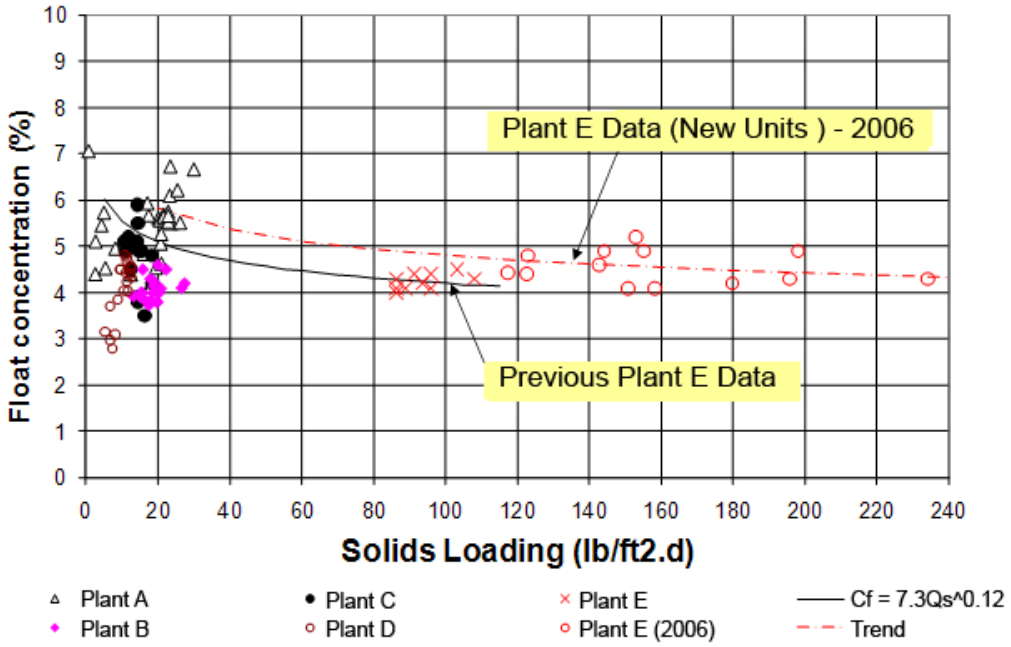

Figure 3-2. DAFT performance for selected plants – WAS only with polymer.

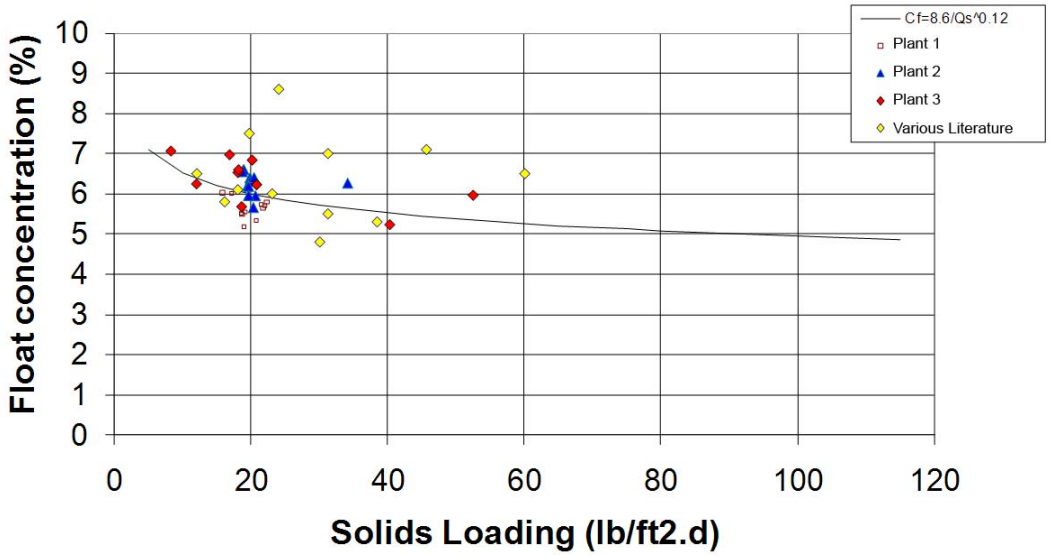

Figure 3-3. DAFT performance for selected plants – co-thickening with polymer.

In August 2010, San Jose staff conducted a bench scale study on DAFT co-thickening. The solids loading rates and air-to-solids ratios use in this study are summarized in Table 3-2. This study also confirmed better

thickening of float sludge (higher total solids concentration) achieved with primary sludge and WAS as compared to WAS only.

Table 3-2. Bench Scale Study Parameters

Air-to-Solids (lb/lb)	Solids Loading Rate (ppd/sq ft)
0.008	94
0.015	174

Brown and Caldwell recommends assuming 50 ppd/sq ft as the average solids loading rate for this evaluation. This loading rate is viewed as being conservative, given the higher, more aggressive range of loadings than traditional that are now being discussed and tested in the industry. Testing and future experience may allow taking advantage of even higher loading rates, thus requiring operation of fewer DAFTs. With current primary and secondary sludge loads from the plant, even at peak day conditions, only 5 DAFT tanks would need to be in service to meet the 50 ppd/sq ft criterion (Figure 3-4).

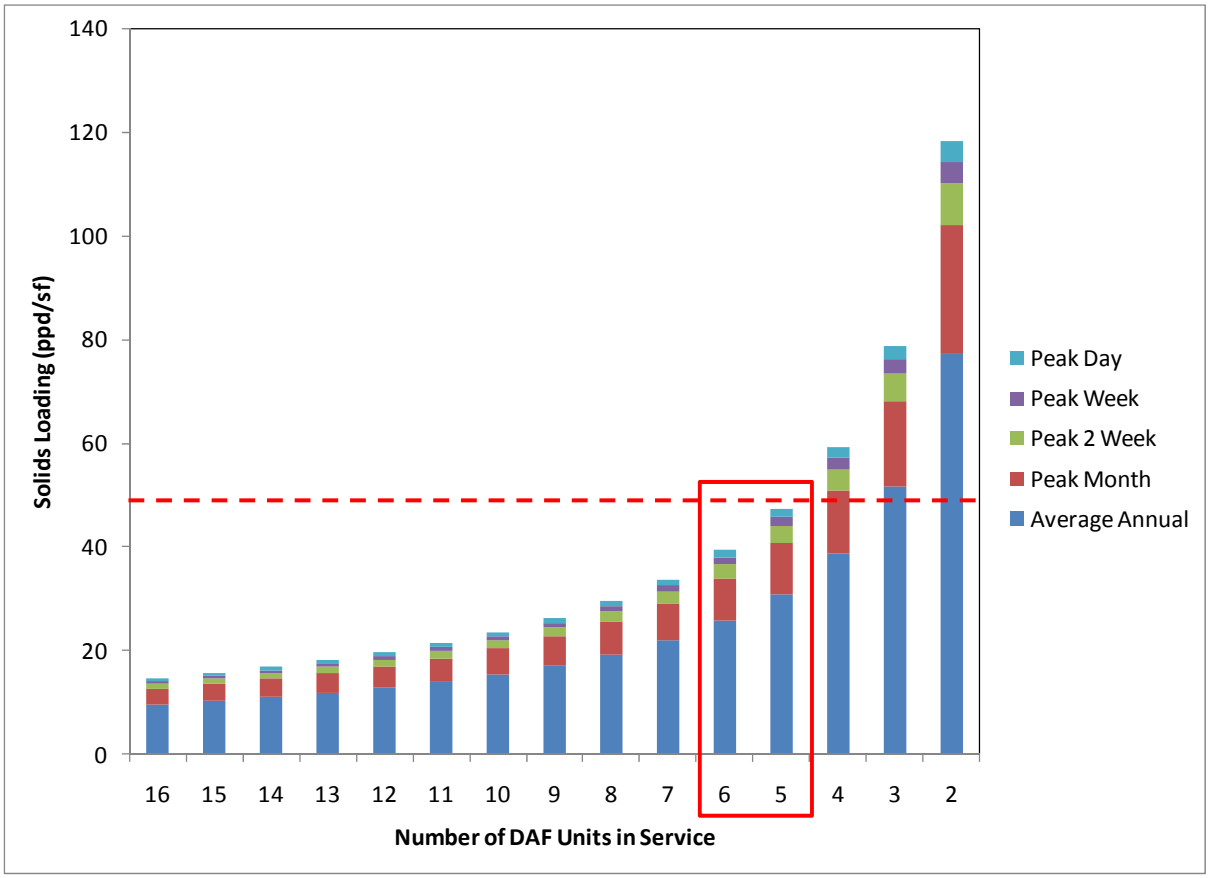

Figure 3-4. Number of tanks required in service at stated solids loading (co-thickening with current loads).

The DAFT loading rates with 2030 primary and secondary sludge loads are shown in Figure 3-5. In 2030 the average annual loading will be less the 50 ppd/sq ft with 5 tanks in service. Peak day conditions at 60 ppd/sq ft can be met with 6 tanks in service.

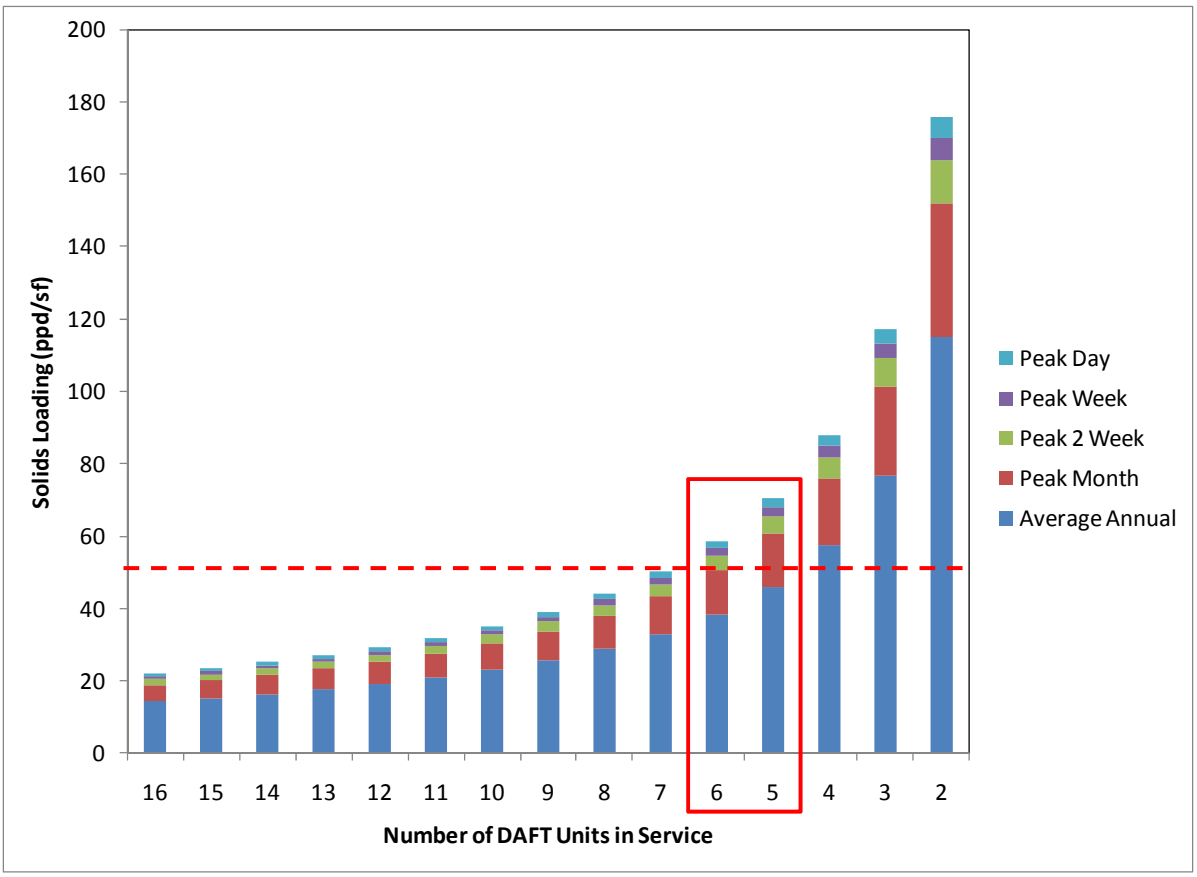

Figure 3-5. Number of tanks required in service at stated solids loading (co-thickening with 2030 loads).

4. DAFT ALTERNATIVES

The four DAFT alternatives that were developed for this evaluation are presented in this section. Improvements to the DAFT system focus on achieving the following objective: improving thickening performance to reduce digester volume needs. The principal assumptions used for the evaluation, leading from the discussion in the previous section include:

- Existing thickened sludge is 3.5 percent TS
- Polymer enhanced WAS thickening achieves 5.0 percent TS (4.1 percent TS total with primary sludge)
- Co-thickened (primary sludge and WAS) sludge achieves 5.5 percent TS
- DAFT loading criterion is 50 ppd/sf
- Operating A/S ratio of 0.008 lb/lb based on bench-top study and existing system operation

4.1 Alternative 1 – Thickening Status Quo

Alternative 1 is the thickening status-quo alternative. No upgrades or changes to the thickening facilities are included in this alternative. There is no reduction in required digester volume. Digester upgrades are necessary at the level required to support associated 15-day HRT with 3.5 percent feed solids for maximum two-week flows. The schematic and major components of this alternative are the same as those for the existing DAFT system, previously shown in Figure 3-1 and summarized in Table 3-1.

4.2 Alternative 2 – Status Quo with Polymer

In Alternative 2 there are no modifications to primary sludge thickening facilities but polymer facilities are added to the DAFT area. There is some reduction in required digester volume due the improvements in WAS thickening performance. Digester upgrades are necessary at the level required to support associated 15-day HRT with 5 percent feed solids for maximum two-week flows. A schematic of the system with polymer addition is shown in Figure 4-1. The major components of the DAFT system are summarized in Table 4-1.

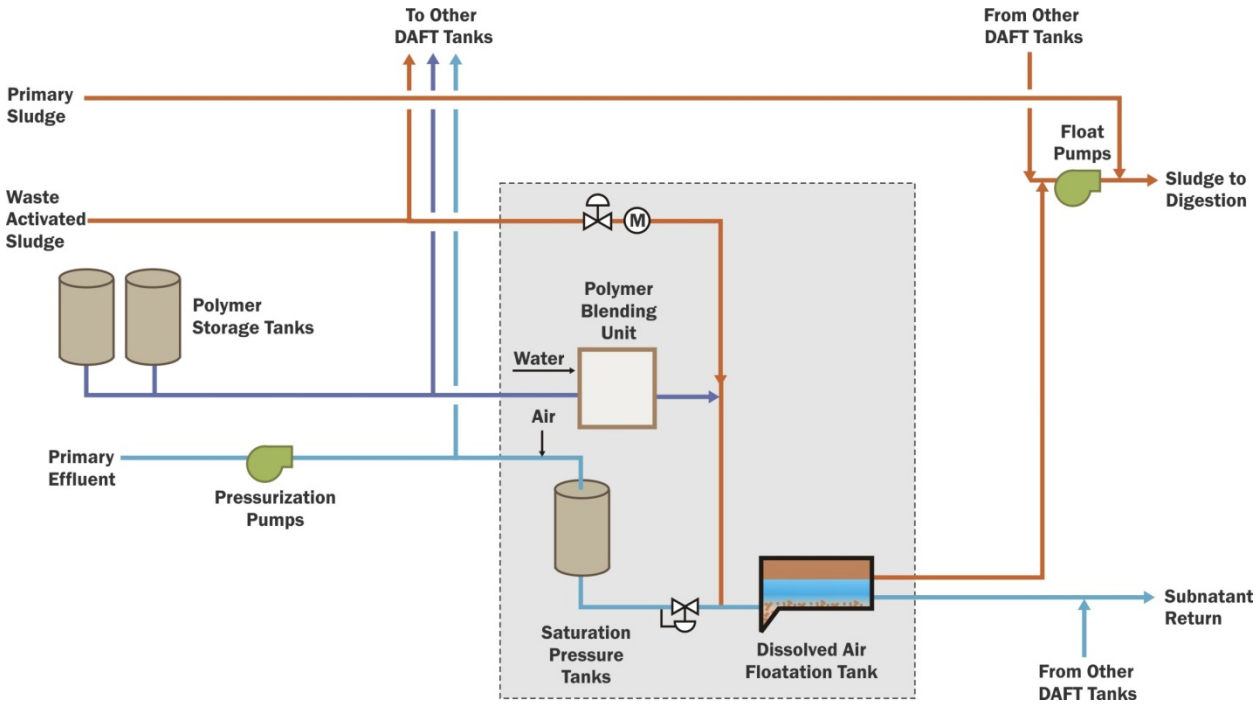

Figure 4-1. Schematic of alternative 2 - DAFT system with polymer addition.

Table 4-1. Alternative 2 - DAFT System Components		
Parameter	Unit	Data
Existing tanks/equipment		
Number of DAFT tanks		16 (6 in service)
Surface area, each	sf	1640
Number of saturation pressure tanks		16 (6 in service)
Capacity, each	cu ft	190
Operating pressure	psi	45
Number of pressurization pumps		4
Type		Centrifugal
Capacity, each	gpm	2 @ 7000 1 @ 4000 1 @ 2000
Number of float pumps		6
Type		Progressing Cavity
Capacity, each	gpm	3 @ 700 3 @ 400
New tanks/equipment		
Number of polymer blending units		6
Polymer flow, each	gal/hr	27
Dilution water flow, each	gal/hr	1330
Number of polymer storage tanks		4
Capacity, each	gal	5700
Diameter, each	ft	10
Height, each	ft	10

4.3 Alternative 3 – Co-Thickening without Odor Control

Alternative 3 includes modifications to the DAFT area to allow for co-thickening. The modifications include new DAFT feed pumps, new float pump stations, retrofits for a blend tank system, new polymer system, saturation system upgrades and piping modifications associated with all upgrades. There is a reduction in required digester volume due the improvement in thickening performance. Digester upgrades are necessary at the level required to support associated 15-day HRT with 5.5 percent feed solids for maximum two-week flows.

A schematic of Alternative 3 is shown in Figure 4-2. The major components of the DAFT system are summarized in Table 4-2. In this Alternative, the saturation system upgrades include a cost for 6 new saturation pressure tanks. This is conservative. A lower cost option would be to re-use a saturation pressure tank from one of the decommissioned DAFT systems. There are 16 existing tanks, 10 of which could potentially be reused.

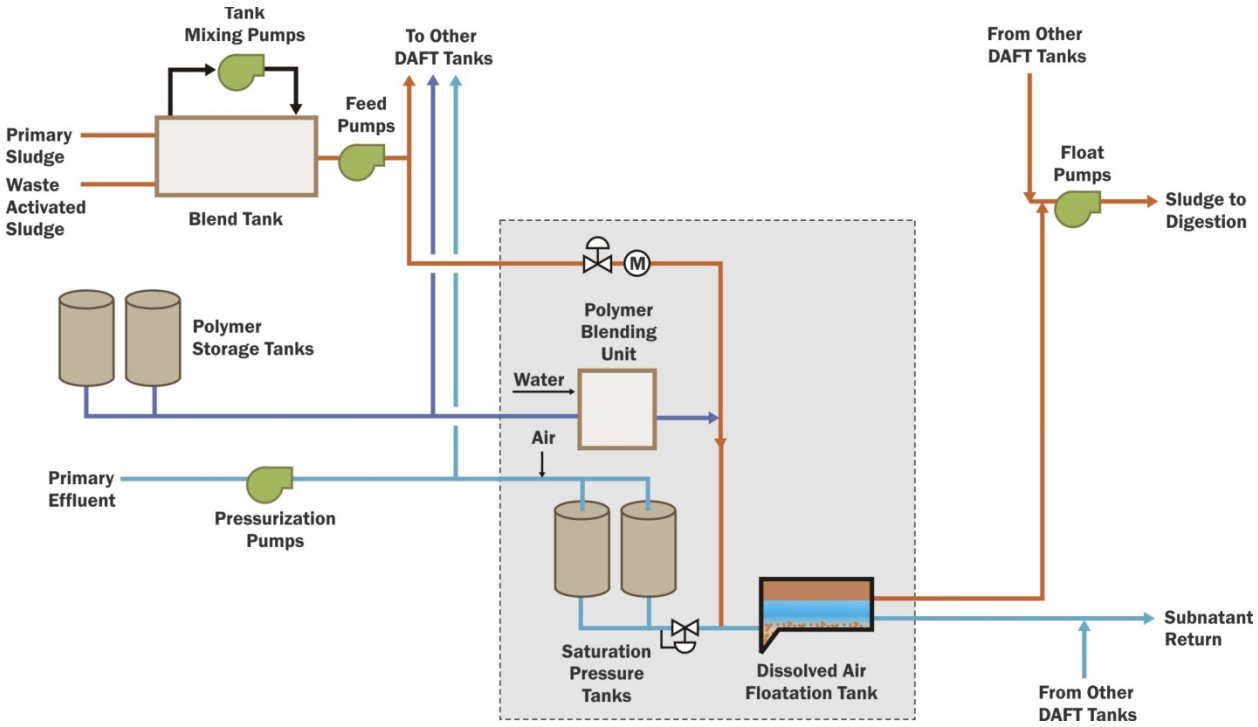

Figure 4-2. Schematic of Alternative 3 – co-thickening.

Table 4-2. Alternative 3 - DAFT System Components		
Parameter	Unit	Data
Existing tanks/equipment		
Number of DAFT tanks		6
Surface area, each	sf	1640
Number of saturation pressure tanks		12 (2 per tank, 6 existing, 6 new)
Capacity, each	cu ft	190
Operating pressure	psi	45
Number of pressurization pumps		4
Type		Centrifugal
Capacity, each	gpm	2 @ 7000 1 @ 4000 1 @ 2000
Number of float pumps		6
Type		Progressing Cavity
Capacity, each	gpm	3 @ 700 3 @ 400
New tanks/equipment		
Number of polymer blending units		6
Polymer flow, each	gal/hr	27
Dilution water flow, each	gal/hr	1330
Number of polymer storage tanks		4
Capacity, each	gal	5700
Diameter, each	ft	10
Height, each	ft	10
Number of blend tanks		1
Type		Retrofit an existing DAFT tank for primary sludge equalization and blending with WAS
Number of blend tank mixing pumps		2
Type		
Capacity, each	gpm	1000
Number of DAFT feed pumps		2
Type		Screw centrifugal, variable speed
Capacity, each	mgd	4.95
Number of float pumps		4
Type		Progressing cavity
Capacity, each	gpm	800

4.4 Alternative 4 – Co-Thickening with Odor Control

Alternative 4 includes modifications to the DAFT area to allow for co-thickening and odor containment and treatment. The thickening modifications include new DAFT feed pumps, new float pump stations, retrofits for a blend tank system, new polymer system, saturation system upgrades and piping modifications associated with all upgrades. There is a reduction in required digester volume due the improvement in thickening performance. Digester upgrades are necessary at the level required to support associated 15-day HRT with 5.5 percent feed solids for maximum two-week flows. The odor containment modifications include covers for DAFT tanks, air ducting and fans. The odor treatment includes addition of a biofilter.

Odor control is necessary when foul odors affect those that work in the process area or when neighbors are a concern. At the WPCP, the concern with DAFT odors lies primarily with workers in the process area. Therefore, a viable option may be to capture the foul area with covers and fans and vent to a stack to take advantage of dispersion effects. This is less expensive than treatment through a biofilter; however, a detailed dispersion model should be developed to determine the effects on neighbors and the surrounding plant area. For this alternative, costs have been developed for the option of odor containment only as well as the option of odor containment and treatment.

A schematic of Alternative 4 is shown in Figure 4-3. The major components of the DAFT system are summarized in Table 4-3. In this alternative, the saturation system upgrades include a cost for six new saturation pressure tanks. This is conservative. A lower cost option would be to re-use a saturation pressure tank from one of the decommissioned DAFT systems. There are 16 existing tanks, 10 of which could potentially be reused.

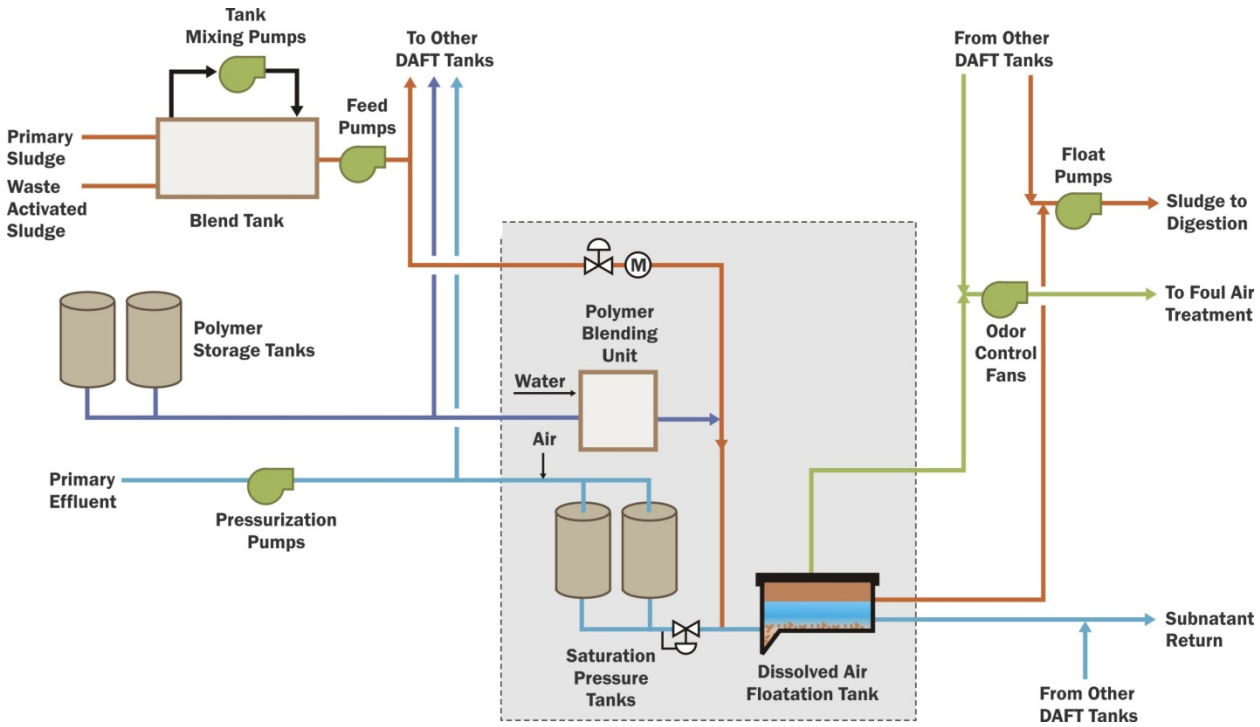

Figure 4-3 Schematic of Alternative 4 – co-thickening with odor control.

Table 4-3. Alternative 4 – DAFT System Components		
Parameter	Unit	Data
Existing tanks/equipment		
Number of DAFT tanks		6
Surface area, each	sf	1640
Number of saturation pressure tanks		12 (6 existing, 6 new)
Capacity, each	cu ft	190
Operating pressure	psi	45
Number of pressurization pumps		4
Type		Centrifugal
Capacity, each	gpm	2 @ 7000, 1 @ 4000, and 1 @ 2000
Number of float pumps		6
Type		Progressing Cavity
Capacity, each	gpm	3 @ 700 3 @ 400
New tanks/equipment		
Number of polymer blending units		6
Polymer flow, each	gal/hr	27
Dilution water flow, each	gal/hr	1330
Number of polymer storage tanks		4
Capacity, each	gal	5700
Diameter, each	ft	10
Height, each	ft	10
Number of blend tanks		1
Type		Retrofit an existing DAFT tank for primary sludge equalization and blending with WAS
Number of blend tank mixing pumps		2
Type		
Capacity, each	gpm	1000
Number of DAFT feed pumps		2
Type		Screw centrifugal, variable speed
Capacity, each	mgd	4.95
Number of float pumps		4
Type		Progressing cavity
Capacity, each	gpm	800
Number of tank covers		6
Length, each	ft	85
Width, each	ft	20
Number of fans		2
Capacity, each	cfm	5000
Area of biofilter	sq ft	1220

The tank covers for the odor control system will be aluminum panels that are easy to remove for tank maintenance purposes. Appropriate spacing will be allocated to allow for operators to move between tanks. An example of the panels is shown in Figure 4-4.

Figure 4-4. Typical aluminum tank covers.

5. BUSINESS CASE EVALUATION

The BCE evaluation is presented in this section.

5.1 Project Costs

Cost estimates for each of the alternatives were prepared. The detailed cost estimates can be found in Appendix A. The project capital costs for the DAFT upgrades are summarized in Table 5-1.

Table 5-1. Summary of Project Capital Costs for DAFT Upgrades

Alternative	Description	Capital Cost, $
1 – Status Quo	Existing saturation system and power	---
2 – Status Quo with Polymer	Alt 1 + Polymer system	680,000
3 – Co-Thickening without Odor Control	Expanded saturation system Polymer system Blend system New float pump station	2,510,000
4a – Co-Thickening with Odor Containment	Alt 3 + Odor containment	3,920,000
4b – Co-Thickening with Odor Containment and Treatment	Alt 3 + Odor containment and treatment	4,410,000

5.2 Operations and Maintenance Costs

The major cost items associated with operation and maintenance (O&M) were quantified for each alternative. Cost assumptions include:

- Power cost – 10.5 cents/kW-hr
- Polymer cost - $1.75/active lb polymer

The O&M cost items included for each alternative are summarized in Table 5-2. Details on the DAFT power calculations and polymer usage calculations are presented in Appendix B. Details on the distribution of O&M costs over the 30 year planning period are presented in Appendix C.

Table 5-2. Summary of Operation Cost Items

Alternative	Operation Cost Items
1 – Thickening Status Quo	- Saturation system power
2 – Status Quo with Polymer	- Saturation system power - Polymer
3 – Co-Thickening without Odor Control	- Saturation system power - Polymer - Blend tank transfer pumping - Blend tank mixing pumping
4a – Co-Thickening with Odor Containment	- Saturation system power - Polymer - Blend tank transfer pumping - Blend tank mixing pumping - Odor control fan power
4b – Co-Thickening with Odor Containment and Treatment	- Saturation system power - Polymer - Blend tank transfer pumping - Blend tank mixing pumping - Odor control fan power

5.3 Life Cycle Costs

The life cycle cost analysis includes project capital costs, O&M costs, and any cost savings over the analysis period. The life cycle cost analysis was done for two time periods, 15 years and 30 years. Previous TMs have included discussion on solids processing capacity in 2030. However, due to design and construction time, an analysis that concludes in 2030 is only over a 15-year period. The analysis was also done for a 30-year period to reflect a more traditional life cycle analysis.

In Alternatives 2, 3 and 4, the thickening performance is improved resulting in a reduction in needed digester capacity. The total number of digesters needed and the reduction in number of digesters at the end of both analysis periods is summarized in Table 5-3. The estimated savings from the reduced number of digester upgrades is shown in Table 5-4. All alternatives assume required digesters are upgraded with submerged fixed covers and mixing upgrades.

There are O&M cost savings associated with the reduction in digester capacity as well. These savings include maintenance to covers, maintenance to mixing equipment, power associated with heating, and power associated with mixing. The results from the life cycle cost analysis are summarized in Table 5-5.

Table 5-3. Reduction in Number of Digesters with Thickening Alternatives				
Alternative	Upgraded Digesters Required (2030)	Upgraded Digesters Saved (2030)	Upgraded Digesters Required (2044)	Upgraded Digesters Saved (2044)
1 – Thickening Status Quo	13	---	17	---
2 – Status Quo with Polymer	11	2	14	3
3 – Co-Thickening without Odor Control	9	4	11	6
4a – Co-Thickening with Odor Containment	9	4	11	6
4b – Co-Thickening with Odor Containment and Treatment	9	4	11	6

Note: Assume upgraded digester are Submerged Fixed Cover Digesters.

Table 5-4. Capital Savings Over 30 Years from Reduction in Digester Upgrades	
Alternative	Capital Saved
1 – Thickening Status Quo	---
2 – Status Quo with Polymer	$17.3M
3 – Co-Thickening without Odor Control	$34.5M
4a – Co-Thickening with Odor Containment	$34.5M
4b – Co-Thickening with Odor Containment and Treatment	$34.5M

Table 5-5. Life Cycle Cost Analysis Results		
Alternative	15 yr NPV Benefit	30 yr NPV Benefit
1 – Thickening Status Quo	(700,000)	(1,100,000)
2 – Status Quo with Polymer	11,700,000	16,000,000
3 – Co-Thickening without Odor Control	18,600,000	27,100,000
4a – Co-Thickening with Odor Containment	17,100,000	25,600,000
4b – Co-Thickening with Odor Containment and Treatment	16,600,000	25,100,000

5.4 Non-Economic and Risk Factors

The main infrastructure for DAFT co-thickening or polymer-enhanced thickening of WAS is already in place. The alternatives presented here reuse existing DAFTs tanks, pressurization pumping, some saturation pressure tanks and much of the existing piping. This helps to reduce the risk associated with converting to enhanced thickening. The risk lies in the performance assumptions made in this TM. If the thickening performance, air/solid ratio, and loading assumptions do not hold, additional tanks will be needed. This does not add significant cost compared to the savings in digester capacity. Therefore, this risk is minimal. Further discussion on performance optimization is included in Section 6.

Another risk associated with the alternatives is the choice in level of odor control. Some level of odor control is typically applied to co-thickening DAFTs, making the risk level high for Alternative 3, where no odor containment or treatment is included. Dispersion modeling could reduce the uncertainty associated with Alternative 4a, where contained odor would be discharged through a stack. Furthermore, with Alternative 4a, a biofilter could be added at a later stage if odor treatment is found to be necessary.

6. FUTURE CONSIDERATIONS AND CONCLUSIONS

Future optimization considerations and the recommended alternative are presented in this section.

6.1 Operational Considerations and Future Pilot Studies

The benefits of co-thickening depend on the performance of the DAFT system. A well performing DAFT will maximize float concentration, minimizing underflow concentration and minimize power consumption. The underflow concentration and the power consumption depend heavily on the air-to-solids ratio and the efficiency of the saturation system. The ability to thicken float depends on the sludge itself, the sludge volume index (SVI), and the operation of the float collection system. A discussion on several ways to optimize DAFT performance is included here.

6.1.1 Maximizing Float Thickness

The mechanism of thickening by DAFT is essentially drainage of interstitial water from the part of the float that extends above the water level. At lower solids loading rates, the float accumulates at a lower rate and the passage of the float above the water level proceeds at a lower rate of rise, thereby providing more opportunity for drainage before the thickened float is removed by the float scrapers.

Usually the DAFT system cannot control the amount of solids processed and thereby the solids loading rate. But the operator can control the amount of float accumulation and the degree of drainage from the float. This is done by the speed of the float scraper and/or intermittent operation of the scraper. By reducing the speed of the float scraper, more opportunity is allowed for the float to rise further and increase drainage, between passes of the scrapers.

One limitation on allowing the float to extend above the water level is the depth of float below the water level that is required to support the float layers above the water level. Therefore, there is a lower limit to the float scraper speed below which the float will accumulate and be swept down with the underflow, thereby inordinately increasing underflow solids concentrations. Usually this is controlled by the operator by using a bottom-of-float level detector, such as a sludge judge or, more effectively, by a specifically adapted Raven sludge blanket probe.

However, Brown and Caldwell has devised an automatic control approach that detects the transition from normal underflow solids to incipient float failure. By coupling this with the speed of the scraper, operation of scraper speed can be automated. This can be tested on an experimental basis and, if successful, can be implemented to maximize thickening performance of the DAFTs.

6.1.2 Direct Air Saturation Pumps

Some recent DAFT systems have used direct air saturation pumps as a means of dissolving air in place of pressure vessel based saturators. These systems are a simplification of the more formal, mass transfer reactor based solution to air saturation. A direct air saturation pump is typically a high pressure (regenerative turbine multi-stage) centrifugal pump where compressed air is added to the suction side of the pump. The action of the pump impeller and the sudden pressure increase in the pump are the drivers to dissolve air into solution (along with micro-sized air bubbles). Optimized pump design is employed to allow as much suction side air injection as possible without "air binding" the impeller of the pump. These systems generally use discharge pump pressures in the 70 to 100 psi range, whereas systems with saturation tanks are generally run in the 40 to 70 psi range. There is little specific information available that allows a direct comparison of electric power to air dissolution efficiency between these systems and traditional mass transfer reactor systems. Manufacturer's claim actual to theoretical saturation efficiencies of 100 percent or more, often owing to the entrainment of microscopic sized bubbles in the pressurization flow stream that may have never been dissolved but may be, nonetheless, available for attachment to solids. The direct air saturation pumps are

generally favored for the simplicity and capital cost savings that they lend to, typically, smaller sized DAFT systems. A system the size of San Jose (1,500 to 3,250 gpm pressurized water) is economically sensitive to the specific saturation efficiency and the investment in the more complex saturation vessel systems has already been made. Further, these pumps are not available in sizes large enough (available pumps <250 gpm) to replace the "central" pressurization water supply scheme already in place. Therefore, there is little driver to consider this class of pumping equipment for application at the WPCP.

6.1.3 Saturation System Optimization

There are two common reasons for low observed saturator efficiencies, physical damage within the tank and accumulation of nitrogen in the headspace of the saturators. The saturation pressure tanks at the WPCP have been replaced in recent years so the physical damage is not likely. None of the tanks have nitrogen purge systems, which could lead to future inefficiencies in the system. Further testing should be conducted to determine the efficiency of the current tanks. If low efficiencies are found, addition of a nitrogen purge system is a likely recommendation. Another concept for minimizing power consumption by the saturation system is discussed in the next section.

6.1.4 Low Energy Saturation Overview and Pilot Testing

DAFT systems operate by the precipitation of air that has been dissolved at high pressure. Typically, pressures in DAFT saturation systems may be from 50 psi to 80 psi. The energy expended in DAFT systems arises principally from the pressurization pump that lifts recycled water typically from about atmospheric pressure to saturation pressure. Therefore, the pumping head of these pumps can be from 125 to 200 feet.

Recognizing the significant amount of energy expended for waste sludge thickening by conventional DAFT systems, the concept introduced here is to significantly reduce the pumping energy for saturation by recycling water under pressure by having the suction and discharge sides of the pump at essentially the same pressure. Figure 6-1 is a schematic representation of the low energy saturation concept.

The concept involves two interconnected loops, operated intermittently. During an initial cycle, the first loop operates under pressure and water is cycled around the loop into a retention vessel where compressed air is injected. After saturation, a switchover allows the pump to convey and displace the air-saturated water in the loop to the DAFT unit.

During the displacement operation, the second loop repeats the saturation cycle until it too is discharged to the DAFT unit. Operation is such that saturated and pressurized flow to the DAFT is uninterrupted. It is estimated that this low pressure concept has a total energy requirement of approximately one-third that of a conventional DAFT system.

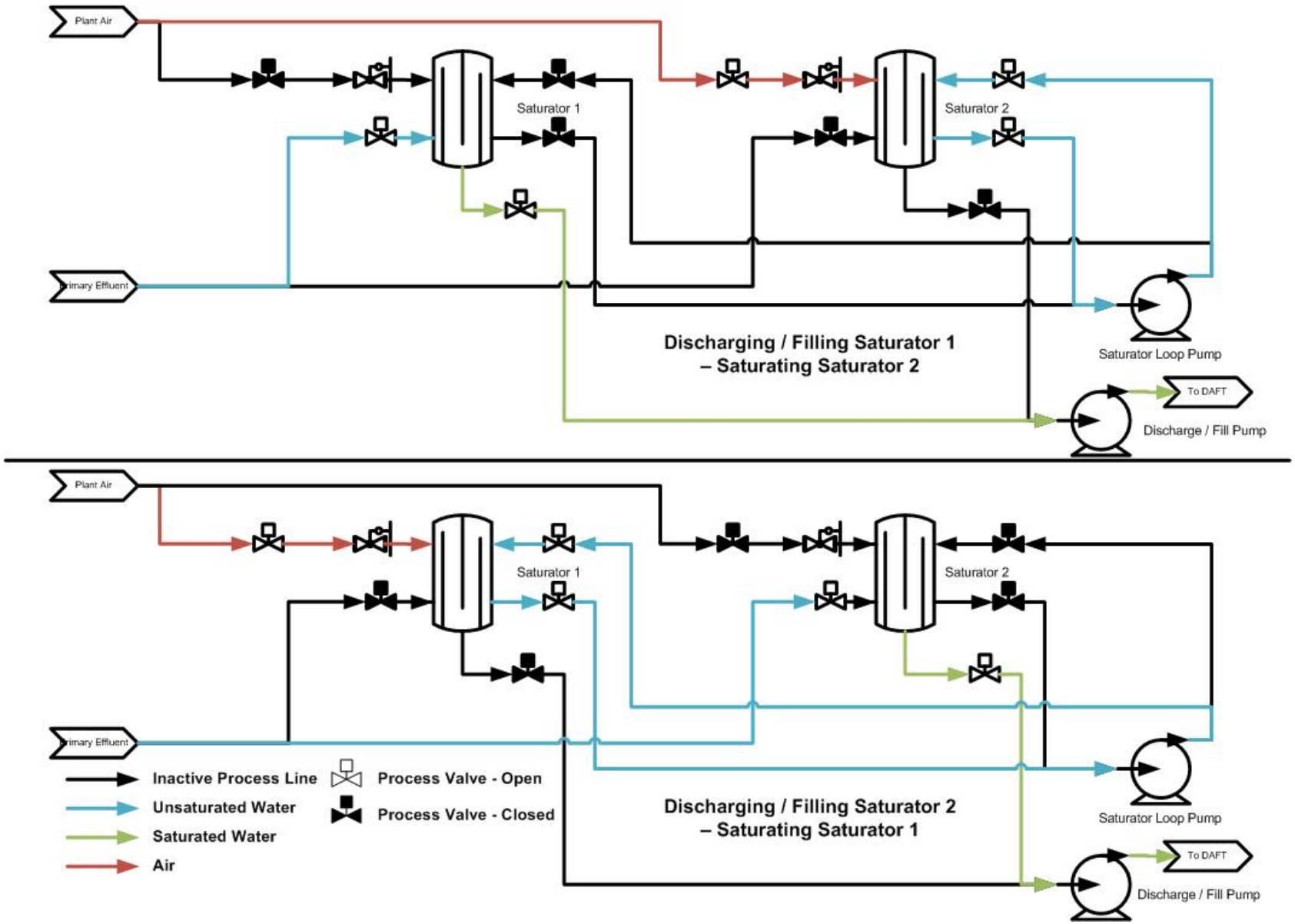

Figure 6-1. Schematic of low pressure saturation system concept operating in two modes.

This concept has been tested successfully on a bench-scale experimental basis. However, there are no known full scale applications. However, since each application is unique and there has been a significant time lag since previous tests, specific pilot trials are recommended. The equipment requirements to conduct this pilot testing include the following:

- An internal recycle pump with pumping head of approximately 5 psig (for saturation);
- A transfer pump to convey air-saturated water to the DAFT (also approximately 5 psig);
- A gas transfer chamber connected to existing compressed air source;
- Two automatically operated 4-way valves to switch flow between pressurized loops.
- Electrical and control system to operate the intermittent cycles.

This San Jose pilot test would be the first full scale test of the concept. There is always risk of new concepts in not being successful at full scale application. Therefore, it is recommended that the tests be conducted prior to full scale implementation of co-thickening modifications. It may be prudent to first repeat bench scale tests to prove the concept. The benefit of proceeding with this test is the potential for saving two thirds of the otherwise required saturation power.

6.2 Conclusions

The results from the life cycle cost analysis show that there is significant economic benefit to improvements in thickening. Co-thickening can save as much as 30 percent of overall project costs over upgrading digesters without DAFT upgrades. By simply adding polymer to existing WAS thickening, multiple digesters can be eliminated from service. Further upgrading the system to co-thickening brings additional benefit in cost savings. Within the three co-thickening alternatives, the one with no odor control brings the highest benefit. However, this alternative also bears the highest odor risk.

Based on the results of the BCE, Brown and Caldwell recommends implementing Alterative 4b, upgrading to co-thickening with odor containment and treatment. This alternative maximizes the cost savings while minimizing odor risk. Pilot testing is recommended to confirm DAFT solids loading, air-to-solids ratio, polymer dose, inlet baffles, nitrogen purge, and skimmer speed. Testing is also recommended to confirm performance of the optimized saturation system concept discussed in Section 6.1.

7. REFERENCES

Bratby J., Jones G. (2007) "How far can you take flotation thickeners?". 5th International Conference on Flotation in Water and Wastewater Systems, 11 September 2007, Seoul, Korea

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ATTACHMENT A: COST ESTIMATE

BROWN AND CALDWELL

Environmental Engineers & Consultants

SUMMARY ESTIMATE REPORT
WITH MARK-UPS ALLOCATED

Business Case Evaluation
DAFT Modification Alternates
Conceptual Estimate

Project Number:	136242-007
BC Project Manager:	Steve Krugel
BC Office:	Walnut Creek
Estimate Issue Number:	01
Estimate Original Issue Date:	October 25, 2010
Estimate Revision Number:	01
Estimate Revision Date:	October 27, 2010
Lead Estimator:	Don Snowden
Estimate QA/QC Reviewer:	Butch Matthews & Fran Burlingham
Estimate QA/QC Date:	October 25, 2010

BROWN AND CALDWELL

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SUMMARY ESTIMATE REPORT
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PROCESS LOCATION/AREA INDEX

Business Case Evaluation
DAFT Modification Alternates

Description		Total w/ Markups Allocated
Alternative 2		**679,914**
1130 - Polymer Blending Units		
03100 - Concrete Forms & Accessories		4,932
03200 - Concrete Reinforcement		1,903
03300 - Cast-In-Place Concrete		3,213
05050 - Basic Metal Materials & Methods		20,070
05500 - Metal Fabrications		19,609
09900 - Paints & Coatings		1,781
11000 - Equipment		302,579
15100 - Building Services Piping		56,474
	1130 - Polymer Blending Units Total	410,561
1135 - Polymer Storage Tank		
03100 - Concrete Forms & Accessories		6,576
03200 - Concrete Reinforcement		5,373
03300 - Cast-In-Place Concrete		11,514
05050 - Basic Metal Materials & Methods		15,478
11000 - Equipment		89,100
15050 - Basic Materials & Methods		10,423
	1135 - Polymer Storage Tank Total	138,464
5000 - Electrical, Instrumentation & Controls		
16000 - Electrical and Instrumentation		130,890
	5000 - Electrical, Instrumentation & Controls Total	130,890
Alternative 3/4 - No Odor Control Biofilter		**3,924,264**
1110 - Piping Modifications		
09900 - Paints & Coatings		2,493
15001 - Pipe, Water Supply		93,700
	1110 - Piping Modifications Total	96,193
1115 - Blend Tank		
02300 - Earthwork		15,867
03100 - Concrete Forms & Accessories		6,820
03200 - Concrete Reinforcement		21,806
03300 - Cast-In-Place Concrete		25,557
05050 - Basic Metal Materials & Methods		18,624
05500 - Metal Fabrications		216,317
11000 - Equipment		233,144
15001 - Pipe, Water Supply		31,014
16200 - Electrical Power		37,926

Description		Total w/ Markups Allocated
	1115 - Blend Tank Total	607,074
1120 - DAFT Feed Pumps		
02300 - Earthwork		15,867
03100 - Concrete Forms & Accessories		6,820
03200 - Concrete Reinforcement		21,806
03300 - Cast-In-Place Concrete		25,557
05050 - Basic Metal Materials & Methods		8,089
05500 - Metal Fabrications		6,536
11000 - Equipment		117,870
15050 - Basic Materials & Methods		31,270
16200 - Electrical Power		21,700
	1120 - DAFT Feed Pumps Total	255,515
1125 - Float Pumps		
02050 - Basic Site Materials & Methods		35,462
02300 - Earthwork		9,611
02600 - Drainage & Containment		921
05050 - Basic Metal Materials & Methods		3,645
05500 - Metal Fabrications		8,604
08300 - Specialty Doors		5,906
11000 - Equipment		58,048
15050 - Basic Materials & Methods		33,355
	1125 - Float Pumps Total	155,551
1130 - Polymer Blending Units		
03100 - Concrete Forms & Accessories		4,932
03200 - Concrete Reinforcement		1,903
03300 - Cast-In-Place Concrete		3,213
05050 - Basic Metal Materials & Methods		20,070
05500 - Metal Fabrications		19,609
09900 - Paints & Coatings		1,781
11000 - Equipment		302,579
15100 - Building Services Piping		56,474
	1130 - Polymer Blending Units Total	410,561
1135 - Polymer Storage Tank		
03100 - Concrete Forms & Accessories		6,576
03200 - Concrete Reinforcement		5,373
03300 - Cast-In-Place Concrete		11,514
05050 - Basic Metal Materials & Methods		15,478
11000 - Equipment		89,100

Description		Total w/ Markups Allocated
15050 - Basic Materials & Methods		10,423
	1135 - Polymer Storage Tank Total	138,464
1140 - Pressure Retention Tank		
11000 - Equipment		262,011
13005 - Selective Demolition		14,910
	1140 - Pressure Retention Tank Total	276,920
1145 - Odor Control Covers		
05050 - Basic Metal Materials & Methods		63,210
05500 - Metal Fabrications		1,231,630
	1145 - Odor Control Covers Total	1,294,840
1150 - Odor Control Fans & Ductwork		
11 - EQUIPMENT		87,269
15 - MECHANICAL		34,689
	1150 - Odor Control Fans & Ductwork Total	121,958
5000 - Electrical, Instrumentation & Controls		
16000 - Electrical and Instrumentation		567,189
	5000 - Electrical, Instrumentation & Controls Total	567,189
Alternative 3/4 - With Odor Control Biofilter		**4,408,843**
1110 - Piping Modifications		
09900 - Paints & Coatings		2,493
15001 - Pipe, Water Supply		93,700
	1110 - Piping Modifications Total	96,193
1115 - Blend Tank		
02300 - Earthwork		15,867
03100 - Concrete Forms & Accessories		6,820
03200 - Concrete Reinforcement		21,806
03300 - Cast-In-Place Concrete		25,557
05050 - Basic Metal Materials & Methods		18,624
05500 - Metal Fabrications		216,317
11000 - Equipment		233,144
15001 - Pipe, Water Supply		31,014
16200 - Electrical Power		37,926
	1115 - Blend Tank Total	607,074
1120 - DAFT Feed Pumps		

Description		Total w/ Markups Allocated
02300 - Earthwork		15,867
03100 - Concrete Forms & Accessories		6,820
03200 - Concrete Reinforcement		21,806
03300 - Cast-In-Place Concrete		25,557
05050 - Basic Metal Materials & Methods		8,089
05500 - Metal Fabrications		6,536
11000 - Equipment		117,870
15050 - Basic Materials & Methods		31,270
16200 - Electrical Power		21,700
	1120 - DAFT Feed Pumps Total	255,515
1125 - Float Pumps		
02050 - Basic Site Materials & Methods		35,462
02300 - Earthwork		9,611
02600 - Drainage & Containment		921
05050 - Basic Metal Materials & Methods		3,645
05500 - Metal Fabrications		8,604
08300 - Specialty Doors		5,906
11000 - Equipment		58,048
15050 - Basic Materials & Methods		33,355
	1125 - Float Pumps Total	155,551
1130 - Polymer Blending Units		
03100 - Concrete Forms & Accessories		4,932
03200 - Concrete Reinforcement		1,903
03300 - Cast-In-Place Concrete		3,213
05050 - Basic Metal Materials & Methods		20,070
05500 - Metal Fabrications		19,609
09900 - Paints & Coatings		1,781
11000 - Equipment		302,579
15100 - Building Services Piping		56,474
	1130 - Polymer Blending Units Total	410,561
1135 - Polymer Storage Tank		
03100 - Concrete Forms & Accessories		6,576
03200 - Concrete Reinforcement		5,373
03300 - Cast-In-Place Concrete		11,514
05050 - Basic Metal Materials & Methods		15,478
11000 - Equipment		89,100
15050 - Basic Materials & Methods		10,423
	1135 - Polymer Storage Tank Total	138,464

Description		Total w/ Markups Allocated
1140 - Pressure Retention Tank		
11000 - Equipment		262,011
13005 - Selective Demolition		14,910
	1140 - Pressure Retention Tank Total	276,920
1145 - Odor Control Covers		
05050 - Basic Metal Materials & Methods		63,210
05500 - Metal Fabrications		1,231,630
	1145 - Odor Control Covers Total	1,294,840
1150 - Odor Control Fans & Ductwork		
11 - EQUIPMENT		87,269
15 - MECHANICAL		86,623
	1150 - Odor Control Fans & Ductwork Total	173,892
1155 - Odor Control Biofilter		
01 - GENERAL REQUIREMENTS		612
02 - SITE CONSTRUCTION		91,217
03 - CONCRETE		137,034
11 - EQUIPMENT		77,731
15 - MECHANICAL		27,884
	1155 - Odor Control Biofilter Total	334,478
5000 - Electrical, Instrumentation & Controls		
16000 - Electrical and Instrumentation		665,357
	5000 - Electrical, Instrumentation & Controls Total	665,357

BROWN AND CALDWELL

Environmental Engineers & Consultants

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DETAILED ESTIMATE REPORT

Business Case Evaluation
DAFT Modification Alternates
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PROCESS LOCATION/AREA INDEX

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Alternative 2									
	1130 - Polymer Blending Units									**186,873**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	120.0	sfca	17.59	1.98				19.57	2,349
	Concrete Forms & Accessories Total									**2,349**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	399.4	lb	0.54	0.48				1.02	409
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	108.0	EA	2.63	1.78				4.41	476
	Concrete Reinforcement Total									**885**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	3.6	CY		106.00				106.00	377
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	3.6	CY	20.01			4.62		24.62	88
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	120.0	SF	2.64					2.64	317
0750	Concrete finishing, walls, sandblast, heavy penetration	96.0	SF	5.50	1.41		0.56		7.48	718
	Cast-In-Place Concrete Total									**1,499**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	108.0	EA	11.90	0.08				11.98	1,293
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	48.0	EA	60.26	98.50		7.24		166.00	7,968
	Basic Metal Materials & Methods Total									**9,261**
	05500 - Metal Fabrications									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	05580950 - Miscellaneous Fabrication									
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	6.0	each	714.60	795.79				1,510.40	9,062
	Metal Fabrications Total									**9,062**
	09900 - Paints & Coatings									
	09910640 - B & C coating specification									
0010bc	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe & equipment)	500.0	sqft	0.92	0.74				1.66	828
	Paints & Coatings Total									**828**
	11000 - Equipment									
	11000100 - Process Equipment									
0300IK	Polymer Blending Unit	6.0	each	1,532.30	15,000.00		279.11		16,811.41	100,868
1660	Polymer static mixer, inline type, 2" dia	6.0	each	786.56	1,497.16				2,283.72	13,702
	11000900 - Pumps, general utility									
0160	Pump, cntfgl, horiz mtd, end suct,vert splt,5HP,1.5"D. Dilution Pump	6.0	each	832.80	2,850.00				3,682.80	22,097
	Equipment Total									**136,668**
	15100 - Building Services Piping									
	15108520 - Pipe, Plastic									
2520	Pipe, plastic, PVC, 2-1/2" diameter, schedule 80	360.0	LF	27.23	4.60				31.83	11,457
2520	Fittings, appurtenances,2-1/2" diameter, schedule 80, includes couplings 10' OC, and hangers 3 per 10'	360.0	LF	12.25	2.07				14.32	5,156
	15110500 - Valves, Plastic									
2680	Valves, plastic, PVC	24.0	EA	59.49	345.00				404.49	9,708
	Building Services Piping Total									**26,321**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1135 - Polymer Storage Tank									**63,409**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	160.0	sfca	17.59	1.98				19.57	3,132
	Concrete Forms & Accessories Total									**3,132**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1,664.0	lb	0.54	0.48				1.02	1,705
2000	Reinforcing steel, unload and sort, add to base	1.0	ton	41.39			8.54		49.93	51
2210	Reinforcing steel, crane cost for handling, average, add	1.0	ton	44.77			9.30		54.07	55
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	156.0	EA	2.63	1.78				4.41	688
	Concrete Reinforcement Total									**2,498**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	14.8	CY		106.00				106.00	1,570
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	14.8	CY	20.01			4.62		24.62	365
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	160.0	SF	2.64					2.64	423
0750	Concrete finishing, walls, sandblast, heavy penetration	400.0	SF	5.50	1.41		0.56		7.48	2,990
	Cast-In-Place Concrete Total									**5,348**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	156.0	EA	11.90	0.08				11.98	1,868
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	32.0	EA	60.26	98.50		7.24		166.00	5,312
	Basic Metal Materials & Methods Total									**7,180**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	11000 - Equipment									
	11000600 - Chemical Tanks									
0200	Tanks,xl-hdpe,5,800 gal,nutrient tank	4.0	each	1,415.00	8,647.64				10,062.64	40,251
	Equipment Total									**40,251**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					5,000.00	5,000.00	5,000
	Basic Materials & Methods Total									**5,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	5000 - Electrical, Instrumentation & Controls									**60,000**
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
0001	Electrical and Instrumentation Subcontract	1.0	lsum			60,000.00			60,000.00	60,000
	Electrical and Instrumentation Total									**60,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Alternative 3/4 - No Odor Control Biofilter									
	1110 - Piping Modifications									**44,338**
	09900 - Paints & Coatings									
	09910640 - B & C coating specification									
0010bc	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe & equipment)	700.0	sqft	0.92	0.74				1.66	1,159
	Paints & Coatings Total									**1,159**
	15001 - Pipe, Water Supply									
	15001002 - Water Supply, Ductile Iron Pipe									
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter (PS)	120.0	LF	25.86	26.50		5.67		58.04	6,965
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter - Fittings, Valves & Supports (PS)	120.0	LF	11.64	11.93		2.55		26.12	3,134
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter (WAS)	120.0	LF	40.59	45.50		8.97		95.06	11,407
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter - Fittings, Valves & Supports (WAS)	120.0	LF	18.26	20.48		4.04		42.78	5,133
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter (Feed Sludge)	120.0	LF	40.59	45.50		8.97		95.06	11,407
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter - Fittings, Valves & Supports (Feed Sludge)	120.0	LF	18.26	20.48		4.04		42.78	5,133
	Pipe, Water Supply Total									**43,179**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1115 - Blend Tank									**277,155**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	31.9	L.C.Y.	1.07			1.59		2.66	85
	02315310 - Compaction, General									
7500	Compaction, 2 passes, 24" wide, 6" lifts, walk behind, vibrating roller	28.7	E.C.Y.	1.89			0.38		2.27	65
7520	Compaction, 3 passes, 24" wide, 6" lifts, walk behind, vibrating roller	33.3	E.C.Y.	2.83			0.56		3.39	113
7540	Compaction, 4 passes, 24" wide, 6" lifts, walk behind, vibrating roller	66.7	E.C.Y.	3.78			0.75		4.53	302
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	134.9	cuyd	0.81			1.10		1.91	258
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	134.9	L.C.Y.	2.68			3.65		6.33	854
	02315610 - Excavating, Trench									
0060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering	139.8	B.C.Y.	5.06			1.86		6.92	967
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	77.5	L.C.Y.	9.37	48.02		2.12		59.51	4,613
	Earthwork Total									**7,257**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	96.0	sfca	17.59	1.98				19.57	1,879
	03110445 - Forms In Place, Slab On Grade									
3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	240.0	sfca	4.95	0.74				5.69	1,366
	Concrete Forms & Accessories Total									**3,245**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	8,576.1	lb	0.54	0.48				1.02	8,790
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	449.3	lb	0.54	0.48				1.02	460

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
2000	Reinforcing steel, unload and sort, add to base	4.6	ton	41.39			8.54		49.93	228
2210	Reinforcing steel, crane cost for handling, average, add	4.6	ton	44.77			9.30		54.07	247
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	92.0	EA	2.63	1.78				4.41	406
	Concrete Reinforcement Total									**10,131**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	66.7	CY		106.00				106.00	7,067
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	4.0	CY		106.00				106.00	424
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	66.7	CY	20.01			4.62		24.62	1,641
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	4.0	CY	20.01			4.62		24.62	98
	03350300 - Finishing Floors									
0150	Concrete finishing, floors, manual screed, bull float, manual float, broom finish	1,880.0	SF	0.74					0.74	1,390
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	96.0	SF	2.64					2.64	254
0750	Concrete finishing, walls, sandblast, heavy penetration	108.0	SF	5.50	1.41		0.56		7.48	807
	Cast-In-Place Concrete Total									**11,681**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	92.0	EA	11.90	0.08				11.98	1,102
0500	Concrete impact drilling, for anchors, up to 4" D, 3/4" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	214.0	EA	12.70	0.10				12.80	2,739
	05090380 - Expansion Anchors									
8300	Wedge anchor, stainless steel, 1/2" dia x 7" L, in concrete, brick or stone, excl layout & drilling	214.0	EA	4.58	5.81				10.39	2,223
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	16.0	EA	60.26	98.50		7.24		166.00	2,656
	Basic Metal Materials & Methods Total									**8,720**
	05500 - Metal Fabrications									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	05530300 - Floor Grating, Aluminum									
1900	Floor grating, aluminum, heavy duty extruded plank, 5.0 lb per S.F., 2-1/4" D, field fabricated from panels	1,700.0	SF	2.74	50.00		0.16		52.90	89,928
	05530360 - Grating Frame									
0020	Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	210.0	LF	8.34	2.88				11.22	2,357
	05580950 - Miscellaneous Fabrication									
0020bc	Pump mounting base plate, complete w/ anchor bolts, 8 sf	2.0	each	857.52	1,671.17				2,528.69	5,057
	Metal Fabrications Total									**97,343**
	11000 - Equipment									
	11000100 - Process Equipment									
0290	DAFT demo, (incl. piping; Excluding compressor, air sat tanks and covrs elsewhere)	1.0	each	36,000.00			18,000.00		54,000.00	54,000
	11001000 - Pumps miscellaneous									
0310	Pump, cntfgl, sludge mix pump, 25hp	2.0	each	2,246.06	24,276.94				26,523.00	53,046
	Equipment Total									**107,046**
	15001 - Pipe, Water Supply									
	15001002 - Water Supply, Ductile Iron Pipe									
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter (PS)	170.0	LF	25.86	26.50		5.67		58.04	9,866
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter - Fittings, Valves & Supports (PS)	170.0	LF	11.64	11.93		2.55		26.12	4,440
	Pipe, Water Supply Total									**14,306**
	16200 - Electrical Power									
	16220900 - Variable Frequency Drives/Adjustable Frequency Drives									
1160	Variable frequency drives, custom-engineered, 460 volt, 25 HP motor size	2.0	EA	3,387.91	5,325.00				8,712.91	17,426
	Electrical Power Total									**17,426**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1120 - DAFT Feed Pumps									**117,076**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	31.9	L.C.Y.	1.07			1.59		2.66	85
	02315310 - Compaction, General									
7500	Compaction, 2 passes, 24" wide, 6" lifts, walk behind, vibrating roller	28.7	E.C.Y.	1.89			0.38		2.27	65
7520	Compaction, 3 passes, 24" wide, 6" lifts, walk behind, vibrating roller	33.3	E.C.Y.	2.83			0.56		3.39	113
7540	Compaction, 4 passes, 24" wide, 6" lifts, walk behind, vibrating roller	66.7	E.C.Y.	3.78			0.75		4.53	302
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	134.9	cuyd	0.81			1.10		1.91	258
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	134.9	L.C.Y.	2.68			3.65		6.33	854
	02315610 - Excavating, Trench									
0060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering	139.8	B.C.Y.	5.06			1.86		6.92	967
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	77.5	L.C.Y.	9.37	48.02		2.12		59.51	4,613
	Earthwork Total									**7,257**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	96.0	sfca	17.59	1.98				19.57	1,879
	03110445 - Forms In Place, Slab On Grade									
3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	240.0	sfca	4.95	0.74				5.69	1,366
	Concrete Forms & Accessories Total									**3,245**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	8,576.1	lb	0.54	0.48				1.02	8,790
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	449.3	lb	0.54	0.48				1.02	460

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
2000	Reinforcing steel, unload and sort, add to base	4.6	ton	41.39			8.54		49.93	228
2210	Reinforcing steel, crane cost for handling, average, add	4.6	ton	44.77			9.30		54.07	247
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	92.0	EA	2.63	1.78				4.41	406
	Concrete Reinforcement Total									**10,131**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	66.7	CY		106.00				106.00	7,067
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	4.0	CY		106.00				106.00	424
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	66.7	CY	20.01			4.62		24.62	1,641
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	4.0	CY	20.01			4.62		24.62	98
	03350300 - Finishing Floors									
0150	Concrete finishing, floors, manual screed, bull float, manual float, broom finish	1,880.0	SF	0.74					0.74	1,390
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	96.0	SF	2.64					2.64	254
0750	Concrete finishing, walls, sandblast, heavy penetration	108.0	SF	5.50	1.41		0.56		7.48	807
	Cast-In-Place Concrete Total									**11,681**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	92.0	EA	11.90	0.08				11.98	1,102
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	16.0	EA	60.26	98.50		7.24		166.00	2,656
	Basic Metal Materials & Methods Total									**3,758**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	2.0	each	714.60	795.79				1,510.40	3,021
	Metal Fabrications Total									**3,021**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	11000 - Equipment									
	11001000 - Pumps miscellaneous									
0310	Pump, cntfgl, dilute sludge pump, complete w/ motor	2.0	each	2,246.06	24,276.94				26,523.00	53,046
	Equipment Total									**53,046**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					15,000.00	15,000.00	15,000
	Basic Materials & Methods Total									**15,000**
	16200 - Electrical Power									
	16220900 - Variable Frequency Drives/Adjustable Frequency Drives									
1130	Variable frequency drives, custom-engineered, 460 volt, 10 HP motor size	2.0	EA	1,693.96	3,275.00				4,968.96	9,938
	Electrical Power Total									**9,938**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1125 - Float Pumps									**71,548**
	02050 - Basic Site Materials & Methods									
	02080400 - Utility Boxes									
0540	Utility structures, utility vaults precast concrete, 10' x 10', 10' deep, excludes excavation and backfill	1.0	EA	4,893.62	10,207.21		1,096.18		16,197.00	16,197
	Basic Site Materials & Methods Total									**16,197**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	183.0	L.C.Y.	1.07			1.59		2.66	488
	02315310 - Compaction, General									
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	2.0	E.C.Y.	2.17			0.17		2.34	5
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	2.0	E.C.Y.	2.17			0.17		2.34	5
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	165.0	E.C.Y.	2.17			0.17		2.34	387
	02315424 - Excavating, Bulk Bank Measure									
4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	204.0	B.C.Y.	6.61			7.41		14.02	2,860
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	72.0	cuyd	0.81			1.10		1.91	138
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	72.0	L.C.Y.	2.68			3.65		6.33	456
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	2.0	L.C.Y.	9.37	43.50		2.12		54.99	110
	Earthwork Total									**4,447**
	02600 - Drainage & Containment									
	02630400 - Storm Drainage Manholes, Frames & Covers									
1300	Storm Drainage Manholes, Frames, and Covers, precast concrete, 4' diameter manhole, 8" thick top	1.0	EA	175.33	209.00		39.47		423.80	424
	Drainage & Containment Total									**424**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	30.0	EA	11.90	0.08				11.98	359
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	8.0	EA	60.26	98.50		7.24		166.00	1,328
	Basic Metal Materials & Methods Total									**1,687**
	05500 - Metal Fabrications									
	05514500 - Ladder									
0400	Ladder, shop fabricated, aluminum, 20" W, bolted to concrete, excl cage	10.0	vlft	28.20	64.50		1.71		94.40	944
	05580950 - Miscellaneous Fabrication									
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	2.0	each	714.60	795.79				1,510.40	3,021
	Metal Fabrications Total									**3,965**
	08300 - Specialty Doors									
	08310350 - Floor, Industrial									
1550	Doors, specialty, access, floor, industrial, aluminum, 300 psf L.L., double leaf, 5' x 5', 235 lb	1.0	Opng	260.16	2,400.00				2,660.16	2,660
	Specialty Doors Total									**2,660**
	11000 - Equipment									
	11001000 - Pumps miscellaneous									
0131DS	Progressive cavity pump, CI, 50 GPM, 100 PSI, 10 HP, 2 stage	2.0	each	1,433.46	11,650.44				13,083.90	26,168
	Equipment Total									**26,168**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					16,000.00	16,000.00	16,000
	Basic Materials & Methods Total									**16,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1130 - Polymer Blending Units									**186,873**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	120.0	sfca	17.59	1.98				19.57	2,349
	Concrete Forms & Accessories Total									**2,349**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	399.4	lb	0.54	0.48				1.02	409
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	108.0	EA	2.63	1.78				4.41	476
	Concrete Reinforcement Total									**885**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	3.6	CY		106.00				106.00	377
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	3.6	CY	20.01			4.62		24.62	88
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	120.0	SF	2.64					2.64	317
0750	Concrete finishing, walls, sandblast, heavy penetration	96.0	SF	5.50	1.41		0.56		7.48	718
	Cast-In-Place Concrete Total									**1,499**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	108.0	EA	11.90	0.08				11.98	1,293
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	48.0	EA	60.26	98.50		7.24		166.00	7,968
	Basic Metal Materials & Methods Total									**9,261**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	6.0	each	714.60	795.79				1,510.40	9,062
	Metal Fabrications Total									**9,062**
	09900 - Paints & Coatings									
	09910640 - B & C coating specification									
0010bc	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe & equipment)	500.0	sqft	0.92	0.74				1.66	828
	Paints & Coatings Total									**828**
	11000 - Equipment									
	11000100 - Process Equipment									
0300IK	Polymer Blending Unit	6.0	each	1,532.30	15,000.00		279.11		16,811.41	100,868
1660	Polymer static mixer, inline type, 2" dia	6.0	each	786.56	1,497.16				2,283.72	13,702
	11000900 - Pumps, general utility									
0160	Pump, cntfgl, horiz mtd, end suct,vert splt,5HP,1.5"D. Dilution Pump	6.0	each	832.80	2,850.00				3,682.80	22,097
	Equipment Total									**136,668**
	15100 - Building Services Piping									
	15108520 - Pipe, Plastic									
2520	Pipe, plastic, PVC, 2-1/2" diameter, schedule 80	360.0	LF	27.23	4.60				31.83	11,457
2520	Fittings, appurtenances,2-1/2" diameter, schedule 80, includes couplings 10' OC, and hangers 3 per 10'	360.0	LF	12.25	2.07				14.32	5,156
	15110500 - Valves, Plastic									
2680	Valves, plastic, PVC	24.0	EA	59.49	345.00				404.49	9,708
	Building Services Piping Total									**26,321**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1135 - Polymer Storage Tank									**63,409**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	160.0	sfca	17.59	1.98				19.57	3,132
	Concrete Forms & Accessories Total									**3,132**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1,664.0	lb	0.54	0.48				1.02	1,705
2000	Reinforcing steel, unload and sort, add to base	1.0	ton	41.39			8.54		49.93	51
2210	Reinforcing steel, crane cost for handling, average, add	1.0	ton	44.77			9.30		54.07	55
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	156.0	EA	2.63	1.78				4.41	688
	Concrete Reinforcement Total									**2,498**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	14.8	CY		106.00				106.00	1,570
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	14.8	CY	20.01			4.62		24.62	365
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	160.0	SF	2.64					2.64	423
0750	Concrete finishing, walls, sandblast, heavy penetration	400.0	SF	5.50	1.41		0.56		7.48	2,990
	Cast-In-Place Concrete Total									**5,348**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	156.0	EA	11.90	0.08				11.98	1,868
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	32.0	EA	60.26	98.50		7.24		166.00	5,312
	Basic Metal Materials & Methods Total									**7,180**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	11000 - Equipment									
	11000600 - Chemical Tanks									
0200	Tanks,xl-hdpe,5,800 gal,nutrient tank	4.0	each	1,415.00	8,647.64				10,062.64	40,251
	Equipment Total									**40,251**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					5,000.00	5,000.00	5,000
	Basic Materials & Methods Total									**5,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1140 - Pressure Retention Tank									**129,085**
	11000 - Equipment									
	11001700 - Compressors & Accessories									
0320	Compressors, air, receiver, 1500 gal. capacity	6.0	each	11,386.66	8,393.96			562.39	20,343.00	122,058
	Equipment Total									**122,058**
	13005 - Selective Demolition									
	13005201 - Selective Demolition, Storage Tanks									
0520	Steel tank, single wall, above ground, 550 thru 2,000 gallon, selective demolition, not including foundation, pumps or piping	6.0	EA	881.41			289.74		1,171.16	7,027
	Selective Demolition Total									**7,027**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1145 - Odor Control Covers									**583,485**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0500	Concrete impact drilling, for anchors, up to 4" D, 3/4" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	1,284.0	EA	12.70	0.10				12.80	16,435
	05090380 - Expansion Anchors									
8300	Wedge anchor, stainless steel, 1/2" dia x 7" L, in concrete, brick or stone, excl layout & drilling	1,284.0	EA	4.58	5.81				10.39	13,340
	Basic Metal Materials & Methods Total									**29,775**
	05500 - Metal Fabrications									
	05530300 - Floor Grating, Aluminum									
1900	Floor grating, aluminum, heavy duty extruded plank, 5.0 lb per S.F., 2-1/4" D, field fabricated from panels	10,200.0	SF	2.74	50.00		0.16		52.90	539,567
	05530360 - Grating Frame									
0020	Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	1,260.0	LF	8.34	2.88				11.22	14,143
	Metal Fabrications Total									**553,710**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1150 - Odor Control Fans & Ductwork									**55,306**
	11 - EQUIPMENT									
	11010 - Process Equipment									
0140	Odor control , centrifugal fan	2.0	each	1,624.68	18,010.00				19,634.68	39,269
	EQUIPMENT Total									**39,269**
	15 - MECHANICAL									
	15045 - Pipe, Fiberglass									
0100	Pipe, fitting, fbgl., 24" x 16" Tee	1.0	each	733.60	1,148.00				1,881.60	1,882
B0016	Duct, FRP, 16" dia.	25.0	lnft	67.20	36.83				104.03	2,601
B0024	Duct, FRP, 24" dia.	28.9	lnft	84.00	74.93				158.93	4,593
B1016	Fitting, FRP, 90 Elbow, 16" dia.	1.0	ea	425.60	261.62				687.22	687
B4024	Fitting, FRP, Weld, 24" dia.	8.0	ea	178.23	74.93				253.16	2,025
B4024	Fitting, FRP, Weld, 24" dia.	4.0	ea	178.23	74.93				253.16	1,013
	15095 - Pipe,drng&sewg,plyv chlrd									
0020	Piping,drainage & sewage, PVC, no exc/bkfill,10' L,SDR 35,B&S,4" dia	87.7	lnft	2.44	1.68				4.12	361
	15245 - Pipe,hgh dns ply hdpe									
0760	Pipe, plastic, HDPE, flange adapter w/ring, DR 26, 1/2 bolts, 16" dia	5.0	each		551.20				551.20	2,756
	15665 - Duct accessories									
2920	Round damper, butterfly, vol control w/lever lock rgltr, 24" dia	1.0	each	44.96	74.04				119.00	119
	MECHANICAL Total									**16,037**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	5000 - Electrical, Instrumentation & Controls									**260,000**
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
0001	Electrical and Instrumentation Subcontract	1.0	lsum			260,000.00			260,000.00	260,000
	Electrical and Instrumentation Total									**260,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Alternative 3/4 - With Odor Control Biofilter									
	1110 - Piping Modifications									**44,338**
	09900 - Paints & Coatings									
	09910640 - B & C coating specification									
0010bc	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe & equipment)	700.0	sqft	0.92	0.74				1.66	1,159
	Paints & Coatings Total									**1,159**
	15001 - Pipe, Water Supply									
	15001002 - Water Supply, Ductile Iron Pipe									
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter (PS)	120.0	LF	25.86	26.50		5.67		58.04	6,965
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter - Fittings, Valves & Supports (PS)	120.0	LF	11.64	11.93		2.55		26.12	3,134
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter (WAS)	120.0	LF	40.59	45.50		8.97		95.06	11,407
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter - Fittings, Valves & Supports (WAS)	120.0	LF	18.26	20.48		4.04		42.78	5,133
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter (Feed Sludge)	120.0	LF	40.59	45.50		8.97		95.06	11,407
2140	Ductile iron pipe, cement lined, no fittings, 16" diameter - Fittings, Valves & Supports (Feed Sludge)	120.0	LF	18.26	20.48		4.04		42.78	5,133
	Pipe, Water Supply Total									**43,179**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1115 - Blend Tank									**277,155**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	31.9	L.C.Y.	1.07			1.59		2.66	85
	02315310 - Compaction, General									
7500	Compaction, 2 passes, 24" wide, 6" lifts, walk behind, vibrating roller	28.7	E.C.Y.	1.89			0.38		2.27	65
7520	Compaction, 3 passes, 24" wide, 6" lifts, walk behind, vibrating roller	33.3	E.C.Y.	2.83			0.56		3.39	113
7540	Compaction, 4 passes, 24" wide, 6" lifts, walk behind, vibrating roller	66.7	E.C.Y.	3.78			0.75		4.53	302
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	134.9	cuyd	0.81			1.10		1.91	258
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	134.9	L.C.Y.	2.68			3.65		6.33	854
	02315610 - Excavating, Trench									
0060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering	139.8	B.C.Y.	5.06			1.86		6.92	967
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	77.5	L.C.Y.	9.37	48.02		2.12		59.51	4,613
	Earthwork Total									**7,257**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	96.0	sfca	17.59	1.98				19.57	1,879
	03110445 - Forms In Place, Slab On Grade									
3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	240.0	sfca	4.95	0.74				5.69	1,366
	Concrete Forms & Accessories Total									**3,245**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	8,576.1	lb	0.54	0.48				1.02	8,790
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	449.3	lb	0.54	0.48				1.02	460

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
2000	Reinforcing steel, unload and sort, add to base	4.6	ton	41.39			8.54		49.93	228
2210	Reinforcing steel, crane cost for handling, average, add	4.6	ton	44.77			9.30		54.07	247
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	92.0	EA	2.63	1.78				4.41	406
	Concrete Reinforcement Total									**10,131**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	66.7	CY		106.00				106.00	7,067
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	4.0	CY		106.00				106.00	424
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	66.7	CY	20.01			4.62		24.62	1,641
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	4.0	CY	20.01			4.62		24.62	98
	03350300 - Finishing Floors									
0150	Concrete finishing, floors, manual screed, bull float, manual float, broom finish	1,880.0	SF	0.74					0.74	1,390
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	96.0	SF	2.64					2.64	254
0750	Concrete finishing, walls, sandblast, heavy penetration	108.0	SF	5.50	1.41		0.56		7.48	807
	Cast-In-Place Concrete Total									**11,681**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	92.0	EA	11.90	0.08				11.98	1,102
0500	Concrete impact drilling, for anchors, up to 4" D, 3/4" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	214.0	EA	12.70	0.10				12.80	2,739
	05090380 - Expansion Anchors									
8300	Wedge anchor, stainless steel, 1/2" dia x 7" L, in concrete, brick or stone, excl layout & drilling	214.0	EA	4.58	5.81				10.39	2,223
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	16.0	EA	60.26	98.50		7.24		166.00	2,656
	Basic Metal Materials & Methods Total									**8,720**
	05500 - Metal Fabrications									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	05530300 - Floor Grating, Aluminum									
1900	Floor grating, aluminum, heavy duty extruded plank, 5.0 lb per S.F., 2-1/4" D, field fabricated from panels	1,700.0	SF	2.74	50.00		0.16		52.90	89,928
	05530360 - Grating Frame									
0020	Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	210.0	LF	8.34	2.88				11.22	2,357
	05580950 - Miscellaneous Fabrication									
0020bc	Pump mounting base plate, complete w/ anchor bolts, 8 sf	2.0	each	857.52	1,671.17				2,528.69	5,057
	Metal Fabrications Total									**97,343**
	11000 - Equipment									
	11000100 - Process Equipment									
0290	DAFT demo, (incl. piping; Excluding compressor, air sat tanks and covrs elsewhere)	1.0	each	36,000.00			18,000.00		54,000.00	54,000
	11001000 - Pumps miscellaneous									
0310	Pump, cntfgl, sludge mix pump, 25hp	2.0	each	2,246.06	24,276.94				26,523.00	53,046
	Equipment Total									**107,046**
	15001 - Pipe, Water Supply									
	15001002 - Water Supply, Ductile Iron Pipe									
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter (PS)	170.0	LF	25.86	26.50		5.67		58.04	9,866
2080	Ductile iron pipe, cement lined, no fittings, 10" diameter - Fittings, Valves & Supports (PS)	170.0	LF	11.64	11.93		2.55		26.12	4,440
	Pipe, Water Supply Total									**14,306**
	16200 - Electrical Power									
	16220900 - Variable Frequency Drives/Adjustable Frequency Drives									
1160	Variable frequency drives, custom-engineered, 460 volt, 25 HP motor size	2.0	EA	3,387.91	5,325.00				8,712.91	17,426
	Electrical Power Total									**17,426**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1120 - DAFT Feed Pumps									**117,076**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	31.9	L.C.Y.	1.07			1.59		2.66	85
	02315310 - Compaction, General									
7500	Compaction, 2 passes, 24" wide, 6" lifts, walk behind, vibrating roller	28.7	E.C.Y.	1.89			0.38		2.27	65
7520	Compaction, 3 passes, 24" wide, 6" lifts, walk behind, vibrating roller	33.3	E.C.Y.	2.83			0.56		3.39	113
7540	Compaction, 4 passes, 24" wide, 6" lifts, walk behind, vibrating roller	66.7	E.C.Y.	3.78			0.75		4.53	302
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	134.9	cuyd	0.81			1.10		1.91	258
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	134.9	L.C.Y.	2.68			3.65		6.33	854
	02315610 - Excavating, Trench									
0060	Excavating, trench or continuous footing, common earth, 1/2 C.Y. excavator, 1' to 4' deep, excludes sheeting or dewatering	139.8	B.C.Y.	5.06			1.86		6.92	967
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	77.5	L.C.Y.	9.37	48.02		2.12		59.51	4,613
	Earthwork Total									**7,257**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	96.0	sfca	17.59	1.98				19.57	1,879
	03110445 - Forms In Place, Slab On Grade									
3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	240.0	sfca	4.95	0.74				5.69	1,366
	Concrete Forms & Accessories Total									**3,245**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	8,576.1	lb	0.54	0.48				1.02	8,790
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	449.3	lb	0.54	0.48				1.02	460

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
2000	Reinforcing steel, unload and sort, add to base	4.6	ton	41.39			8.54		49.93	228
2210	Reinforcing steel, crane cost for handling, average, add	4.6	ton	44.77			9.30		54.07	247
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	92.0	EA	2.63	1.78				4.41	406
	Concrete Reinforcement Total									**10,131**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	66.7	CY		106.00				106.00	7,067
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	4.0	CY		106.00				106.00	424
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	66.7	CY	20.01			4.62		24.62	1,641
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	4.0	CY	20.01			4.62		24.62	98
	03350300 - Finishing Floors									
0150	Concrete finishing, floors, manual screed, bull float, manual float, broom finish	1,880.0	SF	0.74					0.74	1,390
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	96.0	SF	2.64					2.64	254
0750	Concrete finishing, walls, sandblast, heavy penetration	108.0	SF	5.50	1.41		0.56		7.48	807
	Cast-In-Place Concrete Total									**11,681**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	92.0	EA	11.90	0.08				11.98	1,102
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	16.0	EA	60.26	98.50		7.24		166.00	2,656
	Basic Metal Materials & Methods Total									**3,758**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	2.0	each	714.60	795.79				1,510.40	3,021
	Metal Fabrications Total									**3,021**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	11000 - Equipment									
	11001000 - Pumps miscellaneous									
0310	Pump, cntfgl, dilute sludge pump, complete w/ motor	2.0	each	2,246.06	24,276.94				26,523.00	53,046
	Equipment Total									**53,046**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					15,000.00	15,000.00	15,000
	Basic Materials & Methods Total									**15,000**
	16200 - Electrical Power									
	16220900 - Variable Frequency Drives/Adjustable Frequency Drives									
1130	Variable frequency drives, custom-engineered, 460 volt, 10 HP motor size	2.0	EA	1,693.96	3,275.00				4,968.96	9,938
	Electrical Power Total									**9,938**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1125 - Float Pumps									**71,548**
	02050 - Basic Site Materials & Methods									
	02080400 - Utility Boxes									
0540	Utility structures, utility vaults precast concrete, 10' x 10', 10' deep, excludes excavation and backfill	1.0	EA	4,893.62	10,207.21		1,096.18		16,197.00	16,197
	Basic Site Materials & Methods Total									**16,197**
	02300 - Earthwork									
	02315120 - Backfill, Structural									
4420	Backfill, structural, common earth, 200 H.P. dozer, 300' haul	183.0	L.C.Y.	1.07			1.59		2.66	488
	02315310 - Compaction, General									
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	2.0	E.C.Y.	2.17			0.17		2.34	5
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	2.0	E.C.Y.	2.17			0.17		2.34	5
7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	165.0	E.C.Y.	2.17			0.17		2.34	387
	02315424 - Excavating, Bulk Bank Measure									
4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	204.0	B.C.Y.	6.61			7.41		14.02	2,860
	02315492 - Hauling									
0009	Loading Trucks, F.E. Loader, 3 C.Y.	72.0	cuyd	0.81			1.10		1.91	138
4498	Cycle hauling(wait, load,travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 25 min load/wait/unload, 20 CY truck, cycle 20 miles, 45 MPH, no loading equipment	72.0	L.C.Y.	2.68			3.65		6.33	456
	02315640 - Utility Bedding									
0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	2.0	L.C.Y.	9.37	43.50		2.12		54.99	110
	Earthwork Total									**4,447**
	02600 - Drainage & Containment									
	02630400 - Storm Drainage Manholes, Frames & Covers									
1300	Storm Drainage Manholes, Frames, and Covers, precast concrete, 4' diameter manhole, 8" thick top	1.0	EA	175.33	209.00		39.47		423.80	424
	Drainage & Containment Total									**424**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	30.0	EA	11.90	0.08				11.98	359
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	8.0	EA	60.26	98.50		7.24		166.00	1,328
	Basic Metal Materials & Methods Total									**1,687**
	05500 - Metal Fabrications									
	05514500 - Ladder									
0400	Ladder, shop fabricated, aluminum, 20" W, bolted to concrete, excl cage	10.0	vlft	28.20	64.50		1.71		94.40	944
	05580950 - Miscellaneous Fabrication									
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	2.0	each	714.60	795.79				1,510.40	3,021
	Metal Fabrications Total									**3,965**
	08300 - Specialty Doors									
	08310350 - Floor, Industrial									
1550	Doors, specialty, access, floor, industrial, aluminum, 300 psf L.L., double leaf, 5' x 5', 235 lb	1.0	Opng	260.16	2,400.00				2,660.16	2,660
	Specialty Doors Total									**2,660**
	11000 - Equipment									
	11001000 - Pumps miscellaneous									
0131DS	Progressive cavity pump, CI, 50 GPM, 100 PSI, 10 HP, 2 stage	2.0	each	1,433.46	11,650.44				13,083.90	26,168
	Equipment Total									**26,168**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					16,000.00	16,000.00	16,000
	Basic Materials & Methods Total									**16,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1130 - Polymer Blending Units									**186,873**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	120.0	sfca	17.59	1.98				19.57	2,349
	Concrete Forms & Accessories Total									**2,349**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	399.4	lb	0.54	0.48				1.02	409
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	108.0	EA	2.63	1.78				4.41	476
	Concrete Reinforcement Total									**885**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	3.6	CY		106.00				106.00	377
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	3.6	CY	20.01			4.62		24.62	88
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	120.0	SF	2.64					2.64	317
0750	Concrete finishing, walls, sandblast, heavy penetration	96.0	SF	5.50	1.41		0.56		7.48	718
	Cast-In-Place Concrete Total									**1,499**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	108.0	EA	11.90	0.08				11.98	1,293
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	48.0	EA	60.26	98.50		7.24		166.00	7,968
	Basic Metal Materials & Methods Total									**9,261**
	05500 - Metal Fabrications									
	05580950 - Miscellaneous Fabrication									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0010bc	Pump mounting base plate, complete w/ anchor bolts, 4 sf	6.0	each	714.60	795.79				1,510.40	9,062
	Metal Fabrications Total									**9,062**
	09900 - Paints & Coatings									
	09910640 - B & C coating specification									
0010bc	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe & equipment)	500.0	sqft	0.92	0.74				1.66	828
	Paints & Coatings Total									**828**
	11000 - Equipment									
	11000100 - Process Equipment									
0300IK	Polymer Blending Unit	6.0	each	1,532.30	15,000.00		279.11		16,811.41	100,868
1660	Polymer static mixer, inline type, 2" dia	6.0	each	786.56	1,497.16				2,283.72	13,702
	11000900 - Pumps, general utility									
0160	Pump, cntfgl, horiz mtd, end suct,vert splt,5HP,1.5"D. Dilution Pump	6.0	each	832.80	2,850.00				3,682.80	22,097
	Equipment Total									**136,668**
	15100 - Building Services Piping									
	15108520 - Pipe, Plastic									
2520	Pipe, plastic, PVC, 2-1/2" diameter, schedule 80	360.0	LF	27.23	4.60				31.83	11,457
2520	Fittings, appurtenances,2-1/2" diameter, schedule 80, includes couplings 10' OC, and hangers 3 per 10'	360.0	LF	12.25	2.07				14.32	5,156
	15110500 - Valves, Plastic									
2680	Valves, plastic, PVC	24.0	EA	59.49	345.00				404.49	9,708
	Building Services Piping Total									**26,321**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1135 - Polymer Storage Tank									**63,409**
	03100 - Concrete Forms & Accessories									
	03110425 - Forms In Place, Equipment Foundations									
0050	C.I.P. concrete forms, equipment foundations, 2 use, includes erecting, bracing, stripping and cleaning	160.0	sfca	17.59	1.98				19.57	3,132
	Concrete Forms & Accessories Total									**3,132**
	03200 - Concrete Reinforcement									
	03210600 - Reinforcing In Place									
0602	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1,664.0	lb	0.54	0.48				1.02	1,705
2000	Reinforcing steel, unload and sort, add to base	1.0	ton	41.39			8.54		49.93	51
2210	Reinforcing steel, crane cost for handling, average, add	1.0	ton	44.77			9.30		54.07	55
2420	Reinforcing steel, in place, dowels, deformed, 2' long, #5, A615, grade 60	156.0	EA	2.63	1.78				4.41	688
	Concrete Reinforcement Total									**2,498**
	03300 - Cast-In-Place Concrete									
	03310220 - Concrete, Ready Mix Normal Weight									
0300	Structural concrete, ready mix, normal weight, 4000 PSI, includes local aggregate, sand, Portland cement and water, delivered, excludes all additives and treatments	14.8	CY		106.00				106.00	1,570
	03310700 - Placing Concrete									
4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes vibrating, excludes material	14.8	CY	20.01			4.62		24.62	365
	03350350 - Finishing Walls									
0150	Concrete finishing, walls, carborundum rub, wet, includes breaking ties and patching voids	160.0	SF	2.64					2.64	423
0750	Concrete finishing, walls, sandblast, heavy penetration	400.0	SF	5.50	1.41		0.56		7.48	2,990
	Cast-In-Place Concrete Total									**5,348**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	156.0	EA	11.90	0.08				11.98	1,868
	05090540 - Machinery Anchors									
0800	Machinery anchor, heavy duty, 1" dia stud & bolt, incl sleeve, floating base nut, lower stud & coupling nut, fiber plug, connecting stud, washer & nut	32.0	EA	60.26	98.50		7.24		166.00	5,312
	Basic Metal Materials & Methods Total									**7,180**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	11000 - Equipment									
	11000600 - Chemical Tanks									
0200	Tanks,xl-hdpe,5,800 gal,nutrient tank	4.0	each	1,415.00	8,647.64				10,062.64	40,251
	Equipment Total									**40,251**
	15050 - Basic Materials & Methods									
	15050010 - Miscellaneous Mechanical									
0009	Piping, process, allowance	1.0	lsum					5,000.00	5,000.00	5,000
	Basic Materials & Methods Total									**5,000**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1140 - Pressure Retention Tank									**129,085**
	11000 - Equipment									
	11001700 - Compressors & Accessories									
0320	Compressors, air, receiver, 1500 gal. capacity	6.0	each	11,386.66	8,393.96			562.39	20,343.00	122,058
	Equipment Total									**122,058**
	13005 - Selective Demolition									
	13005201 - Selective Demolition, Storage Tanks									
0520	Steel tank, single wall, above ground, 550 thru 2,000 gallon, selective demolition, not including foundation, pumps or piping	6.0	EA	881.41			289.74		1,171.16	7,027
	Selective Demolition Total									**7,027**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1145 - Odor Control Covers									**583,485**
	05050 - Basic Metal Materials & Methods									
	05090340 - Drilling									
0500	Concrete impact drilling, for anchors, up to 4" D, 3/4" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	1,284.0	EA	12.70	0.10				12.80	16,435
	05090380 - Expansion Anchors									
8300	Wedge anchor, stainless steel, 1/2" dia x 7" L, in concrete, brick or stone, excl layout & drilling	1,284.0	EA	4.58	5.81				10.39	13,340
	Basic Metal Materials & Methods Total									**29,775**
	05500 - Metal Fabrications									
	05530300 - Floor Grating, Aluminum									
1900	Floor grating, aluminum, heavy duty extruded plank, 5.0 lb per S.F., 2-1/4" D, field fabricated from panels	10,200.0	SF	2.74	50.00		0.16		52.90	539,567
	05530360 - Grating Frame									
0020	Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	1,260.0	LF	8.34	2.88				11.22	14,143
	Metal Fabrications Total									**553,710**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1150 - Odor Control Fans & Ductwork									**78,800**
	11 - EQUIPMENT									
	11010 - Process Equipment									
0140	Odor control , centrifugal fan	2.0	each	1,624.68	18,010.00				19,634.68	39,269
	EQUIPMENT Total									**39,269**
	15 - MECHANICAL									
	15045 - Pipe, Fiberglass									
0100	Pipe, fitting, fbgl., 24" x 16" Tee	1.0	each	733.60	1,148.00				1,881.60	1,882
0180	Pipe, fitting, fbgl., 24" x 16" Reducer	1.0	each	532.00	100.96				632.97	633
B0016	Duct, FRP, 16" dia.	16.3	lnft	67.20	36.83				104.03	1,698
B0024	Duct, FRP, 24" dia.	28.9	lnft	84.00	74.93				158.93	4,593
B1016	Fitting, FRP, 90 Elbow, 16" dia.	1.0	ea	425.60	261.62				687.22	687
B4024	Fitting, FRP, Weld, 24" dia.	8.0	ea	178.23	74.93				253.16	2,025
B4024	Fitting, FRP, Weld, 24" dia.	4.0	ea	178.23	74.93				253.16	1,013
B4036	Fitting, FRP, Weld, 36" dia.	1.0	ea	249.22	105.41				354.63	355
	15060 - Pipe,hdpe butt fusn jnts									
0030	Piping, HDPE butt fusion jts, SDR 21, 40' L, 8" dia	312.1	lnft	6.11	6.21		3.27		15.59	4,865
0070	Piping, HDPE butt fusion jts, SDR 21, 40 L, 16" dia	28.6	lnft	10.86	21.36		5.82		38.03	1,086
0240	Piping, HDPE butt fusion jts, SDR 21, fittings, 16" x 8" Cross	12.0	each	79.34	460.00		22.08		561.42	6,737
	15095 - Pipe,drng&sewg,plyv chlrd									
0020	Piping,drainage & sewage, PVC, no exc/bkfill,10' L,SDR 35,B&S,4" dia	87.7	lnft	2.44	1.68				4.12	361
0100	Piping, fittings, bends or elbows, 8" diameter	2.0	each	127.95	7.05				135.00	270
	15245 - Pipe,hgh dns ply hdpe									
0730	Pipe, plastic, HDPE, flange adapter w/ring, DR 26, 1/2 bolts, 8" dia	73.0	each		118.72				118.72	8,667
0760	Pipe, plastic, HDPE, flange adapter w/ring, DR 26, 1/2 bolts, 16" dia	5.0	each		551.20				551.20	2,756
0795	Pipe, plastic, HDPE, flange adapter w/ring, DR 17, 1/2 bolts, 24" dia	1.0	each		1,245.50				1,245.50	1,246
	15270 - Solenoid valves									
0030	Solenoid valve, 1 1/2" . 120 vac, fail open	2.0	each	84.00	185.50				269.50	539
	15665 - Duct accessories									
2920	Round damper, butterfly, vol control w/lever lock rgltr, 24" dia	1.0	each	44.96	74.04				119.00	119

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	MECHANICAL Total									**39,531**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	1155 - Odor Control Biofilter									**154,565**
	01 - GENERAL REQUIREMENTS									
	01220 - Wellpoint equipment rent									
0010	Rent 8" diam wellpoint discharge pipe	102.0	lf_dy			0.45			0.45	46
0040	Rent wellpoint header pipe, 6" diameter, 400 GPM	51.0	lf_dy			0.48			0.48	24
0100	Rent wellpoint 25' long w/fittings & riser pipe 1-1/2" or 2" suction	2.0	ea_dy			3.50			3.50	7
0120	Rent wellpoint pump, diesel, 30 HP, 6" suction	1.0	days			199.00			199.00	203
	GENERAL REQUIREMENTS Total									**280**
	02 - SITE CONSTRUCTION									
	02260 - Wellpoints									
0020	Wellpoints, inst&rmv of sgl stage sys, L, 2.0 hours per L.F. header	17.0	lnft	93.36					93.36	1,587
	02330 - Backfill, structural									
0050	Backfill, structural, 200 H.P., 50' haul, common earth	690.5	cuyd	0.31			0.62		0.93	643
	02340 - Bedding									
0020	Crushed stone 2' to 2.5' - Biofilter	113.2	cuyd	9.60	26.21		2.67		38.48	4,357
	02360 - Compaction									
0090	Compaction, riding, sheepsfoot or wobbly whl rlr, 6" lifts, 3 passes - backfill	497.4	cuyd	0.39			0.66		1.05	523
0090	Compaction, riding, sheepsfoot or wobbly whl rlr, 6" lifts, 3 passes - subgrade	46.9	cuyd	0.39			0.66		1.05	49
0350	Compaction, water, truck, 3000 gal, 3 mile haul	497.4	cuyd	0.48	0.22		0.72		1.42	705
	02420 - Excavating, structural									
0050	Excavating, structural, mach excav, com earth, hyd backhoe, 2 CY bkt	905.8	cuyd	4.90			7.96		12.86	11,645
	02430 - Fill									
0050	Fill, pea gravel fill, compacted, 6" deep - Biofilter	1,224.0	sqft	0.28	0.28		0.03		0.58	715
	02460 - Hauling									
0050	Hauling, LCY, no loading, 20 c.y dump truck, 20 MI RT, 0.4 lds/hr.	831.6	cuyd	5.36			11.58		16.94	14,089
0900	Loading Trucks, F.E. Loader, 3 C.Y.	831.6	cuyd	0.70			1.47		2.17	1,802
	02470 - Soil stabilization									
0020	Soil stabilization, geotextile fabric, woven, H.D., 600 lb. tensile st	482.8	sqyd	0.31	1.85				2.16	1,043
	02590 - Membrane lining systems									
0010	Membrane lining, HDPE, 60 mil thick	2,142.0	sqft	1.18	1.02				2.20	4,721

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	SITE CONSTRUCTION Total									**41,880**
	03 - CONCRETE									
	03090 - Forms place, slab grade									
0030	Forms in place, SOG, edge forms, over 12", wood	486.3	sfca	4.56	2.63				7.19	3,496
0030	Forms in place, SOG, edge forms, over 12", wood	283.3	sfca	4.56	2.63				7.19	2,037
0030	Forms in place, SOG, edge forms, over 12", wood	29.0	sfca	4.56	2.63				7.19	208
	03110 - Forms in place, walls									
0080	Forms in place, walls, job built plyform, 8-16' high	1,586.5	sfca	7.11	2.28				9.39	14,900
0080	Forms in place, walls, job built plyform, 8-16' high	314.2	sfca	7.11	2.28				9.39	2,950
0080	Forms in place, walls, job built plyform, 8-16' high	63.6	sfca	7.11	2.28				9.39	598
	03120 - Waterstop									
0020	Waterstop, PVC, ribbed 3/16" thick, 6" wide	103.0	lnft	2.81	1.58				4.39	452
0020	Waterstop, PVC, ribbed 3/16" thick, 6" wide	20.4	lnft	2.81	1.58				4.39	90
0020	Waterstop, PVC, ribbed 3/16" thick, 6" wide	6.1	lnft	2.81	1.58				4.39	27
0030	Waterstop, PVC, ribbed, w/center bulb, 3/16" thick, 9" wide	283.3	lnft	3.02	12.97				15.99	4,531
0030	Waterstop, PVC, ribbed, w/center bulb, 3/16" thick, 9" wide	243.2	lnft	3.02	12.97				15.99	3,888
0030	Waterstop, PVC, ribbed, w/center bulb, 3/16" thick, 9" wide	29.0	lnft	3.02	12.97				15.99	464
	03130 - Reinforcing in place									
0080	Reinforcing in place, A615 Gr 60, walls, #3 to #7	2.5	ton	640.64	920.00				1,560.64	3,946
0080	Reinforcing in place, A615 Gr 60, walls, #3 to #7	1.9	ton	640.64	920.00				1,560.64	2,914
0080	Reinforcing in place, A615 Gr 60, walls, #3 to #7	0.4	ton	640.64	920.00				1,560.64	586
0080	Reinforcing in place, A615 Gr 60, walls, #3 to #7	0.4	ton	640.64	920.00				1,560.64	556
0080	Reinforcing in place, A615 Gr 60, walls, #3 to #7	0.1	ton	640.64	920.00				1,560.64	126
0080	Reinforcing in place, A615 Gr 60, walls, #3 to #7	0.0	ton	640.64	920.00				1,560.64	57
0130	Reinforcing in place, A615 Gr 60, dowels, longer and heavier dowels	465.6	lb	1.32	2.49				3.81	1,776
0130	Reinforcing in place, A615 Gr 60, dowels, longer and heavier dowels	442.1	lb	1.32	2.49				3.81	1,687
0130	Reinforcing in place, A615 Gr 60, dowels, longer and heavier dowels	150.5	lb	1.32	2.49				3.81	574
0130	Reinforcing in place, A615 Gr 60, dowels, longer and heavier dowels	150.5	lb	1.32	2.49				3.81	574
0130	Reinforcing in place, A615 Gr 60, dowels, longer and heavier dowels	56.4	lb	1.32	2.49				3.81	215
0130	Reinforcing in place, A615 Gr 60, dowels, longer and heavier dowels	42.3	lb	1.32	2.49				3.81	161
	03150 - Concrete, ready mix									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
0030	Concrete, ready mix, regular weight, 4000 psi	39.8	cuyd		106.00				106.00	4,221
0030	Concrete, ready mix, regular weight, 4000 psi	29.4	cuyd		106.00				106.00	3,114
0030	Concrete, ready mix, regular weight, 4000 psi	10.5	cuyd		106.00				106.00	1,110
0030	Concrete, ready mix, regular weight, 4000 psi	5.8	cuyd		106.00				106.00	617
0030	Concrete, ready mix, regular weight, 4000 psi	1.2	cuyd		106.00				106.00	125
0030	Concrete, ready mix, regular weight, 4000 psi	0.5	cuyd		106.00				106.00	53
	03170 - Placing concrete									
0120	Placing conc, incl vib, slab on grade, slab over 6" thick, pumped	39.8	cuyd	17.17			6.60		23.77	947
0120	Placing conc, incl vib, slab on grade, slab over 6" thick, pumped	10.5	cuyd	17.17			6.60		23.77	249
0120	Placing conc, incl vib, slab on grade, slab over 6" thick, pumped	0.5	cuyd	17.17			6.60		23.77	12
0130	Placing conc, incl vib, walls, 8" thick, pumped	29.4	cuyd	31.76			12.22		43.98	1,292
0130	Placing conc, incl vib, walls, 8" thick, pumped	5.8	cuyd	31.76			12.22		43.98	256
0130	Placing conc, incl vib, walls, 8" thick, pumped	1.2	cuyd	31.76			12.22		43.98	52
	03180 - Finishing floors									
0030	Finishing floors, monolithic, screed, float & broom finish	1,075.1	sqft	0.65					0.65	696
0030	Finishing floors, monolithic, screed, float & broom finish	141.3	sqft	0.65					0.65	91
0030	Finishing floors, monolithic, screed, float & broom finish	13.6	sqft	0.65					0.65	9
	03190 - Finishing walls									
0010	Finishing walls, break ties & patch voids	999.3	sqft	0.75	0.03				0.79	786
0010	Finishing walls, break ties & patch voids	197.9	sqft	0.75	0.03				0.79	156
0010	Finishing walls, break ties & patch voids	44.1	sqft	0.75	0.03				0.79	35
0020	Finishing walls, carborundum rub, wet rub	927.2	sqft	2.33	0.03				2.36	2,189
0020	Finishing walls, carborundum rub, wet rub	204.0	sqft	2.33	0.03				2.36	482
0020	Finishing walls, carborundum rub, wet rub	49.0	sqft	2.33	0.03				2.36	116
	CONCRETE Total									**63,419**
	11 - EQUIPMENT									
	11010 - Process Equipment									
0030	Bio-filter media componant, complete	3,672.0	cuft	5.86	2.54		1.40		9.81	36,029
0990	Soaker Hose	20.0	ea		10.00				10.00	200
	EQUIPMENT Total									**36,229**
	15 - MECHANICAL									

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	15045 - Pipe, Fiberglass									
B1036	Fitting, FRP, 90 Elbow, 36" dia.	1.0	ea	896.00	1,121.41				2,017.41	2,017
	15050 - Pipe,watr dstr,plyth,c901									
0030	Piping, piping, 160 p.s.i., 1-1/2" diameter	97.2	lnft	2.04	0.97				3.00	292
0190	Piping, fittings, tee, 1-1/2" diameter	10.0	each	27.77	5.24				33.01	330
	15055 - Pipe,watr dstr,plyv chlrd									
0090	PVC pipe, class 160, sdr 26, 8" diameter	188.7	lnft	3.52	13.45				16.97	3,203
0090	PVC pipe, class 160, sdr 26, 8" diameter	17.0	lnft	4.63	14.38				19.01	323
0710	Piping, fittings, bends or elbows, 8" diameter	1.0	each	11.46	124.96				136.41	136
0760	Piping, fittings, wye or tee, 8" diameter	16.0	each	13.09	198.74				211.83	3,389
	15095 - Pipe,drng&sewg,plyv chlrd									
0120	Piping, drainage & sewage, PVC, tees, 8" diam.	1.0	each	112.03	38.97				151.00	151
	15115 - Pipe,subdraing,plastic									
0030	Piping, subdrainage, perforated PVC, 8" dia	176.8	lnft	8.18	2.43		1.16		11.77	2,081
	15395 - Cleanouts									
0060	Cleanouts, flr type, rnd top, xtra hvy dty, 8" pipe size	1.0	each	201.58	438.15				639.73	640
	15665 - Duct accessories									
2940	Round damper, butterfly, vol control w/lever lock rgltr, 36" dia	1.0	each	56.20	137.31				193.51	194
	MECHANICAL Total									**12,756**

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	5000 - Electrical, Instrumentation & Controls									**305,000**
	16000 - Electrical and Instrumentation									
	16000000 - Electrical and Instrumentation									
0001	Electrical and Instrumentation Subcontract	1.0	lsum			305,000.00			305,000.00	305,000
	Electrical and Instrumentation Total									**305,000**

Business Case Evaluation
DAFT Modification Alternates

Item	Item Description	Qty	Unit	Labor $/Unit	Materials $/Unit	Subs $/Unit	Equip $/Unit	Other $/Unit	Total $/Unit	Total Net Cost $
	Grand Total									**4,109,892**

Category	Percent	Amount
Alternative 2 Totals		
Labor	**1.55 %**	**63,585**
Material	**4.36 %**	**179,062**
Subcontractor	**1.46 %**	**60,000**
Equipment	**0.06 %**	**2,636**
Other	**0.12 %**	**5,000**
User		
Net Costs		**310,282**
Subcontractor Mark-up	5.00 %	3,000
Sales tax	7.75 %	14,082
Escalation to midpoint of construct	7.68 %	23,830
Contractor General Conditions	10.00 %	35,119
Subtotal		386,313
Construction Contingency	25.00 %	96,578
Estimating Contingency	15.00 %	57,947
Engineering, Legal, and Admin	30.00 %	115,894

Category	Percent	Amount
Subtotal		656,732
Bldg Risk, Liability Auto Ins.	2.00 %	13,135
Subtotal		669,866
Bonds	1.50 %	10,048
Subtotal		679,914
Total Alternative 2		**679,914**
Alternative 3/4 - No Odor Control Biofilter Totals		
Labor	**8.48 %**	**348,646**
Material	**26.85 %**	**1,103,496**
Subcontractor	**6.33 %**	**260,000**
Equipment	**0.89 %**	**36,758**
Other	**0.96 %**	**39,374**
User		
Net Costs		**1,788,275**
Subcontractor Mark-up	5.00 %	13,000
Sales tax	7.75 %	88,370
Escalation to midpoint of construct	7.68 %	137,340

Category	Percent	Amount
Contractor General Conditions	10.00 %	202,698
Subtotal		2,229,683
Construction Contingency	25.00 %	557,421
Estimating Contingency	15.00 %	334,452
Engineering, Legal, and Admin	30.00 %	668,905
Subtotal		3,790,461
Bldg Risk, Liability Auto Ins.	2.00 %	75,809
Subtotal		3,866,270
Bonds	1.50 %	57,994
Subtotal		3,924,264
Total Alternative 3/4 - No Odor Control Biofilter		**3,924,264**
Alternative 3/4 - With Odor Control Biofilter Totals		
Labor	**10.35 %**	**425,216**
Material	**28.65 %**	**1,177,569**
Subcontractor	**7.43 %**	**305,280**
Equipment	**1.55 %**	**63,895**
Other	**0.96 %**	**39,374**

Category	Percent	Amount
User		
Net Costs		**2,011,334**
Subcontractor Mark-up	5.00 %	15,264
Sales tax	7.75 %	96,213
Escalation to midpoint of construct	7.68 %	154,470
Contractor General Conditions	10.00 %	227,728
Subtotal		2,505,010
Construction Contingency	25.00 %	626,253
Estimating Contingency	15.00 %	375,752
Engineering, Legal, and Admin	30.00 %	751,503
Subtotal		4,258,518
Bldg Risk, Liability Auto Ins.	2.00 %	85,170
Subtotal		4,343,688
Bonds	1.50 %	65,155
Subtotal		4,408,843
Total Alternative 3/4 - With Odor Control Biofilter		**4,408,843**

ATTACHMENT B: CALCULATIONS

Polymer Feed Calculations

lbPolymer := lb dryton := ton

PeakMonthLoad := 497800 $\frac{lb}{day}$

Polymer dose in active pounds per dry ton of sludge

PolymerDoseMin := 5 $\frac{lbPolymer}{dryton}$

PolymerDoseMax := 5.5 $\frac{lbPolymer}{dryton}$ Value based on Hayward and Annacis

Mannich Polymer Data

MannichWeight := 8.41 $\frac{lbPolymer}{gal}$ Values from Tim Kelley's USD calculations

MannichActivePercent := 0.05 *Use Mannich Polymer with 5% active fraction*

Emulsion Polymer Data

EmulsionWeight := 8.50 $\frac{lb}{gal}$ Values from polymer data sheet

EmulsionActivePercent := 0.40 *Use Emulsion Polymer with 40% active fraction*

Calculate amount of *active* polymer needed to achieve dose

ActivePolymer := PeakMonthLoad PolymerDoseMax *Assume max dose*
Assume dose is the same regardless of influent solids percentage

ActivePolymer = 1369· $\frac{lbPolymer}{day}$

Mannich Polymer flow rate needed for Peak Month Load

$$Q_{Mannich} := \frac{ActivePolymer}{MannichActivePercent \cdot MannichWeight}$$

$$Q_{Mannich} = 135.6 \cdot \frac{gal}{hr}$$

Volume of Mannich Storage

$$VolumeMannich := Q_{Mannich} \cdot 7day$$

Provide storage for a week's worth of polymer

$$VolumeMannich = 22789 \cdot gal$$

Dilution Water for Mannich System

$$DilutionPercentage_{Mannich} := 0.02$$

Value from Tim Kelley - 3/19/07

$$Q_{MannichDil} := \frac{Q_{Mannich}}{DilutionPercentage_{Mannich}}$$

$$Q_{MannichDil} = 6782 \cdot \frac{gal}{hr}$$

$$Q_{DilutionWaterMannich} := Q_{MannichDil} - Q_{Mannich}$$

$$Q_{DilutionWaterMannich} = 6647 \cdot \frac{gal}{hr}$$

Emulsion Polymer flow rate needed for Peak Month Load

$$Q_{Emulsion} := \frac{ActivePolymer}{EmulsionActivePercent \cdot EmulsionWeight}$$

$$Q_{Emulsion} = 16.78 \cdot \frac{gal}{hr}$$

Volume of Emulsion Storage

$$VolumeEmulsion := Q_{Emulsion} \cdot 7day$$

Provide storage for a week's worth of polymer

$$VolumeEmulsion = 2818 \cdot gal$$

Dilution Water

$$DilutionPercentage := 0.005$$

$$Q_{EmulsionDil} := \frac{Q_{Emulsion}}{DilutionPercentage}$$

$$Q_{EmulsionDil} = 3355 \cdot \frac{gal}{hr}$$

$$Q_{DilutionWaterEmulsion} := Q_{EmulsionDil} - Q_{Emulsion}$$

$$Q_{DilutionWaterEmulsion} = 3338 \cdot \frac{gal}{hr}$$

Average Annual Polymer Consumption

$WAS_{Ave} := 144600 \frac{lb}{day}$

$dollar := 1$

$Blend_{Ave} := 377300 \frac{lb}{day}$

$PolymerLoad_{WAS} := WAS_{Ave} \cdot PolymerDoseMax = 145239 \cdot \frac{lb}{yr}$

$PolymerLoad_{Blend} := Blend_{Ave} \cdot PolymerDoseMax = 378966 \cdot \frac{lb}{yr}$

$PolymerCost_{WAS} := PolymerLoad_{WAS} \cdot 1.75 \frac{dollar}{lb} = 254167 \cdot \frac{dollar}{yr}$

$PolymerCost_{Blend} := PolymerLoad_{Blend} \cdot 1.75 \frac{dollar}{lb} = 663191 \cdot \frac{dollar}{yr}$

Assumptions/Definitions

Basis: 65 psig saturation pressure, design for saturation system for each DAFT.

$\rho := 8.34 \cdot \frac{lb}{gal}$ dollar := 1 i := 0 .. 1

SaturationPressure := 65psi

PeakDayTSSLoad := $210400 \frac{lb}{day}$

Peak Day is actually peak 2 week for WAS TSS

Values from TM 3.3

PeakMonthTSSLoad := $202700 \frac{lb}{day}$

AverageTSSLoad := $144600 \frac{lb}{day}$

$$AirSolidsRatio := \begin{pmatrix} 0.0064 \\ 0.012 \end{pmatrix} \cdot \frac{mL}{mg} \cdot 0.078 \frac{lb}{ft^3} = \begin{pmatrix} 0.008 \\ 0.015 \end{pmatrix} \cdot \frac{lb}{lb}$$

Saturation System Design

A. Calculate the peak day, peak month, and average inlet air flowrates

$$ReqAir_{Peak_i} := \frac{AirSolidsRatio_i \cdot PeakDayTSSLoad}{6}$$

$$ReqAir_{Peak} = \begin{pmatrix} 12 \\ 22 \end{pmatrix} \cdot \frac{lb}{hr}$$

$$ReqAir_{PeakMonth_i} := \frac{AirSolidsRatio_i \cdot PeakMonthTSSLoad}{6}$$

$$ReqAir_{PeakMonth} = \begin{pmatrix} 11 \\ 21 \end{pmatrix} \cdot \frac{lb}{hr}$$

$$ReqAir_{Ave_i} := \frac{AirSolidsRatio_i \cdot AverageTSSLoad}{5}$$

$$ReqAir_{Ave} = \begin{pmatrix} 10 \\ 18 \end{pmatrix} \cdot \frac{lb}{hr}$$

Note that during peak day and peak month conditions that all 6 DAFTs will be in service therefore reducing the load on each DAFT's saturation system. At average conditions one unit will be out of service.

Assume: 85% efficiency at saturation pressure
95% efficiency at release pressure

$Eff_{psat} := 85 \cdot \%$ $Eff_{prelease} := 95 \cdot \%$

$$AirInput_{Peak} := \frac{6ReqAir_{Peak}}{Eff_{psat} \cdot Eff_{prelease}} \qquad AirInput_{Peak} = \begin{pmatrix} 87 \\ 163 \end{pmatrix} \cdot \frac{lb}{hr}$$

$$AirInput_{PeakMonth} := \frac{6 \cdot ReqAir_{PeakMonth}}{Eff_{psat} \cdot Eff_{prelease}} \qquad AirInput_{PeakMonth} = \begin{pmatrix} 84 \\ 157 \end{pmatrix} \cdot \frac{lb}{hr}$$

$$AirInput_{Ave} := \frac{5 \cdot ReqAir_{Ave}}{Eff_{psat} \cdot Eff_{prelease}} \qquad AirInput_{Ave} = \begin{pmatrix} 60 \\ 112 \end{pmatrix} \cdot \frac{lb}{hr}$$

B. Calculate the pressurizied liquid flowrate required to saturate the inlet air flowrate

i) Calculate the Saturation Constant (C_S) for Air in Water using Henry's Law at 75 deg F

$P_{AirSat} := 5.42 \cdot atm$ $P_{AirRelease} := 1atm$ $H_C := 70756 \cdot atm$

$$C_s := \frac{55.6 \cdot \frac{mol}{liter}}{H_C} \cdot \left(P_{AirSat} - P_{AirRelease}\right) \cdot 29 \cdot \frac{gm}{mol}$$

(Reference Appendix B of Design Guideline 11.2.1 for derivation)

$$C_s = 101 \cdot \frac{mg}{liter}$$

$$RecycleHydraulicLoad_{Peak} := \frac{AirInput_{Peak}}{C_s} \qquad RecycleHydraulicLoad_{Peak} = \begin{pmatrix} 1721 \\ 3227 \end{pmatrix} \cdot \frac{gal}{min}$$

$$RecycleHydraulicLoad_{PeakMonth} := \frac{AirInput_{PeakMonth}}{C_s} \qquad RecycleHydraulicLoad_{PeakMonth} = \begin{pmatrix} 1658 \\ 3109 \end{pmatrix} \cdot \frac{gal}{min}$$

$$RecycleHydraulicLoad_{Ave} := \frac{AirInput_{Ave}}{C_s} \qquad RecycleHydraulicLoad_{Ave} = \begin{pmatrix} 1183 \\ 2218 \end{pmatrix} \cdot \frac{gal}{min}$$

$\rho_{air} := 1.199 \cdot \frac{kg}{m^3}$ $\rho_{air} = 0.07 \cdot \frac{lb}{ft^3}$

$AirFlow_{design} := \frac{AirInput_{Peak}}{\rho_{air}}$

$AirFlow_{design} = \begin{pmatrix} 19 \\ 36 \end{pmatrix} \cdot \frac{ft^3}{min}$

The basis for compressor design is that each compressor must meet the peak day air requirement with redundancy

Calculate Ave Annual Power Usage

$PressurizationPumpPower_i := \frac{RecycleHydraulicLoad_{Ave_i} \cdot \frac{65 \cdot psi}{\rho \cdot g} \cdot \rho \cdot g}{.7}$

$PressurizationPumpPower = \begin{pmatrix} 418859 \\ 785361 \end{pmatrix} \cdot \frac{kW \cdot hr}{yr}$ $PressurizationPumpPower = \begin{pmatrix} 64 \\ 120 \end{pmatrix} \cdot hp$

$CompressorRating := 4.0 \cdot \frac{\frac{ft^3}{min}}{hp}$

Value from Scott Parr - rating at 100 psi
Includes compressor efficiencies

$DAFAirPower_i := \frac{AirFlow_{design_i}}{CompressorRating}$ $DAFAirPower = \begin{pmatrix} 31589 \\ 59229 \end{pmatrix} \cdot \frac{kW \cdot hr}{yr}$

$TotalDAFPower_i := PressurizationPumpPower_i + DAFAirPower_i$

$TotalDAFPower = \begin{pmatrix} 450448 \\ 844590 \end{pmatrix} \cdot \frac{kW \cdot hr}{yr}$

$TotalCost_i := TotalDAFPower_i \cdot 0.105 \frac{dollar}{kW \cdot hr}$

$TotalCost = \begin{pmatrix} 47297 \\ 88682 \end{pmatrix} \cdot \frac{dollar}{yr}$

Assumptions/Definitions

Basis: 65 psig saturation pressure, design for saturation system for each DAFT.

$\rho := 8.34 \cdot \frac{lb}{gal}$ dollar := 1 i := 0 .. 1

SaturationPressure := 65psi

PeakDayTSSLoad := $577100 \frac{lb}{day}$

PeakMonthTSSLoad := $497800 \frac{lb}{day}$

Values from TM 3.3

AverageTSSLoad := $377300 \frac{lb}{day}$

$$AirSolidsRatio := \begin{pmatrix} 0.0064 \\ 0.012 \end{pmatrix} \cdot \frac{mL}{mg} \cdot 0.078 \frac{lb}{ft^3} = \begin{pmatrix} 0.008 \\ 0.015 \end{pmatrix} \cdot \frac{lb}{lb}$$

Saturation System Design

A. Calculate the peak day, peak month, and average inlet air flowrates

$$ReqAir_{Peak_i} := \frac{AirSolidsRatio_i \cdot PeakDayTSSLoad}{6}$$

$$ReqAir_{Peak} = \begin{pmatrix} 32 \\ 60 \end{pmatrix} \cdot \frac{lb}{hr}$$

$$ReqAir_{PeakMonth_i} := \frac{AirSolidsRatio_i \cdot PeakMonthTSSLoad}{6}$$

$$ReqAir_{PeakMonth} = \begin{pmatrix} 28 \\ 52 \end{pmatrix} \cdot \frac{lb}{hr}$$

$$ReqAir_{Ave_i} := \frac{AirSolidsRatio_i \cdot AverageTSSLoad}{5}$$

$$ReqAir_{Ave} = \begin{pmatrix} 25 \\ 47 \end{pmatrix} \cdot \frac{lb}{hr}$$

Note that during peak day and peak month conditions that all 6 DAFTs will be in service therefore reducing the load on each DAFT's saturation system. At average conditions one unit will be out of service.

Assume: 85% efficiency at saturation pressure
95% efficiency at release pressure

$Eff_{psat} := 85 \cdot \%$ $Eff_{prelease} := 95 \cdot \%$

$$AirInput_{Peak} := \frac{6ReqAir_{Peak}}{Eff_{psat} \cdot Eff_{prelease}} \qquad AirInput_{Peak} = \begin{pmatrix} 238 \\ 446 \end{pmatrix} \cdot \frac{lb}{hr}$$

$$AirInput_{PeakMonth} := \frac{6 \cdot ReqAir_{PeakMonth}}{Eff_{psat} \cdot Eff_{prelease}} \qquad AirInput_{PeakMonth} = \begin{pmatrix} 205 \\ 385 \end{pmatrix} \cdot \frac{lb}{hr}$$

$$AirInput_{Ave} := \frac{5 \cdot ReqAir_{Ave}}{Eff_{psat} \cdot Eff_{prelease}} \qquad AirInput_{Ave} = \begin{pmatrix} 156 \\ 292 \end{pmatrix} \cdot \frac{lb}{hr}$$

B. Calculate the pressurizied liquid flowrate required to saturate the inlet air flowrate

i) Calculate the Saturation Constant (C_S) for Air in Water using Henry's Law at 75 deg F

$P_{AirSat} := 5.42 \cdot atm$ $P_{AirRelease} := 1atm$ $H_C := 70756 \cdot atm$

$$C_s := \frac{55.6 \cdot \frac{mol}{liter}}{H_C} \cdot \left(P_{AirSat} - P_{AirRelease}\right) \cdot 29 \cdot \frac{gm}{mol}$$

(Reference Appendix B of Design Guideline 11.2.1 for derivation)

$$C_s = 101 \cdot \frac{mg}{liter}$$

$$RecycleHydraulicLoad_{Peak} := \frac{AirInput_{Peak}}{C_s} \qquad RecycleHydraulicLoad_{Peak} = \begin{pmatrix} 4721 \\ 8852 \end{pmatrix} \cdot \frac{gal}{min}$$

$$RecycleHydraulicLoad_{PeakMonth} := \frac{AirInput_{PeakMonth}}{C_s} \qquad RecycleHydraulicLoad_{PeakMonth} = \begin{pmatrix} 4073 \\ 7636 \end{pmatrix} \cdot \frac{gal}{min}$$

$$RecycleHydraulicLoad_{Ave} := \frac{AirInput_{Ave}}{C_s} \qquad RecycleHydraulicLoad_{Ave} = \begin{pmatrix} 3087 \\ 5788 \end{pmatrix} \cdot \frac{gal}{min}$$

$$\rho_{air} := 1.199 \cdot \frac{kg}{m^3} \qquad \rho_{air} = 0.07 \cdot \frac{lb}{ft^3}$$

$$AirFlow_{design} := \frac{AirInput_{Peak}}{\rho_{air}}$$

$$AirFlow_{design} = \begin{pmatrix} 53 \\ 99 \end{pmatrix} \cdot \frac{ft^3}{min}$$

The basis for compressor design is that each compressor must meet the peak day air requirement with redundancy

Calculate Ave Annual Power Usage

$$PressurizationPumpPower_i := \frac{RecycleHydraulicLoad_{Ave_i} \cdot \frac{65 \cdot psi}{\rho \cdot g} \cdot \rho \cdot g}{.7}$$

$$PressurizationPumpPower = \begin{pmatrix} 1092915 \\ 2049216 \end{pmatrix} \cdot \frac{kW \cdot hr}{yr} \qquad PressurizationPumpPower = \begin{pmatrix} 167 \\ 313 \end{pmatrix} \cdot hp$$

$$CompressorRating := 4.0 \cdot \frac{\frac{ft^3}{min}}{hp}$$

Value from Scott Parr - rating at 100 psi
Includes compressor efficiencies

$$DAFAirPower_i := \frac{AirFlow_{design_i}}{CompressorRating}$$

$$DAFAirPower = \begin{pmatrix} 86644 \\ 162458 \end{pmatrix} \cdot \frac{kW \cdot hr}{yr}$$

$$TotalDAFPower_i := PressurizationPumpPower_i + DAFAirPower_i$$

$$TotalDAFPower = \begin{pmatrix} 1179559 \\ 2211674 \end{pmatrix} \cdot \frac{kW \cdot hr}{yr}$$

$$TotalCost_i := TotalDAFPower_i \cdot 0.105 \frac{dollar}{kW \cdot hr}$$

$$TotalCost = \begin{pmatrix} 123854 \\ 232226 \end{pmatrix} \cdot \frac{dollar}{yr}$$

Objective: Calculate the heating savings obtained by thickening to 4.28% or 5.5% vs. 3.5% before the digesters.

Assumptions/Definitions

Analysis takes place in 2015. Subsequent years will be calculated in excel sheet.

$dollar := 1 \qquad therm := 1\,10^{5}BTU \qquad degreeF := 1$

$cost := 0.75\,\frac{dollar}{therm}$ Cost from R. Merlo, used in previous SJ work

$c_p := 1.0\,\frac{BTU}{lb \cdot degreeF}$ Value from Civil Engineering Reference Manual

$Peak2WeekQ_{5.5\%} := \frac{264692\,\frac{lb}{day}}{0.055 \cdot 8.34\,\frac{lb}{gal}} = 0.58 \cdot mgd$

2015 loads derived from 2030 projections

$Peak2WeekQ_{4.28\%} := \frac{264692\,\frac{lb}{day}}{0.0428 \cdot 8.34\,\frac{lb}{gal}} = 0.74 \cdot mgd$

$Peak2WeekQ_{3.5\%} := \frac{264692\,\frac{lb}{day}}{0.035 \cdot 8.34\,\frac{lb}{gal}} = 0.91 \cdot mgd$

$T_{Initial} := 70degreeF$

$T_{Final} := 95degreeF$

$HeatLoss_{Digester} := 672347\,\frac{BTU}{hr}$ Value from digester heating calcs excel sheet by A. Ross

Calculations

$$Heat_{4.5\%} := \left(Peak2WeekQ_{3.5\%} - Peak2WeekQ_{4.28\%}\right) \cdot 8.34 \frac{lb}{gal} \cdot \left(T_{Final} - T_{Initial}\right) \cdot c_p + HeatLoss_{Digester} = 184784 \cdot \frac{therm}{yr}$$

$$CostSavings_{4.5\%} := Heat_{4.5\%} \cdot cost = 138588 \cdot \frac{dollar}{yr}$$

$$Heat_{5.5\%} := \left(Peak2WeekQ_{3.5\%} - Peak2WeekQ_{5.5\%}\right) \cdot 8.34 \frac{lb}{gal} \cdot \left(T_{Final} - T_{Initial}\right) \cdot c_p + HeatLoss_{Digester} = 310045 \cdot \frac{therm}{yr}$$

$$CostSavings_{5.5\%} := Heat_{5.5\%} \cdot cost = 232534 \cdot \frac{dollar}{yr}$$

ATTACHMENT C: LIFE CYCLE COST WORKSHEETS

Net Present Value Detail – 15 yr Analysis

San Jose/Santa Clara WPCP DAFT Alternatives	Results ($000s) Capital Cost	30-year NPV
Status quo		($657,686)
Status quo w/ polymer addition	($10,822,274)	$11,672,386
Co-thickening w/o odor control	($20,496,910)	$18,575,174
Co-thickening w/ odor control light	($19,080,112)	$17,101,127
Co-thickening w/ odor control heavy	($18,595,533)	$16,616,548

From Summary Sheet:

Year of analysis	2015
Escalation rate	3.00%
Discount rate	5.00%

Risk adjustments (+/- percent):

Benefits	
Capital costs	
Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life cycle Alternative Cost Analysis ($000s)
Alternative 1 - Status quo

	Year															
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Expressed in 2015 dollars, unescalated																
Annual Running Costs:																
DAFT power (air saturation)	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297
Total running costs		**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**
Life cycle cost analysis																
PVs in 2015	(47,297)	(46,396)	(45,512)	(44,645)	(43,795)	(42,961)	(42,143)	(41,340)	(40,552)	(39,780)	(39,022)	(38,279)	(37,550)	(36,835)	(36,133)	(35,445)
NPV as of 2015	**(657,686)**															

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 2 - Status quo w/ polymer addition

	Year															
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Expressed in 2015 dollars, unescalated																
Capital Outlays																
Addition of polymer system	679,914															
Reduction in digester volume	(11,502,188)															
Total capital outlays	**(10,822,274)**															
Benefits:																
Digester reduction savings	270,715	265,663	267,811	269,959	272,107	281,456	276,404	278,552	280,700	282,848	1,675,013	287,145	289,293	291,441	293,589	302,938
Total benefits	**270,715**	**265,663**	**267,811**	**269,959**	**272,107**	**281,456**	**276,404**	**278,552**	**280,700**	**282,848**	**1,675,013**	**287,145**	**289,293**	**291,441**	**293,589**	**302,938**
Annual Running Costs:																
DAFT power (air saturation)	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297
Polymer	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167
Total running costs		**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**
Life cycle cost analysis																
PVs in 2015	10,791,525	(35,119)	(32,383)	(29,739)	(27,183)	(18,174)	(22,329)	(20,026)	(17,803)	(15,657)	1,133,244	(11,589)	(9,663)	(7,806)	(6,016)	1,104
NPV as of 2015	**11,672,386**															

Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 3 - Co-thickening w/o odor control

	Year															
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Expressed in 2015 dollars, unescalated																
Capital Outlays																
Project capital cost	2,507,466															
Reduction in digester volume	(17,253,282)				(5,751,094)											
Total capital outlays	**(14,745,816)**				**(5,751,094)**											
Benefits:																
Digester reduction savings	458,579	453,117	458,455	463,793	540,931	560,669	551,607	556,945	562,283	567,621	2,661,583	578,296	583,634	588,972	1,285,718	614,048
Total benefits	**458,579**	**453,117**	**458,455**	**463,793**	**540,931**	**560,669**	**551,607**	**556,945**	**562,283**	**567,621**	**2,661,583**	**578,296**	**583,634**	**588,972**	**1,285,718**	**614,048**
Annual Running Costs:																
DAFT power (air saturation)	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854
Polymer	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191
Blend sludge transfer pumping	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146
Blend sludge mix pumping	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154
Total running costs		**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**
Life cycle cost analysis																
PVs in 2015	14,395,050	(349,443)	(337,650)	(326,180)	5,076,736	(225,878)	(229,650)	(220,610)	(211,832)	(203,307)	1,528,185	(186,996)	(179,196)	(171,626)	363,930	(146,358)
NPV as of 2015	**18,575,174**															

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 4a - Co-thickening w/ odor control light

	Year															
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Expressed in 2015 dollars, unescalated																
Capital Outlays																
Project capital cost	3,924,264															
Reduction in digester volume	(17,253,282)				(5,751,094)											
Total capital outlays	**(13,329,018)**				**(5,751,094)**											
Benefits:																
Digester reduction savings	458,579	453,117	458,455	463,793	540,931	560,669	551,607	556,945	562,283	567,621	2,661,583	578,296	583,634	588,972	1,285,718	614,048
Total benefits	**458,579**	**453,117**	**458,455**	**463,793**	**540,931**	**560,669**	**551,607**	**556,945**	**562,283**	**567,621**	**2,661,583**	**578,296**	**583,634**	**588,972**	**1,285,718**	**614,048**
Annual Running Costs:																
DAFT power (air saturation)	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854
Polymer	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191
Blend sludge transfer pumping	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146
Blend sludge mix pumping	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154
Odor control fan power	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117
Total running costs		**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**
Life cycle cost analysis																
PVs in 2015	12,974,135	(353,482)	(341,612)	(330,067)	5,072,924	(229,618)	(233,319)	(224,209)	(215,362)	(206,770)	1,524,788	(190,328)	(182,464)	(174,832)	360,785	(149,443)
NPV as of 2015	**17,101,127**															

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 4b - Co-thickening w/ odor control heavy

	Year															
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Expressed in 2015 dollars, unescalated																
Capital Outlays																
Project capital cost	4,408,843															
Reduction in digester volume	(17,253,282)				(5,751,094)											
Total capital outlays	**(12,844,439)**				**(5,751,094)**											
Benefits:																
Digester reduction savings	458,579	453,117	458,455	463,793	540,931	560,669	551,607	556,945	562,283	567,621	2,661,583	578,296	583,634	588,972	1,285,718	614,048
Total benefits	**458,579**	**453,117**	**458,455**	**463,793**	**540,931**	**560,669**	**551,607**	**556,945**	**562,283**	**567,621**	**2,661,583**	**578,296**	**583,634**	**588,972**	**1,285,718**	**614,048**
Annual Running Costs:																
DAFT power (air saturation)	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854
Polymer	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191
Blend sludge transfer pumping	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146
Blend sludge mix pumping	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154
Odor control fan power	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117
Total running costs		**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**
Life cycle cost analysis																
PVs in 2015	12,489,556	(353,482)	(341,612)	(330,067)	5,072,924	(229,618)	(233,319)	(224,209)	(215,362)	(206,770)	1,524,788	(190,328)	(182,464)	(174,832)	360,785	(149,443)
NPV as of 2015	**16,616,548**															

Net Present Value Detail – 30 yr Analysis

San Jose/Santa Clara WPCP DAFT Alternatives	Results ($000s) Capital Cost	 30-year NPV
Status quo		($1,088,553)
Status quo w/ polymer addition	($16,573,368)	$16,045,242
Co-thickening w/o odor control	($31,389,098)	$27,113,171
Co-thickening w/ odor control light	($29,972,300)	$25,601,618
Co-thickening w/ odor control heavy	($29,487,721)	$25,117,039

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 1 - Status quo

	Year																													
	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	2041	2042	2043	2044
Expressed in 2015 dollars, unescalated																														
Annual Running Costs:																														
DAFT power (air saturation)	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297
Total running costs		**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**	**47,297**
Life cycle cost analysis																														
PVs in 2015	(47,297)	(46,396)	(45,512)	(44,645)	(43,795)	(42,961)	(42,143)	(41,340)	(40,552)	(39,780)	(39,022)	(38,279)	(37,550)	(36,835)	(36,133)	(35,445)	(34,770)	(34,107)	(33,458)	(32,820)	(32,195)	(31,582)	(30,980)	(30,390)	(29,811)	(29,244)	(28,687)	(28,140)	(27,604)	(27,078)
NPV as of 2015	**(1,088,553)**																													

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 2 - Status quo w/ polymer addition

	Year																													
	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	2041	2042	2043	2044
Expressed in 2015 dollars, unescalated																														
Capital Outlays																														
Addition of polymer system	679,914																													
Reduction in digester volume	(11,502,188)																													(5,751,094)
Total capital outlays	**(10,822,274)**																													**(5,751,094)**
Benefits:																														
Digester reduction savings	270,715	265,663	267,811	269,959	272,107	281,456	276,404	278,552	280,700	282,848	1,675,013	287,145	289,293	291,441	293,589	302,938	297,886	300,034	302,182	304,330	1,696,494	308,627	310,775	312,923	315,071	324,419	319,368	321,516	323,664	397,612
Total benefits	**270,715**	**265,663**	**267,811**	**269,959**	**272,107**	**281,456**	**276,404**	**278,552**	**280,700**	**282,848**	**1,675,013**	**287,145**	**289,293**	**291,441**	**293,589**	**302,938**	**297,886**	**300,034**	**302,182**	**304,330**	**1,696,494**	**308,627**	**310,775**	**312,923**	**315,071**	**324,419**	**319,368**	**321,516**	**323,664**	**397,612**
Annual Running Costs:																														
DAFT power (air saturation)	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297	47,297
Polymer	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167	254,167
Total running costs		**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**	**301,464**
Life cycle cost analysis																														
PVs in 2015	10,791,525	(35,119)	(32,383)	(29,739)	(27,183)	(18,174)	(22,329)	(20,026)	(17,803)	(15,657)	1,133,244	(11,589)	(9,663)	(7,806)	(6,016)	1,104	(2,631)	(1,031)	508	1,989	949,603	4,783	6,099	7,363	8,577	14,193	10,859	11,930	12,957	3,347,657
NPV as of 2015	**16,045,242**																													

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 3 - Co-thickening w/o odor control

	Year																												
	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	2041	2042	2043	2044
Expressed in 2015 dollars, unescalated																														
Capital Outlays																														
Project capital cost	2,507,466																					610,000								
Reduction in digester volume	(17,253,282)				(5,751,094)												(5,751,094)													(5,751,094)
Total capital outlays	**(14,745,816)**				**(5,751,094)**												**(5,751,094)**					**610,000**								**(5,751,094)**
Benefits:																														
Digester reduction savings	458,579	453,117	458,455	463,793	540,931	560,669	551,607	556,945	562,283	567,621	2,661,583	578,296	583,634	588,972	1,285,718	614,048	676,786	682,124	687,462	692,800	2,790,362	703,476	708,814	714,152	1,410,898	742,827	1,421,573	735,503	740,841	817,979
Total benefits	**458,579**	**453,117**	**458,455**	**463,793**	**540,931**	**560,669**	**551,607**	**556,945**	**562,283**	**567,621**	**2,661,583**	**578,296**	**583,634**	**588,972**	**1,285,718**	**614,048**	**676,786**	**682,124**	**687,462**	**692,800**	**2,790,362**	**703,476**	**708,814**	**714,152**	**1,410,898**	**742,827**	**1,421,573**	**735,503**	**740,841**	**817,979**
Annual Running Costs:																														
DAFT power (air saturation)	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854
Polymer	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191
Blend sludge transfer pumping	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146
Blend sludge mix pumping	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154
Total running costs		**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**	**809,346**
Life cycle cost analysis																														
PVs in 2015	14,395,050	(349,443)	(337,650)	(326,180)	5,076,736	(225,878)	(229,650)	(220,610)	(211,832)	(203,307)	1,528,185	(186,996)	(179,196)	(171,626)	363,930	(146,358)	4,130,379	(91,743)	(86,220)	(80,874)	1,348,486	(478,014)	(65,850)	(61,166)	379,161	(41,128)	371,329	(43,934)	(39,982)	3,297,553
NPV as of 2015	**27,113,171**																													

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 4a - Co-thickening w/ odor control light

	Year																												
	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	2041	2042	2043	2044
Expressed in 2015 dollars, unescalated																														
Capital Outlays																														
Project capital cost	3,924,264																					610,000								
Reduction in digester volume	(17,253,282)				(5,751,094)												(5,751,094)													(5,751,094)
Total capital outlays	**(13,329,018)**				**(5,751,094)**												**(5,751,094)**					**610,000**								**(5,751,094)**
Benefits:																														
Digester reduction savings	458,579	453,117	458,455	463,793	540,931	560,669	551,607	556,945	562,283	567,621	2,661,583	578,296	583,634	588,972	1,285,718	614,048	676,786	682,124	687,462	692,800	2,790,362	703,476	708,814	714,152	1,410,898	742,827	1,421,573	735,503	740,841	817,979
Total benefits	**458,579**	**453,117**	**458,455**	**463,793**	**540,931**	**560,669**	**551,607**	**556,945**	**562,283**	**567,621**	**2,661,583**	**578,296**	**583,634**	**588,972**	**1,285,718**	**614,048**	**676,786**	**682,124**	**687,462**	**692,800**	**2,790,362**	**703,476**	**708,814**	**714,152**	**1,410,898**	**742,827**	**1,421,573**	**735,503**	**740,841**	**817,979**
Annual Running Costs:																														
DAFT power (air saturation)	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854
Polymer	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191
Blend sludge transfer pumping	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146
Blend sludge mix pumping	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154
Odor control fan power	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117
Total running costs		**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**
Life cycle cost analysis																														
PVs in 2015	12,974,135	(353,482)	(341,612)	(330,067)	5,072,924	(229,618)	(233,319)	(224,209)	(215,362)	(206,770)	1,524,788	(190,328)	(182,464)	(174,832)	360,785	(149,443)	4,127,352	(94,712)	(89,132)	(83,730)	1,345,684	(480,763)	(68,547)	(63,812)	376,566	(43,674)	368,832	(46,383)	(42,384)	3,295,196
NPV as of 2015	**25,601,618**																													

From Summary Sheet:		Risk adjustments (+/- percent):	
Year of analysis	2015	Benefits	
Escalation rate	3.00%	Capital costs	
Discount rate	5.00%	Running costs	

San Jose/Santa Clara WPCP
DAFT Alternatives
Life Cycle Alternative Cost Analysis ($000s)
Alternative 4b - Co-thickening w/ odor control heavy

	Year																												
	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	2041	2042	2043	2044
Expressed in 2015 dollars, unescalated																														
Capital Outlays																														
Project capital cost	4,408,843																					610,000								
Reduction in digester volume	(17,253,282)				(5,751,094)												(5,751,094)													(5,751,094)
Total capital outlays	**(12,844,439)**				**(5,751,094)**												**(5,751,094)**					**610,000**								**(5,751,094)**
Benefits:																														
Digester reduction savings	458,579	453,117	458,455	463,793	540,931	560,669	551,607	556,945	562,283	567,621	2,661,583	578,296	583,634	588,972	1,285,718	614,048	676,786	682,124	687,462	692,800	2,790,362	703,476	708,814	714,152	1,410,898	742,827	1,421,573	735,503	740,841	817,979
Total benefits	**458,579**	**453,117**	**458,455**	**463,793**	**540,931**	**560,669**	**551,607**	**556,945**	**562,283**	**567,621**	**2,661,583**	**578,296**	**583,634**	**588,972**	**1,285,718**	**614,048**	**676,786**	**682,124**	**687,462**	**692,800**	**2,790,362**	**703,476**	**708,814**	**714,152**	**1,410,898**	**742,827**	**1,421,573**	**735,503**	**740,841**	**817,979**
Annual Running Costs:																														
DAFT power (air saturation)	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854	123,854
Polymer	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191	663,191
Blend sludge transfer pumping	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146	5,146
Blend sludge mix pumping	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154	17,154
Odor control fan power	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117	4,117
Total running costs		**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**	**813,463**
Life cycle cost analysis																														
PVs in 2015	12,489,556	(353,482)	(341,612)	(330,067)	5,072,924	(229,618)	(233,319)	(224,209)	(215,362)	(206,770)	1,524,788	(190,328)	(182,464)	(174,832)	360,785	(149,443)	4,127,352	(94,712)	(89,132)	(83,730)	1,345,684	(480,763)	(68,547)	(63,812)	376,566	(43,674)	368,832	(46,383)	(42,384)	3,295,196
NPV as of 2015	**25,117,039**																													