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Technical Memorandum

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Technical Memorandum 2


Subject: Fluidized-Bed Incinerator Conceptual Plan

Date: October 29, 2018

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List of Abbreviations

°F	degree(s) Fahrenheit	lb	pound(s)
AACEI	Association for the Advancement of Cost Engineering International	MACT	maximum achievable control technology
APC	air pollution control	mg	milligram(s)
As	arsenic	MHF	multiple-hearth furnace
Be	beryllium	MMBtuh	million British thermal units per hour
BFP	belt filter press	MW	megawatt(s)
Btu	British thermal unit(s)	N	nitrogen
C	carbon	Ni	nickel
Cd	cadmium	NO	nitrogen oxide
CEMS	continuous-emissions monitoring system	NO ₂	nitrogen dioxide
City	City of Bellingham	NO _x	nitrogen oxides
CO	carbon monoxide	NWCAA	Northwest Clean Air Agency
Cr	chromium	O	oxygen
d	day(s)	O&M	operations and maintenance
dscf	dry standard cubic foot(feet)	Pb	lead
dscm	dry standard cubic meter(s)	PCDD	polychlorinated dibenzo-P-dioxin(s)
dtpd	dry ton(s) per day	PCDF	polychlorinated dibenzofuran(s)
Ecology	Washington State Department of Ecology	PHX	primary heat exchanger
EPA	U.S. Environmental Protection Agency	PM	particulate matter
FBI	fluidized-bed incinerator	Post Point	Post Point Wastewater Treatment Plant
ft	foot (feet)	ppm _{vd}	part(s) per million, volumetric dry
ft ²	square foot (feet)	psia	pounds per square inch absolute
ft ³	cubic foot (feet)	psig	pound(s) per square inch gauge
GAC	granular activated carbon	s	second(s)
gal	gallon(s)	S	sulfur
GBT	gravity belt thickener	scfm	standard cubic foot (feet) per minute
gpd	gallons per day	SHX	secondary heat exchanger
gpm	gallons per minute	SO ₂	sulfur dioxide
H	hydrogen	SSV	superficial space velocity
HCl	hydrochloric acid	TEQ	toxic equivalency
HEX	heat exchanger	TM	technical memorandum
Hg	mercury	TMB	total mass basis
hp	horsepower	VS	volatile solids
hr	hour(s)	WAC	Washington Administrative Code
ID	induced draft	WEF	Water Environment Federation
kg	kilogram(s)	WESP	wet electrostatic precipitator
kV	kilovolt(s)	WHB	waste heat boiler
kW	kilowatt(s)	WWTP	wastewater treatment plant
kWh	kilowatt-hour(s)		

Executive Summary

The City of Bellingham (City) currently uses multiple-hearth furnaces (MHFs) to incinerate the wastewater residual solids recovered from the Post Point Wastewater Treatment Plant (WWTP) (Post Point). Because of the age of the existing MHFs and the desire to employ a more sustainable solids management solution, the City has initiated investigations into alternative means of managing its solids. The current planning project identified anaerobic digestion as the solids stabilization process that would best align with the City's values and commitments. In addition, it was established that digested solids from Post Point would be trucked to an offsite facility to produce a Class A biosolids material that could be beneficially used locally.

Before moving ahead with this anaerobic digestion-based project, the City decided to further assess continuing with an incineration-based process to have a basis for comparing the scale and cost of these two approaches. This technical memorandum (TM) presents a conceptual plan and cost estimate for installation of a new fluidized-bed incinerator (FBI) system to replace the existing MHFs.

The design capacity of the conceptual FBI system used the 2045 projected solids flow and loads presented in the first TM (TM 1) prepared for this planning project. Assuming that the existing thickened sludge storage volume (110,000 gallons [gal]) was available either in the existing tankage or a like-sized new facility, the maximum day dewatered cake sludge feed rate to the FBI system would be 36 dry tons per day (dtpd).

The City requested similar redundancy to the digestion-based alternative, so two FBI trains with a 36 dtpd capacity were assumed for this conceptual plan. Should the FBI system justify additional design effort in the future, this capacity rating and redundancy requirement could be evaluated further.

Predicted emissions from the FBI system, based on historical sludge metal data and experience at other FBI facilities, require treatment to meet the Clean Water Act and Clean Air Act emissions limits. The Clean Air Act limits are typically the most stringent and commonly referred to as the maximum achievable control technology (MACT) limits. Air pollution control (APC) equipment required the "new FBI" category of the MACT requirements, and the existing Clean Water Act and Northwest Clean Air Agency (NWCAA) limits, include the following:

- Nitrogen oxide (NO_x) ammonia or urea-based conversion system
- Multiple-venturi wet scrubber for particulate matter (PM), acid gas, and metal removal
- Wet electrostatic precipitator (WESP) for PM and heavy metal polishing
- Granular activated carbon (GAC) for mercury (Hg) removal and provide polychlorinated dibenzo-P-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) removal

Based on the projected dewatered sludge characteristics, processing 36 dtpd of dewatered sludge generates about 500 pounds per hour (lb/hr) of ash collected as a slurry in the multiple-venturi wet scrubber and WESP. The conceptual plan assumes that the slurry gets thickened in a gravity thickener and is then dewatered to 50 percent solids on a belt filter press (BFP). Typically, the ash gets landfilled, but some facilities are looking at beneficial reuse applications and one is working on getting the ash permitted for phosphorus fertilizer applications. The City indicated that the current ash is considered "hazardous" in some regard and is difficult to dispose, so it is interested in a system to separate toxins (i.e., metals) from the phosphorus. Several emerging technologies were identified in Europe and Japan that separate the toxins but have not yet established a reliable history of operation. Further investigation is required to determine potential reuse of the ash, ash characteristics, and additional treatment if required.

Figure ES- 1 shows the base FBI system process schematic for one train. This analysis locates the new FBI facility in the open space to the east of the administration building, for direct comparison to the digestion-based approach. The general footprint of the incineration facility is 11,700 square feet (ft²) with a floor-to-ceiling height of about 60 feet. The footprint reflects the facility outline and does not include the area of intermediate floors within the building.



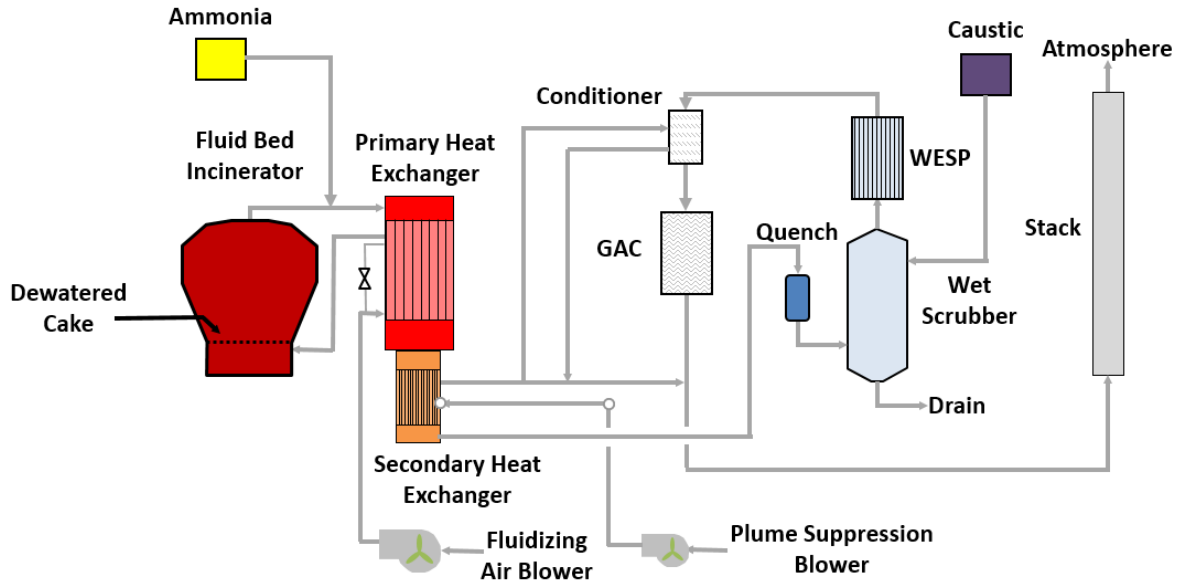


Figure ES- 1. Base alternative FBI train process schematic

For direct comparison with the digestion-based approach, the conceptual FBI facility includes sludge thickening on gravity belt thickeners (GBTs), dewatering in centrifuges, and piston-type cake pumps with feed bins.

The City also requested that the conceptual plan consider an FBI system with an energy production alternative. This includes a waste heat boiler (WHB) extracting heat from the flue gas to produce steam that drives a turbine generator. Based on the expected operating performance, about 0.5 megawatt (MW) of power generation is predicted. Figure ES- 2 shows the process schematic of the system with the energy production features. The energy production increases the approximate building footprint to 14,300 ft² and height of 70 feet.

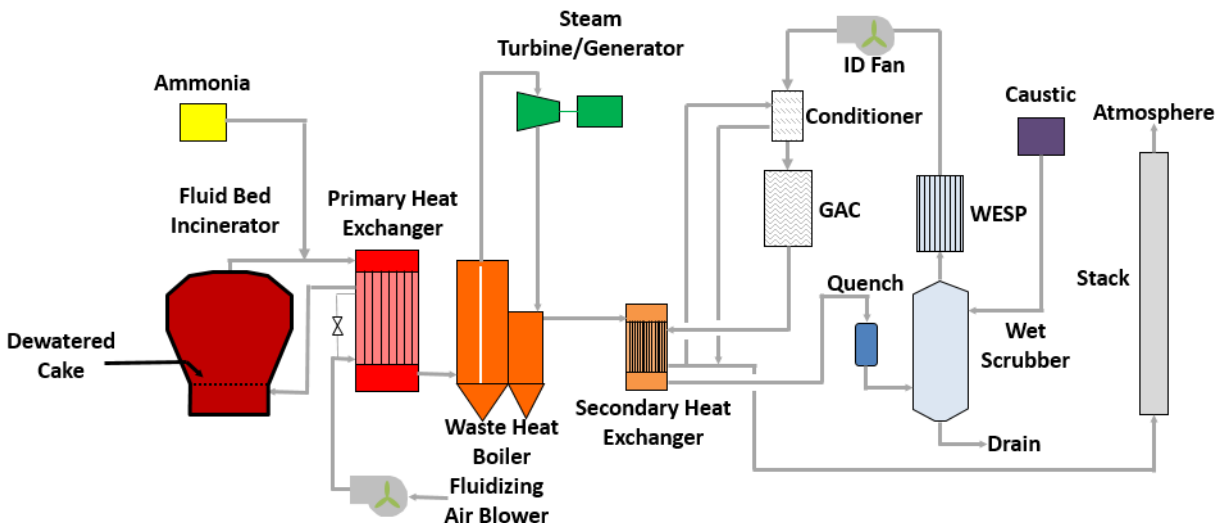


Figure ES- 2. WHB alternative FBI train schematic

This conceptual plan developed an opinion of probable costs for both FBI alternatives. Table ES- 1 summarizes the cost for each. These costs do not include additional costs for ash treatment and beneficial use. Ash treatment technologies are just becoming commercialized overseas and Post Point would possibly

represent the first United States installation. As a result there is a wide range of possible outcomes and costs, ranging from minimal costs if the ash is landfilled or regulators determine the ash is “clean” enough for fertilizer application to several million dollars if complex additional equipment and processing is required.

Table ES- 1. Construction Cost Estimates for Incineration Alternatives (2023 dollars)

Alternative	Construction Cost
Base	\$131,980,000
Waste heat boiler	\$160,950,000

The conceptual planning effort also produced a life-cycle cost estimate. Table ES- 2 summarizes the results of a 20-year analysis.

Table ES- 2. Life Cycle Cost Estimates for Incineration Alternatives (2018 dollars)

Item	Base Alternative	WHB Alternative
Capital costs	\$167,470,000	\$204,230,000
Labor and materials	\$37,940,000	\$48,270,000
Utilities and chemicals	\$6,090,00	\$3,830,000
Ash disposal	\$3,520,000	\$3,520,000
Equipment and media replacement	\$11,190,000	\$10,530,000
Total	\$226,210,000	\$270,370,000

Section 1: Introduction

This section provides background on the City of Bellingham's (City's) biosolids planning efforts, summarizes previous findings, and outlines the structure for this technical memorandum (TM).

1.1 Background

The City currently uses multiple-hearth furnaces (MHFs) to incinerate the wastewater residual solids recovered from the Post Point Wastewater Treatment Plant (WWTP) (Post Point). Because of the age of the existing MHFs and the desire to employ a more sustainable solids management solution, the City has initiated investigations into alternative means of managing its solids. CDM Smith completed initial studies in 2010 and 2012 to investigate and evaluate a limited number of biosolids management alternatives, with the conclusion that anaerobic digestion coupled with thermal drying is the preferred alternative that best meets the City's objectives. The purpose of the current Post Point Biosolids Planning project is to further evaluate and develop solids management options to select a preferred alternative for implementation.

1.2 Previous Findings

The first TM (TM 1) for the current project included the initial screening and first-round evaluation of all possible alternatives and identified anaerobic digestion as the solids stabilization process that would best align with the City's values and commitments. In addition, it was established that digested solids from Post Point would be trucked to an offsite facility to produce a Class A biosolids material that could be beneficially used locally.

Before moving ahead with this anaerobic digestion-based project, the City decided to further assess continuing with an incineration-based project to have a basis for comparing the scale and cost of these two approaches. Therefore, the City requested that the project team develop a conceptual plan and cost estimate for installation of a fluidized-bed incinerator (FBI) system to replace the existing MHFs.

1.3 Document Outline

This TM presents the FBI concept. The results of this effort will support the City's evaluation of the potential cost impacts of a new biosolids program and communication with the City Council.

The following sections document the approach and results of the conceptual design effort:

- **Section 2:** Concept Basis and Criteria
- **Section 3:** Incineration System Design
- **Section 4:** Energy Recovery
- **Section 5:** Supporting Systems
- **Section 6:** Conceptual Layout and Costs

Section 2: Concept Basis and Criteria

The following subsections identify the bases and criteria used for the conceptual plan. In short, the requirements establish the design amount and quality of solids while meeting the emission parameters. Later sections determine the equipment sizing and costs.

2.1 Dewatered Sludge Cake Characteristics

Dewatered sludge cake (cake) characteristics determine the FBI size, operational requirements, and many of the regulated air emissions. The key characteristics include the following:



- The amount of solids to process, including future projections.
- Percent solids defines the amount of dry solids versus water in the cake. The water content has a large impact on the combustion process.
- Volatile solids (VS) content represents the fraction of the dry solids that combust with the balance becoming ash.
- The carbon (C), nitrogen (N), oxygen (O), hydrogen (H), and sulfur (S) makeup of the VS determine the amount of combustion air required and flue gas composition. The S content also sets a basis for sulfur dioxide (SO₂) emissions, which are regulated. This composition is typically measured with an ultimate analysis.
- Chlorine is often measured as a supplement in the ultimate analysis described above. Chlorine is regulated as hydrochloric acid (HCl) in the flue gas.
- The heating value of the VS provides heat to the combustion process and where inadequate for efficient combustion auxiliary fuel is required.
- Regulated metals include beryllium (Be), cadmium (Cd), lead (Pb), and mercury (Hg). All metal emissions stem from the metals introduced in the cake.

Each of these parameters is defined in the subsections below. As stated above, these criteria will be used to develop the conceptual FBI system.

2.1.1 Solids Loading Projections

TM 1 presented year 2025 and 2045 projected solids handling flows and loads. Table 2-1 summarizes the flow in gallons per day (gpd) and load in pounds per day (lb/d) used for the conceptual FBI design.

Table 2-1. Solids Handling Flow and Load Projections								
Parameter	2025				2045			
	Average	Maximum Month	Maximum Week	Maximum Day	Average	Maximum Month	Maximum Week	Maximum Day
Combined Raw Sludge								
Flow (gpd)	466,900	615,400	732,300	676,100	616,600	790,600	683,600	980,900
Solids load (lb/d)	41,600	47,800	54,800	86,500	57,400	65,800	75,300	120,000
Volatile solids (lb/d)	36,400	41,000	41,700	70,200	50,100	56,500	56,300	95,400
Thickened Sludge ^a								
Flow (gpd)	96,800	111,300	127,400	201,200	133,600	153,000	175,100	280,000
Solids load (lb/d)	40,400	46,400	53,100	83,900	55,700	63,800	73,000	116,400
Volatile solids (lb/d)	35,300	39,800	40,500	68,100	48,600	54,800	54,600	92,500

a. Thickened sludge assumes a 5% solids and 97% capture rate across thickening equipment.

2.1.2 Percent Solids

The two existing Alfa Laval G2-95 centrifuges were designed to process 2,500 dry pounds per hour (lb/hr) at 25 percent cake solids. An additional Sharples DS-705 is available for backup duty with a roughly 2,300 dry lb/hr capacity. This conceptual analysis assumed 25 percent cake solids for design purposes.

2.1.3 Volatile Solids

Related work on this project identified a range of VS content for various conditions in the future. For simplicity, this conceptual design applied a median value of 83 percent VS.

2.1.4 Heating Value

For planning-level efforts typical heating values of the sludge generally provide a reasonable basis. For more detailed design purposes the City should compile any historical data and undertake a sampling program (minimum one sample per month) over several years to establish a baseline heating value data set. Three years of data would provide a good data set covering seasonal, or otherwise, changes in triplicate.

In the absence of a robust data set this analysis used typical heating values noted in Water Environment Federation (WEF) (1992), 10,800 British thermal units per pound of volatile solids (Btu/lb VS) for raw primary sludge and 9,700 Btu/lb VS for raw secondary sludge. Table 2-2 summarizes the heating values based on the projected loads. The heating values listed pertain to the “higher” classification where the latent heat of water vaporization produced during combustion is included. The design ultimately applied a conservative value of 10,350 Btu/lb VS.

Table 2-2. Estimated Sludge Heating Values				
Parameter	2025		2045	
	Average	Maximum Day	Average	Maximum Day
Raw primary sludge volatile solids (lb/d)	24,400	49,100	33,700	74,500
Raw secondary sludge volatile solids (lb/d)	16,200	29,600	22,400	45,500
Combined heating value ^a	10,360	10,390	10,360	10,380

a. Applies 10,800 Btu/lb VS for raw primary sludge and 9,700 Btu/lb VS for raw secondary sludge, calculated based on the weighted average of combined raw primary and secondary sludge.

2.1.5 Ultimate Sludge Composition

Like the heating value estimate, this analysis applied typical sludge ultimate composition percentages from WEF (1992). The ultimate composition of C, H, O, N, and S provides the basis for estimating O₂ or combustion air, requirements. Table 2-3 summarizes the values applied in this analysis.

Table 2-3. Estimated Sludge Ultimate Composition	
Element	Percent of Volatile
Carbon	57
Hydrogen	7
Oxygen	30
Nitrogen	5
Sulfur	1

The sludge S content used for estimating worst-case air emissions was higher than that used for the combustion air estimates in Table 2-C. WEF (1992) stated 2 percent of dry solids as the upper range for typical S content and this value was applied in this analysis for emissions characterization.

The chlorine content of the sludge is not typically included in the ultimate composition but is important from an air emissions standpoint. CDM (2008) used a value of 0.3 percent of dry solids as the chlorine content, or 3,000 milligrams per kilogram (mg/kg).

2.1.6 Metal Content

The Northwest Clean Air Agency (NWCAA) would regulate the emissions from the FBI. The current regulations for the MHFs include arsenic (As), Be, Cd, chromium (Cr), Pb, Hg, and nickel (Ni). Be, Cd, Pb, and Hg have emissions limits while As, Cr, and Ni are regulated based on the concentration in the cake.

The City provided intermittent cake metals data from March 1993 to March 2018. The City provided a total of 156 sample dates. Figure 2-1 and Figure 2-2 display the historical cake metals data. Except for As and Cd, the cake metals concentration generally declines from 1993 to 2018. The values reported as “0” in the figures were reported as below the analytical method detection limit. This analysis used the data from January 2012 to March 2018 so as not to overly skew the loading to the FBI.

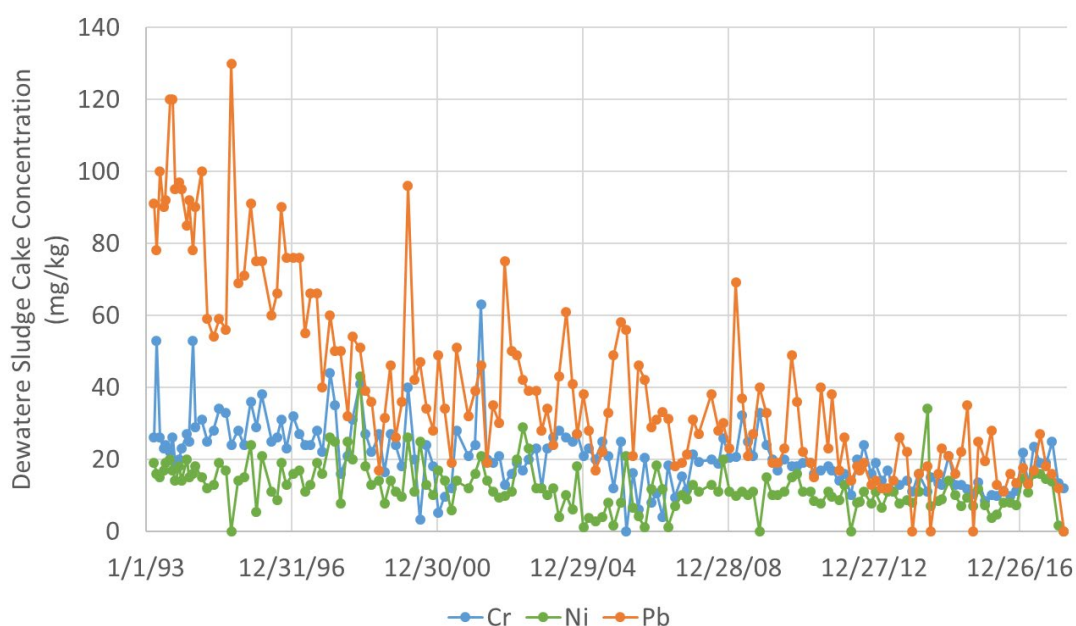


Figure 2-1. Dewatered sludge cake historical Cr, Ni, and Pb content

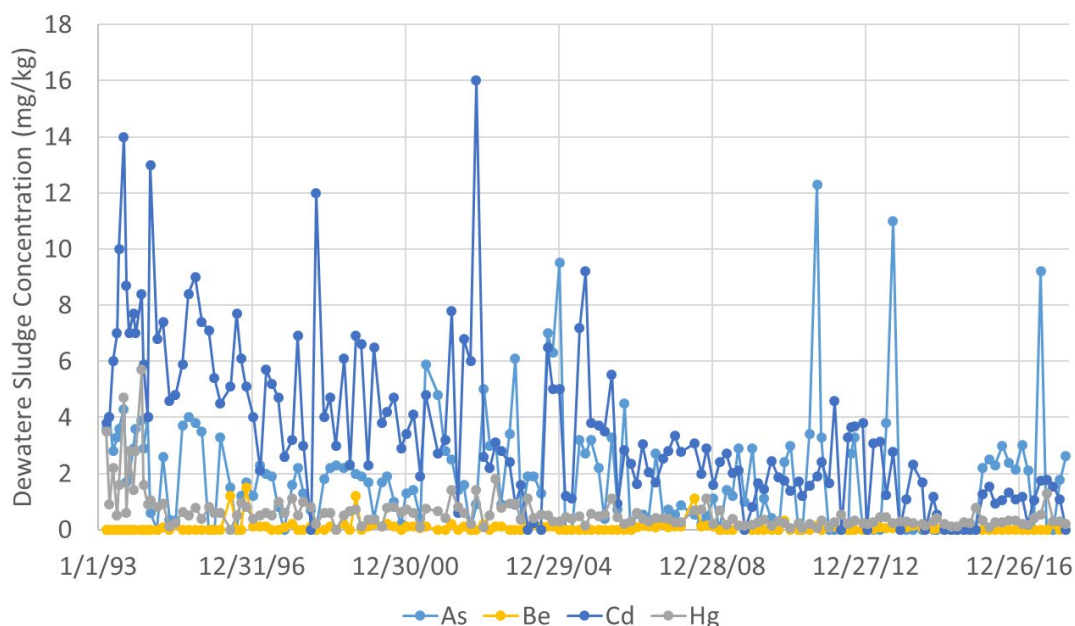


Figure 2-2. Dewatered sludge cake historical As, Be, Cd, and Hg content

Table 2-4 summarizes the values applied in this analysis. The values listed in Table 2-D represent the maximum reported values from January 2012 to March 2018. This approach provides a conservative basis for estimating emissions.

Metal	Dewatered Sludge Cake Concentration (mg/kg)^a
Arsenic	11
Beryllium	1.5
Cadmium	4.6
Chromium	25
Mercury	1.3
Lead	35
Nickel	34

a. Maximum value reported from January 2012 to March 2018.

2.2 Regulatory Limitations

The NWCAA would have regulatory jurisdiction over the FBI at Post Point. Two key parts of the permit are the processing limits and emissions requirements discussed here. Emissions limits stem from several regulations, including the Clean Water Act and Clean Air Act. The most recent federal regulation affecting sewage sludge incinerators revised the Clean Air Act to apply maximum achievable control technology (MACT) emissions limits. The expected permit limits are summarized in Table 2-5. Installation of a new FBI requires a new air permit, which may result in changes to some of the parameters listed below, specifically the cake concentration limits listed in the Clean Water Act section and both NWCAA limits. Attachments A and B include the existing MHF permits for reference.

Table 2-5. Expected FBI Regulatory Processing and Emissions Limits				
Regulation	Parameter	Unit	Limit Value	Comments
Clean Water Act	Particulate matter	lb/dry ton sludge burned	1.3	Based on existing MHF permit
	Beryllium	lb/d emitted	0.022	Based on existing MHF permit
	Mercury	lb/d emitted	7.1	Based on existing MHF permit
	Arsenic	mg/kg dry cake	1,425	Based on existing MHF system: provided by City
	Cadmium	mg/kg dry cake	4,439	
	Chromium	mg/kg dry cake	4,552	
	Lead	mg/kg dry cake	45,461	
	Nickel	mg/kg dry cake	144,470	
Clean Air Act	Particulate matter	mg/dscm at 7% O ₂	9.6	
	Carbon monoxide	ppm _{vd} at 7% O ₂	27	
	Nitrogen oxides	ppm _{vd} at 7% O ₂	30	
	Sulfur dioxide	ppm _{vd} at 7% O ₂	5.3	
	Cadmium	mg/dscm at 7% O ₂	0.0011	
	Hydrochloric acid	ppm _{vd} at 7% O ₂	0.24	
	Mercury	mg/dscm at 7% O ₂	0.001	
	Lead	mg/dscm at 7% O ₂	0.00062	
	Dioxins/furans (toxic equivalency)	ng/dscm at 7% O ₂	0.013	
	Dioxins/furans (total mass)	ng/dscm at 7% O ₂	0.0044	
NWCAA	Particulate matter	Grains/dscf at 7% O ₂	0.02	Based on existing MHF permit
	Visible emissions	Percent opacity (6-minute average)	5	Based on existing MHF permit

Since the inception of the MACT emissions regulations only one domestic FBI has been constructed that falls under the emissions limits. That FBI meets all MACT requirements. A second FBI installation is currently under construction with possible testing in summer 2018. These two facilities carried performance guarantees from the supplier and construction of an FBI at Post Point would include the same guarantee.

In addition to air permitting, biosolids management permitting with the Washington State Department of Ecology (Ecology) would be needed for a new incineration facility. Informal communications with staff at Ecology has indicated that it would be resistant to permitting a new incineration facility. This stems from the biosolids rule in Washington Administrative Code (WAC) 173-380 encouraging “the maximum beneficial use of biosolids,” which is defined as “the application of biosolids to the land for the purposes of improving soil characteristics.” This is not a formal statement or official ruling from Ecology but should be identified as a potential risk to the City if an incineration-based alternative is pursued.

Section 3: Incineration System Design

Based on the concept basis and criteria listed above the following presents the resulting FBI conceptual design.

3.1 Design Capacity

Incinerators are typically sized to handle peak solids production unless the design includes storage. Design documents provided by the City indicate that the existing sludge storage tanks represent a total volume of 110,400 gallons (gal).

To determine the size of the new FBI an analysis was conducted using the solids loading projections listed in Section 2. The analysis included a 30-day itinerary representing the projected thickened sludge flows and included the maximum month, maximum week, and maximum day values. Up to 90 percent of the thickened sludge storage volume was assumed available to be conservative because some deposition in the tanks is expected. Figure 3-1 shows the results of the analysis on three different FBI design capacities in dry tons per day (dtpd) based on 2045 thickened sludge loads. The analysis assumed a thickened sludge percent solids of 5 with a 97 percent capture rate across the gravity belt thickeners (GBTs) and a 95 percent capture rate across the dewatering centrifuges. The analysis identified an FBI design capacity requirement of 36 dtpd to stay within the capacity of the existing thickened sludge storage tanks.

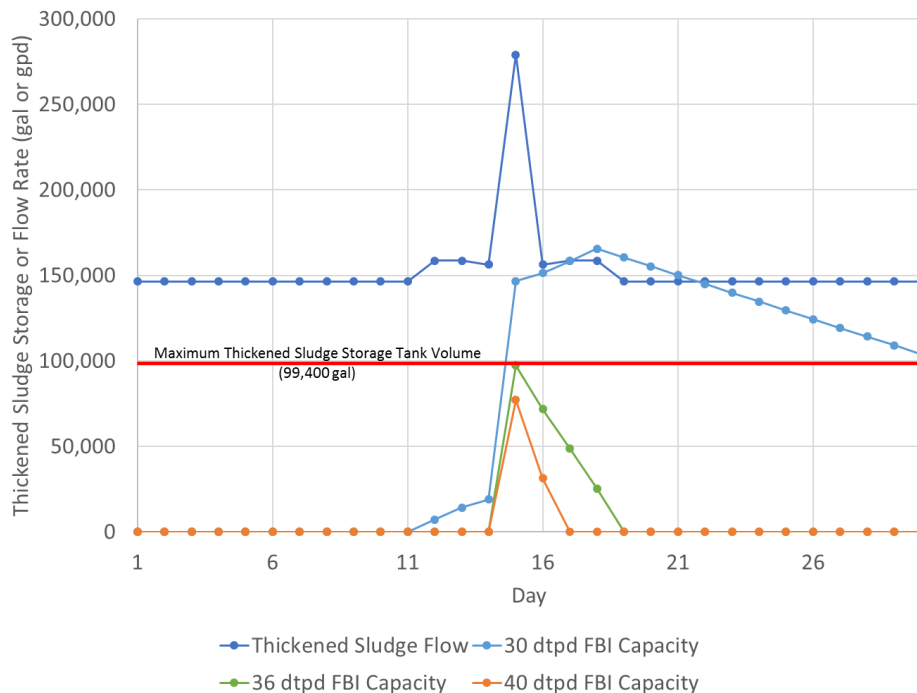


Figure 3-1. FBI capacity and thickened sludge storage requirements: 2045

The design 36 dtpd feed rate and cake characteristics established in Section 2 were entered into a heat and materials balance around the incinerator and primary heat exchanger (PHX); the latter was required to provide heated combustion air to avoid auxiliary fuel consumption. The following list identifies other assumptions applied in development of the heat and materials balance:

- Ambient air temperature of 60 degrees Fahrenheit (°F) with 50 percent relative humidity
- 40 percent excess air above that required for stoichiometric combustion

- FBI outlet temperature of 1,550°F
- Combustion air preheat temperature of 1,100°F
- Bed temperatures ranging from 1,350°F to 1,450°F
- 20 percent of VS combustion above the sand bed (freeboard burning)
- Purge air blower supplies 400 standard cubic feet per minute (scfm)

Figure 3-B shows the results of the heat and materials balance analysis. Using the cake characteristics in Section 2 resulted in autogenous operation, or no auxiliary fuel required to maintain combustion temperatures. The resulting flue gas loadings were passed on to energy recovery and air pollution control equipment suppliers for sizing the downstream equipment.

The size of the FBI reactor was roughly determined by the gas flow predicted in Figure 3-2. In the sand bed, a superficial space velocity (SSV) of roughly 3 feet per second (ft/s) was used to determine the internal sand bed diameter of roughly 11 feet at the 36 dtpd loading. The SSV is calculated using the combustion airflow through at the sand bed pressure and temperature as if the sand were not present. The upper portion of the FBI, or freeboard, was expanded to roughly 18 feet to achieve an approximate 6-second residence time. Overall, the FBI reactor will reach 30 to 40 feet in height based on other facilities. Each vendor uses different reactor geometries and standard sizing, which will dictate the final dimensions.

Post Point

Bellingham, WA

FBI Conceptual Design

Reactor Mass Balance		
	Inputs (lb/hr)	Outputs (lb/hr)
Dry Sludge - Volatiles	2,496	-
Dry Sludge - Ash	504	504
Sludge Water	9,000	-
Sludge Combustion Air	26,974	-
Purge Air	1,834	-
Auxiliary Fuel - Volatiles/H ₂ O	0	-
Auxiliary Fuel - Ash	-	-
Auxiliary Fuel Comb Air	0	-
Freeboard Sprays	1,023	-
Exhaust	-	41,327
Total	41,831	41,831

Reactor Energy Balance		
	Inputs (MMBtuh)	Outputs (MMBtuh)
Sensible Heat	7.2	0.0
Chemical Energy	25.8	0.0
Radiation	0.0	0.5
Latent Heat	0.1	10.4
Exhaust - Sensible	0.0	22.3
Total	33.2	33.2

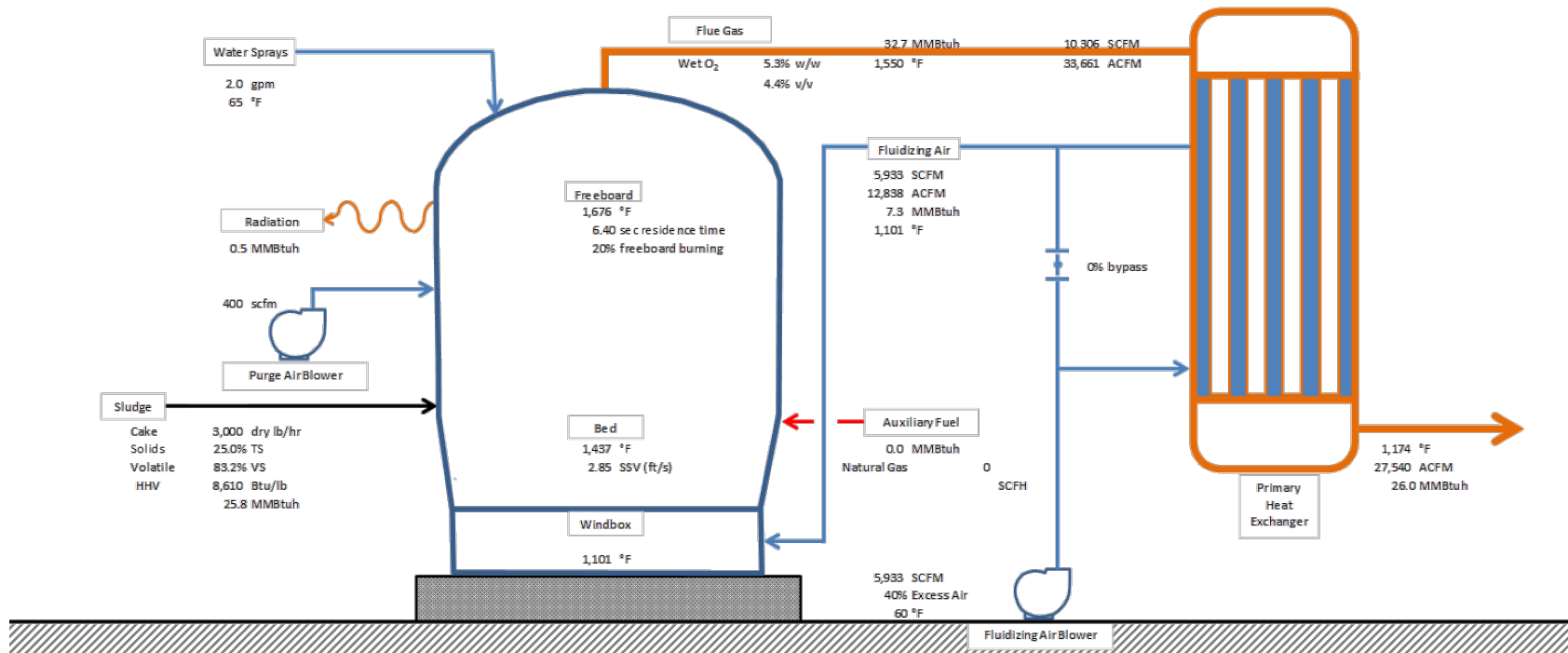


Figure 3-2. Conceptual heat and materials balance at 36 dtpd

The design feed rate often translates into oversized equipment for operating under conditions experienced immediately after construction. This situation typically leads to lower feed rates than those required for autogenous operation. One potential mitigating strategy involves operating for a limited number of days per week to increase the effective FBI loading. Autogenous operation relies on cake characteristics besides feed rate, but at other facilities Brown and Caldwell has investigated, reduced feed rates of 70 percent of capacity still offer a reasonable probability for autogenous operation. With this assumption and using the 2025 average sludge loading identified in Section 2, the FBI would operate between 5 and 6 days per week while using the thickened sludge storage tanks to smooth out the load variation. Other facilities operate in this fashion where at the end of the operating schedule the operators heat the sand bed to temperatures above normal operation and then turn off all blowers, otherwise known as a hot standby. The sand bed will slowly cool over time but can remain at temperatures reasonably high enough for several days that would allow immediate cake feeding or direct auxiliary fuel injection into the bed. This saves the time and resources required to bring the furnace back up to temperature and is one advantage of the FBI technology over an MHF.

After establishing the design FBI feed rate of 36 dtpd, the predicted maximum cake metal concentrations were checked against the existing limits. Table 3-1 summarizes the existing regulatory and predicted maximum regulated cake metal concentrations. The difference between the existing regulatory and predicted values indicates that the FBI will meet the cake concentration requirements currently listed in the MHF permits.

Table 3-1. Existing Regulatory and Predicted Maximum Regulated Cake Metal Concentration		
Metal	Regulatory Limit (mg/kg)	Predicted (mg/kg)
Arsenic	1,425	11
Cadmium	4,439	5
Chromium	4,552	25
Lead	45,461	35
Nickel	144,470	34

3.2 Redundancy

The City currently owns and operates two MHFs. CDM Smith (2012) reported that up to 2011 the City operated the MHFs one at a time with the other unit effectively serving as a backup. This analysis included two 36 dtpd FBI trains for conservatism. If the City chooses to pursue incineration either one large FBI or two smaller FBIs could be considered to reduce capital costs.

Facilities similar in size to the 36 dtpd selected for Post Point often have only one incinerator. If loading conditions exceed the capacity of the incinerator or the incinerator is out of service, the sludge is typically hauled to a landfill for emergency disposal. The City of Vancouver, Washington, currently operates one FBI at the Westside WWTP with a planned 1- to 2-week annual maintenance outage. The Prince William County Service Authority in Woodbridge, Virginia, also operates one FBI at the H.L. Mooney Advanced Water Reclamation Facility with excess solids sent to a local landfill.

3.3 Air Pollution Control Equipment

The FBI requires air pollution control (APC) equipment to treat the flue gas to meet regulatory requirements. Two approaches were used to size APC equipment. The first used the MACT regulatory limits and APC equipment vendor recommendations. Using the 36 dtpd feed rate and resulting flue gas composition calculated with the heat and materials balances, the conservative pollutant (sulfur, chlorine, and metals)

loads summarized in Table 3-2 were submitted to APC suppliers for equipment recommendations and performance estimates. To reduce testing requirements from annually to once every 3 years, the APC suppliers were charged with achieving pollutant removals to less than 75 percent of the MACT limit.

Table 3-2. Pollutant Loading and Flue Gas Conditions Submitted to APC Suppliers: 36 dtpd Basis	
Parameter	Raw FBI Emissions (lb/hr)
Pollutants	
Particulate matter	505
Sulfur dioxide	120
Cadmium	0.014
Hydrochloric acid	9.3
Mercury	0.004
Lead	0.11
Beryllium	0.005
Flue Gas Composition	
Carbon dioxide	5,200
Nitrogen	22,100
Water vapor	11,700
Oxygen	2,200

The second approach used performance data from similar facilities to estimate emissions of pollutants that depend on operating characteristics (e.g., temperature, turbulence, oxygen levels, and residence time).

The following sections discuss the APC equipment required to meet regulatory limits.

3.3.1 Multiple-Venturi Wet Scrubber

The typical APC equipment historically included in sewage sludge incinerator trains is a wet venturi scrubber. The induced pressure drop through the venturi section causes the injected water droplets and particles in the flue gas to contact each other, effectively removing particulate-based pollutants, typically particulate matter (PM) and metals. The contact with water in the venturi section and other areas, typically a tray or packing section, will also sequester acid gases. The modern wet scrubber applied in the sewage sludge industry consists of an inlet quench section to cool the flue gas followed by a section of submerged perforated trays or packing that flue gas flows upward and cooling water flows down. The last pollutant removal section includes multiple venturi-type nozzles that the flue gas is forced through and sprayed with water in the process. This configuration provides a much higher pollutant removal efficiency by placing the high-energy multiple-venturi section at the downstream end of the scrubber, which benefits from the cooling of the flue gas that will condense some of the smaller particulates, acid gases, and metals. Figure 3-3 depicts a typical modern wet scrubber.

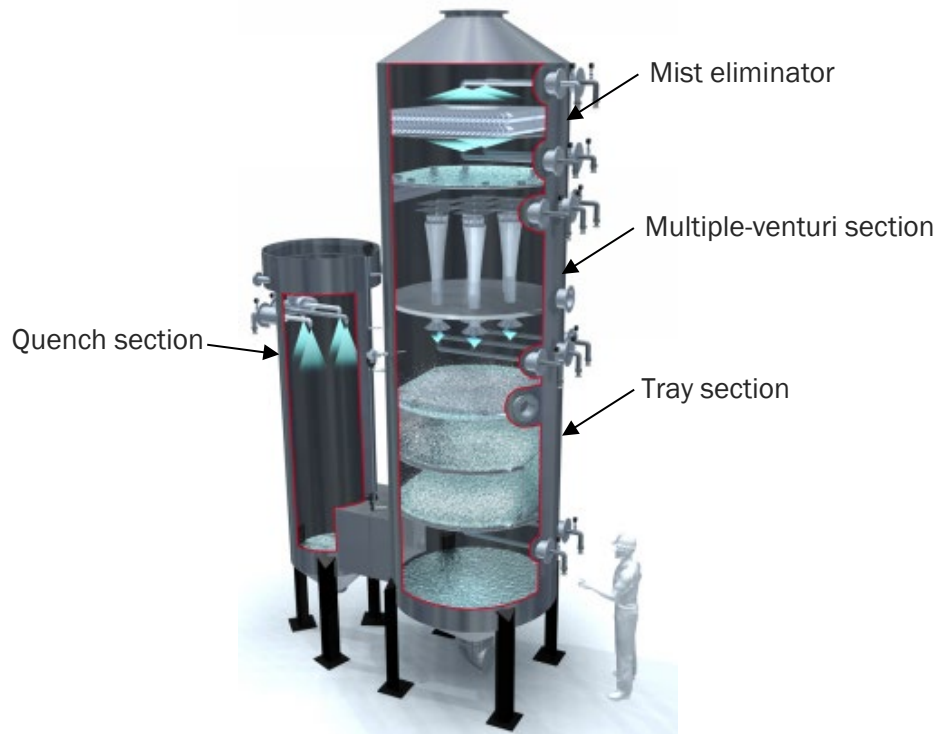


Figure 3-3. Modern wet scrubber

Source: EnviroCare International.

Typical heavy metal removal rates exceed 95 percent in this type of scrubber. This level of removal will reduce the Be load to nearly an order of magnitude less than the required regulatory limit of 0.022 lb/d. The remaining metals, except Hg, and PM pollutants will be removed to a high degree but may not meet the stringent MACT requirements. This requires another piece of equipment, typically a wet electrostatic precipitator (WESP), discussed in the next section.

Likewise, the modern wet scrubber removes acid gases, SO₂, and hydrochloric acid (HCl) at a high efficiency. The alkalinity within the spray water may not be adequate to effectively neutralize the acid gases, which can lead to exceeding the MACT requirements. Reliably achieving MACT limits requires caustic (sodium hydroxide) addition to the spray water to maintain adequate alkalinity.

This analysis includes a modern wet scrubber system in the APC system. The main section of the scrubber with the multiple-venturi section requires an approximately 7-foot diameter vessel. The inlet quench section diameter requires less space and typically matches the connection ductwork diameter, likely less than 3-foot diameter. The overall height of the scrubber approaches 30 feet as quoted by one supplier and includes the WESP, described in Section 3.3.2 below.

Instantaneous water demands of the scrubber may exceed 600 gallons per minute (gpm) and require a booster pumping skid to achieve pressures of nearly 300 pounds per square inch gauge (psig).

Caustic requirements will be based on the alkalinity of the water source, but for this analysis a design flow of 14 gpd (50 percent solution by weight) neutralizes the expected acid gas load on a molar basis at the selected 36 dtpd feed rate. At this rate a 4-cubic-foot (ft³) tote provides more than a month of caustic.

3.3.2 Wet Electrostatic Precipitator

As noted in Section 3.3.1, a WESP will remove the remaining metals and PM to meet the stringent MACT requirements. A WESP consists of a housing containing a series of collection tubes arrayed in a parallel

fashion. Within each tube resides a shaft acting as a discharge electrode. A high voltage is applied to the discharge electrode, typically resulting in a negative polarity, while the outer collection tube is positive. Particles passing through the WESP become charged and collect on the collection tube surfaces. An intermittent water spray washes the collection tubes.

This analysis includes the installation of a WESP on top of the wet scrubber. Section 3.3.1 above includes a discussion on dimensions.

WESPs require nominal utilities. The electrifying component of the WESP would require a nominal 20-kilowatt (kW) power demand. A small, nominal 5-horsepower (hp) blower purges the sensitive electrical compartments of the WESP and requires a 15 kW air heater to prevent condensation buildup in these areas. Intermittent wash water requires approximately 60 gpm while operating.

3.3.3 Mercury Removal

The wet scrubber and WESP will remove some Hg, but the stringent MACT requires additional removal. Currently, two technologies dominate the sewage sludge industry. The historically applied granular activated carbon (GAC) vessel provides a high removal efficiency for reliable performance. An alternative technology uses a proprietary adsorbing polymer composite material that adsorbs Hg and SO₂ (to a lesser extent). So far, this technology has been successfully applied at facilities operating under the less stringent “existing” MACT limits, but the supplier will now provide a performance guarantee to meet the “new” MACT limits. While the media does require periodic replacement, like the GAC, the technology is simpler and more affordable.

This analysis will include a Hg removal device and assumes the GAC system for reliable and proven performance. If the City desires to avoid the higher capital and operating costs, the simpler polymer composite technology can be reconsidered.

The GAC requires an approximately 1,000-square-foot (ft²) footprint including a 12-foot-diameter and roughly 20-foot-tall carbon vessel plus a gas conditioning system, which increases the flue gas temperature above the saturation point.

3.3.4 Nitrogen Oxide Control

Combustion processes generate oxides of nitrogen (NO_x). NO_x includes nitrogen oxide (NO) and nitrogen dioxide (NO₂). Most of the NO_x measured in the stack consists of NO as the wet scrubber recommended readily removes NO₂. NO_x emissions are not easily predicted and depend on the N present in the cake, temperature, and O levels in the FBI. This analysis reviewed stack testing data on existing FBIs at Prince William County Service Authority’s H.L. Mooney Advanced Water Reclamation Facility (Woodbridge, Virginia), the Northeast Ohio Regional Sanitary District Southerly Wastewater Treatment Center (Cleveland, Ohio), and the Metropolitan Environmental Services Metro WWTP (St. Paul, Minnesota). Typical values ranged from 15 to 40 parts per million by volume dry (ppm_{vd}) corrected to 7 percent oxygen.

To reliably achieve the MACT NO_x of 30 ppm_{vd} corrected to 7 percent oxygen, a select non-catalytic reduction technology will be required. This typically involves injection of an ammonia or urea solution into the flue gas at the outlet of the FBI that reacts with NO_x to form benign N gas.

This analysis used a raw NO_x concentration of 40 ppm_{vd} corrected to 7 percent oxygen for conservatism to estimate the control demands. A 19 percent strength ammonia solution applied at a 3:1 ammonia to NO_x molar ratio with a 40 percent removal efficiency resulted in a 30 gpd demand at flue gas conditions established above for the 36 dtpd cake feed rate. The predicted NO_x stack concentration after treatment is 23 ppm_{vd} corrected to 7 percent oxygen, or 77 percent of the MACT limit.

A 4 ft³ tote would provide 15 days of storage at the 36 dtpd cake feed rate. Small metering pumps and a carrier water system encompass the other equipment required.

3.3.5 Carbon Monoxide Control

Like NO_x, carbon monoxide (CO) emissions cannot easily be predicted. The same three facilities referenced for the expected NO_x emission also collected CO data. The results of several stack tests ranged from 3 to 19 ppm_{vd} corrected to 7 percent oxygen, well below the MACT limit. One of the advantages of the FBI technology over an MHF is the more efficient and complete combustion, resulting in low CO levels. Based on the performance of the reference facilities no additional controls are anticipated for CO.

3.3.6 Dioxin and Furan Control

The MACT regulations included limits for polychlorinated dibenzo-P-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). The MACT presents two limits, toxic equivalency (TEQ) and total mass basis (TMB), and considers success if either limit is met during an emissions test. Like NO_x and CO, PCDD/PCDF emissions are difficult to predict. Typical temperatures in an FBI will destroy PCDDs/PCDFs, but they have the capacity to reform downstream at cooler flue gas temperatures. Equipment such as waste heat boilers, baghouses, and reactor towers placed ahead of a quenching scrubber provide the correct temperatures and residence time for reformation. Fortunately, FBIs combusting sewage sludge reform very small amounts of PCDD/PCDFs based on operational experience at other facilities.

Activated carbon and possibly the polymer composite technology would remove PCDD/PCDFs. The Metropolitan Environmental Services Metro WWTP (St. Paul, Minnesota) uses activated carbon designed to remove mercury. Stack testing over several years passed both the TEQ and TMB basis from the MACT requirements. The Prince William County Service Authority's H.L. Mooney Advanced Water Reclamation Facility (Woodbridge, Virginia) and Northeast Ohio Regional Sanitary District Southerly Wastewater Treatment Center (Cleveland, Ohio) each employ a polymer composite Hg removal device. Both easily passed MACT emissions requirements on the TEQ basis in recent emissions testing.

Based on experience at other facilities no additional PCDD/PCDF control technology is anticipated. At this time only the GAC supplier can guarantee a removal rate. The polymer composite technology supplier has yet to measure significant enough concentrations required to quote a specific removal rate.

3.4 Ash Handling

FBIs emit all the ash via the flue gas, which differs from an MHF, where most of the ash falls to the bottom of the incinerator and is handled there. For practical purposes, the FBI system captures all the ash as particulate in the wet scrubber. A pumping system transfers the ash slurry to a gravity thickener.

The wet ash slurry will be thickened and dewatered. Overall, the ash slurry thickens and dewater to about 50 percent solids. A polymer addition system provides better settling performance in the gravity thickener and dewatering on the belt filter press (BFP); as a result, two dilution units would be included for this system. This analysis assumes an approximate 3 lb/dry ton active polymer consumption rate for either process.

Ash dewatering would take place on a 1-meter BFP. Based on an 8-hour per day and 5-day per week operation the BFP would be loaded to approximately 2,100 lb/hr if the FBI operated at the 36 dtpd cake feed rate. The dewatering system would more likely operate continuously if the FBI processed 36 dtpd of cake so as not to build up ash in the gravity thickener but the intermittent design provides a conservative design.

Ash slurry and thickened ash pumping systems are estimated to require 10 and 3 hp systems, respectively. The BFP power demands are minimal, estimated at 10 hp in total, while the belt wash water would utilize 50 gpm of non-potable water supplied by a 15 hp pump. The polymer addition system has no significant utility demands. The ash loadout conveyors may require up to 15 hp.

For redundancy each incineration train would have a dedicated ash handling system, so two gravity thickeners and BFPs are required. The BFPs would be in a new truck loading facility with a rough footprint of 1,000 ft² including two loadout bays.

In the past, other facilities have implemented beneficial reuses of incinerator ash. Practices such as concrete amendments, soil conditioners, and flowable fill have all been instituted. More recently, the Metropolitan Council Environmental Service (St. Paul, Minnesota) initiated greenhouse and field studies to determine the fertilizing potential (mostly from phosphorus) of sewage sludge incinerator ash. Greenhouse studies indicate a positive crop growth response to ash amendments on par with commercial fertilizers at similar agronomic addition rates. The greenhouse study also did not observe abnormal metals uptake into plant tissue in ash-amended treatments. As is, the Metropolitan Council Environmental Service ash generally met the U.S. Environmental Protection Agency's (EPA's) metal limits for exceptional quality biosolids. The Post Point ash would also likely meet most if not all of the metal limits for exceptional quality biosolids, but a sampling and analysis campaign would be required. A 2011 hazardous waste leachate test on the Post Point ash indicated a relatively "clean" product; see Table 3-3.

Table 3-3. Post Point Ash Leachate Test Results (2011)		
Pollutant	Hazardous Waste Threshold (mg/L)	Measured (mg/L)
Arsenic	5.0	<0.1
Barium	100	0.091
Cadmium	1.0	<0.025
Chromium	5.0	<0.005
Lead	5.0	0.05
Mercury	0.2	<0.0002
Selenium	1.0	<0.025
Silver	5.0	<0.01

The ash produced from an FBI at Post Point would contain similar concentrations of metals and nutrients (phosphorus and potassium) as the current MHF ash. Ideally the ash would be land-applied as a fertilizer without further treatment. In the event that regulators required additional treatment (i.e., metal removal) certain technologies are emerging in Europe to drive off metals while retaining the phosphorus. One approach involves thermally treating the ash with a magnesium chloride supplement. The magnesium replaces the heavy metals in the ash, which are volatilized and captured in an air pollution control system. This process is unproven at full scale, but a pilot operated in Europe treated more than 600 lb/hr, which is more than Post Point is projected to produce. Heavy metal removal efficiencies ranged from 80 to 100 percent.

A second approach runs the ash through a leaching and precipitation or ion exchange process to separate the phosphorus and metals. Vendors using this approach also report good phosphorus recovery. While these technologies show promise they currently are in the process of transitioning from development to commercialization and do not have long track records. In addition, the technologies are in Europe or Japan with no domestic references. Based on this lack of operational experience at full scale, the lack of commercial vendors, and an inability to secure a proposal for additional ash treatment, this system was not included within this analysis. Should the City decide to proceed with an FBI system, this technology could be further evaluated and incorporated into the facility to maximize the recovery of resources.

Section 4: Energy Recovery

FBI's require energy recovery for efficient operation while additional energy recovery may be implemented for other uses outside of the FBI system. This analysis considered two alternatives related to energy recovery, the first without and the second with a waste heat boiler (WHB). The WHB alternative produces steam to drive a turbine coupled to an electrical generator. The following sections describe the energy recovery equipment.

4.1 Primary Heat Exchanger

The PHX recovers heat from the flue gas immediately after the FBI reactor. The heat transfers to the combustion air prior to entering the lower chamber of the FBI, typically called the windbox. With this arrangement, the FBI does not require auxiliary fuel to reach combustion temperatures despite the relatively wet cake.

Figure 4-A depicts the typical PHX configuration used with sewage sludge FBI's. Relatively hot flue gas (1,550°F) enters the top inlet plenum and then proceeds downward through the array of heat exchanging tubes prior to leaving via the outlet plenum. Relatively cold combustion air (150°F) enters the shell of the heat exchanging section just above the lower outlet plenum and flows upward around the heat exchanging tubes. This analysis assumed the combustion air preheating achieves 1,100°F, which roughly results in the flue gas dropping to 1,200°F at the 36 dtpd cake feed rate.

Figure 4-1 also shows a relatively new feature offered by the PHX suppliers, the interstage bypass. This bypass allows some, usually up to 50 percent, of the combustion air to bypass most of the heat exchange section prior to entering near the top of the PHX. This simple feature provides more flexible operation. For example, if the FBI feed cake has a higher heating value than anticipated or the feed rate is higher than design, the internal temperature of the reactor will increase. Bed temperatures higher than 1,450°F may lead to issues where the sand starts to melt with individual grains starting to stick together. The worst sand bed failure due to melting conditions results in a solidified block that must be jack-hammered out. Use of the interstage bypass reduces the combustion air preheat temperature and thus sand bed temperature.

The same cooling effect of the interstage bypass also offsets roof sprays in the FBI reactor used to keep outlet temperatures within the acceptable range of the PHX. Reducing water sprays into the reactor, especially at the outlet, reduces the chances of forming scale resulting from the combination of the spray water and free lime in the ash.

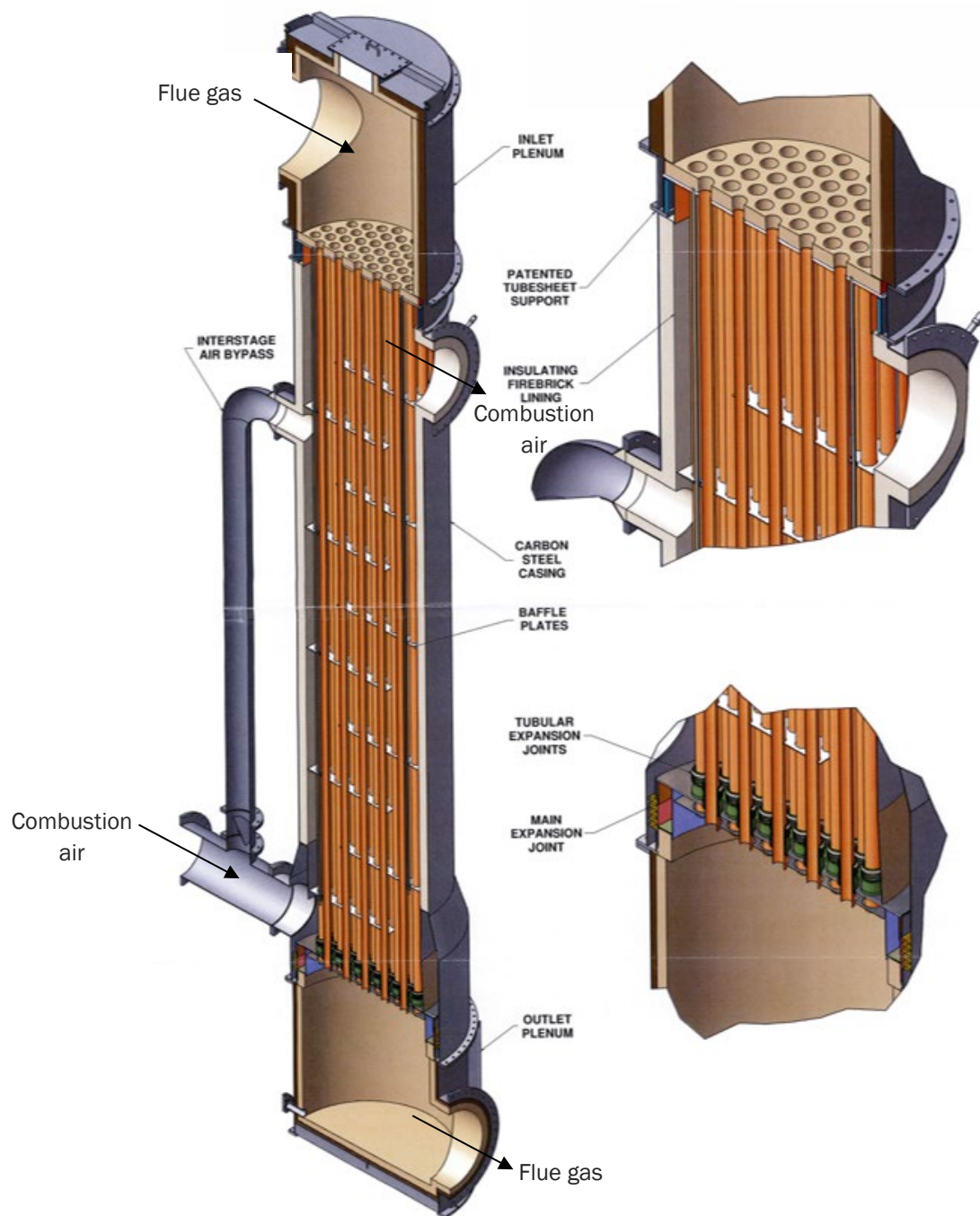


Figure 4-1. Diagram of typical FBI primary heat exchanger

Source: Arvos Schmidtsche Schack LLC.

The PHX requires a rough footprint of 7 feet diameter and is 32 feet tall. The PHX requires no utilities for operation except for pneumatic pressure to operate the interstage bypass dampers.

4.2 Secondary Heat Exchanger

The secondary heat exchanger (SHX) looks and operates like the PHX, less the interstage bypass and smaller size. The SHX transfers heat from the relatively hot flue gas coming out of the PHX or WHB to increase the temperature of the cleaned flue gas just prior to leaving through the stack. The elevated temperature of the flue gas leaving the stack avoids the development of a visible plume caused by condensing water vapor. The design of the SHX depends on whether the design includes a WHB.

Without a WHB the design of the SHX is more compact given the higher flue gas inlet temperature (about 1,200 °F). The design is so compact that suppliers can likely stack the SHX underneath the PHX without adding additional height to the building housing the FBI system. The City of Vancouver, Washington, installation previously mentioned uses this stacked arrangement to reduce the required floor space. In the stacked arrangement the diameter of the SHX is less than that of the PHX so no additional area is required. The height of the combined heat exchangers (HEXs) would reach roughly 50 feet. Typically, the SHX heats a stream of air supplied by a standalone blower, or plume suppression blower. For this application roughly 1,200 scfm of air heated to 450 °F would suppress plume formation at atmospheric temperatures as low as 15 °F. The plume suppression blower would require a nominal 10 hp motor.

If the layout includes a WHB, the size of the SHX increases because the flue gas temperature out of the WHB would be roughly 425 °F. The SHX outlet further constrains the heat transfer because a minimum temperature of about 300 °F to 350 °F is required to keep above the acid gas dewpoint. The increase in size of the SHX also eliminates the stacked configuration option with the PHX and requires additional floor space. The standalone SHX stands roughly 20 feet tall and is 6 feet in diameter. This configuration does not require a plume suppression blower because the inclusion of the WHB requires an induced draft (ID) fan to keep the WHB under a slight vacuum. The ID fan would pull the flue gas through the SHX and subsequent APC equipment prior to then discharging the relatively clean flue gas back through the SHX for reheating.

4.3 Waste Heat Boiler

Incineration can require a significant amount of energy and WHBs are commonly installed to recover some energy for beneficial use. Figure 4-2 depicts the type of WHB commonly used in the sewage sludge incineration industry today. This WHB is a three-pass unit consisting of an initial steam superheater, followed by an evaporator, and finally outlet through an economizer section. The incinerator flue gas would typically be cooled to a roughly 425 °F outlet temperature from the economizer. These outlet temperatures keep the flue gas above the acid gas dewpoint, which typically ranges from 300 °F to 350 °F. WHB feedwater initially passes through the steam drum for minimal preheating prior to passing into the economizer. After passing through the economizer the now water/steam mixture returns to the steam drum with the liquid flowing to the evaporator section for complete steam transformation and returns to the steam drum again. Finally, the dry saturated steam leaves the steam drum and passes through the superheater section to achieve some degree of superheating. Typical steam quality ranges from 600 °F to 750 °F at 450 to 750 pounds per square inch absolute (psia). The superheated steam then proceeds to the steam turbine to drive an electrical generator. The voltage generated by the generator is typically 13.2 kilovolts (kV).

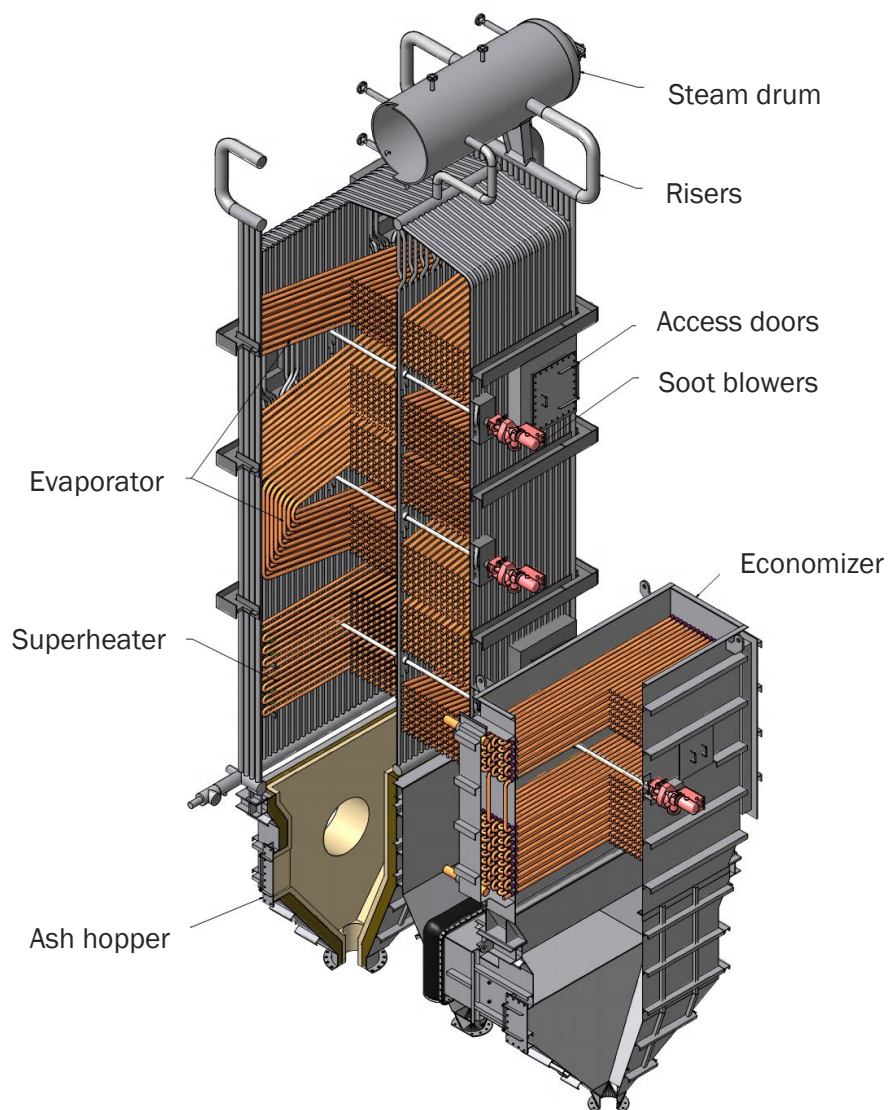


Figure 4-2. Diagram of typical waste heat boiler

Source: Arvos Schmidtsche Schack LLC.

After the high-pressure steam passes through the steam turbine the low-pressure steam is condensed using plant effluent as the heat sink, then the condensed water is de-aerated and returned to the boiler to restart the cycle. Some steam is lost or blown down as needed to limit the amount of solids accumulating in the boiler water. Demineralized potable water would be used for makeup as needed. Figure 4-3 shows the traditional Rankine cycle used by steam systems.

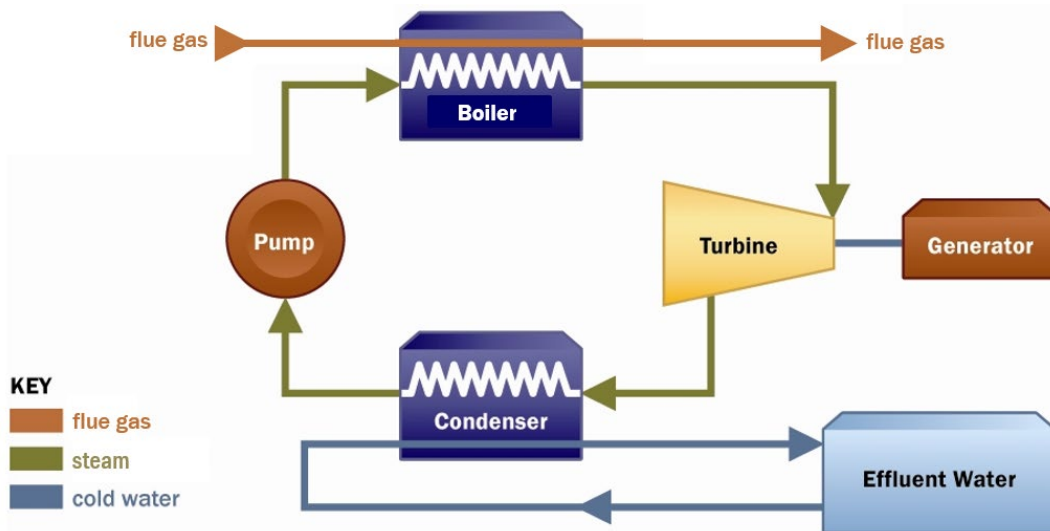


Figure 4-3. Rankine cycle schematic

Based on the 36 dtpd cake feed rate, the WHB could capture about 9 million British thermal units per hour (MMBtuh). Assuming superheated steam at 500 psig and 750°F with a turbine efficiency of 55 percent, approximately 0.5 megawatt (MW) of gross power would be produced.

The WHB footprint roughly requires a 13-by-15-foot area and would be about 60 feet tall. The turbine/generator and WHB feedwater treatment and handling equipment also require a significant footprint. This analysis estimated roughly 2,100 ft² of required space to house the WHB supporting equipment.

The main electrical requirements for the steam system include the condensate and WHB feedwater pumps. This analysis assumed a duty pump for each application at roughly 10 hp.

The potable water quality determines the level of treatment required prior to using a WHB feedwater. This analysis assumed a similar treatment system to that used at the Metropolitan Environmental Services Metro WWTP (St. Paul, Minnesota). This system includes reverse osmosis and ion exchange polishing plus boiler water feed chemicals to remove oxygen and prevent scaling. The City may not require such an extensive system depending on the potable water quality.

In addition to the impacts on the SHX discussed above the WHB requires inclusion of an ID fan in the FBI train. The ID fan would place the WHB under a slight vacuum, which reduces the structural design requirements and prevents leaks from exhausting to the FBI building. The ID fan would require a 300 hp motor while the fluidizing air blower power would operate at a reduced power draw and may reduce the motor size from 300 hp to 250 hp.

Lastly, the WHB would collect ash and therefore requires a removal system. This analysis assumed a slurry system consisting of a slurry pump and slurry pot for transfer to the ash gravity thickener.

Section 5: Supporting Systems

Many other systems at Post Point will support the FBI system. The sludge thickening, cake dewatering, and pumping system are critical to the FBI operations. The following sections discuss the existing systems and improvements included as part of this analysis.

5.1 Thickening and Storage

Post Point currently operates two GBTs to co-thicken primary and secondary sludge prior to dewatering. For this conceptual design these units would be replaced with two new GBTs with the same design ratings as those used for the anaerobic digestion alternative.

The existing thickened sludge storage provides 110,000 gallons of storage. As discussed below, the incineration facility would be constructed in the currently open area to the east of the administration building. This conceptual design assumes that the thickening facilities are also located in this new site and includes construction of new thickened sludge storage. This conceptual design also assumed that the new thickened sludge storage volume remains at 110,000 gallons. If the City ultimately decides to continue with incineration, reusing the existing GBTs, GBT building space, and thickened sludge storage tanks should be considered.

5.2 Dewatering

Post Point installed two new Alfa Laval G2-95 centrifuges around 2010. Each of those units is rated for 30 dtpd. An older Sharples DS-705 is also available with a capacity of 28 dtpd. The newer G2-95s are expected to have remaining service life when the FBI system would be installed (~2025). To match the assumptions used in the digestion evaluation, this evaluation assumes that two new 36 dtpd units would be installed and housed in a new facility to the east of the administration building in the currently open lot.

5.3 Cake Pumping

The age of the existing Schwing cake pumps is not known, but this analysis assumes that they require replacement when the FBI installation takes place (~2025). Two new units rated for 36 dtpd are included. Also, two 800 ft³ bins provide limited storage, assumed 4 hours at 36 dtpd processing rate, prior to feeding the pumps. The new cake/bins pumps would be located underneath the centrifuges in the new dewatering facility.

Section 6: Conceptual Layout and Costs

Based on the findings and recommendations of the previous sections, this analysis developed conceptual layouts and costs for the FBI system. The analysis included two alternatives, with and without a WHB for a steam turbine generator system.

6.1 Conceptual Layouts

The following presents the recommended train configurations and conceptual layouts for the two FBI alternatives. The configurations assume that only one train operates at any time to provide the same level of redundancy as the digestion-based alternative.

6.1.1 Base Alternative

The base alternative presents the equipment requirements for a functioning FBI system without any optional features. The following lists the major equipment required:

- Two GBTs with two thickened sludge pumps
- Two dewatering centrifuges
- Two cake pumps and bins
- Two FBI reactors
- Two preheat burner systems and burner combustion blowers
- One main natural gas train
- Three purge air blowers for flushing penetrations in the FBI reactor or ductwork
- Two fluidizing air blowers
- Two PHXs/SHXs in a stacked configuration
- Two plume suppression blowers
- Two wet scrubbers and WESPs in a stacked configuration
 - Wet scrubbers include a booster pump skid for spray water plus two slurry pumps
 - WESPs each include a purge air blower
- Two GAC units with gas conditioners
- Two flue gas stacks
- Two continuous-emissions monitoring systems (CEMSs)
- Two ash gravity thickeners with two thickened ash pumps and polymer system
- Two BFPs for ash dewatering and polymer system
- One sand storage silo with pneumatic transport system
- Two air compressors and air receiver for instrument and transport air requirements
- Two caustic metering pumps (assume storage tote on a lease basis)
- Two ammonia metering pumps (assume storage tote on a lease basis)
- Associated electrical, instrumentation, ductwork, piping, etc. for a functioning system

Figure 6-1 presents the major FBI process train components. Cake is fed to the FBI and the exhaust gas received ammonia injection for NO_x control. The flue gas proceeds through the PHX to preheat the combustion air. The cooler flue gas leaves the PHX and enters the SHX to heat plume suppression air, which combines with the clean flue gas just prior to the stack. Cooler but still dirty flue gas leaves the SHX and passes through the wet scrubber and WESP systems for particulate, acid gas, and metal removal. A caustic system provides the alkalinity required for optimal acid gas removal. The partially clean flue gas then flows through the mercury module to remove mercury. Finally, the flue gas exits the stack with the plume suppression air used to eliminate a visible plume.

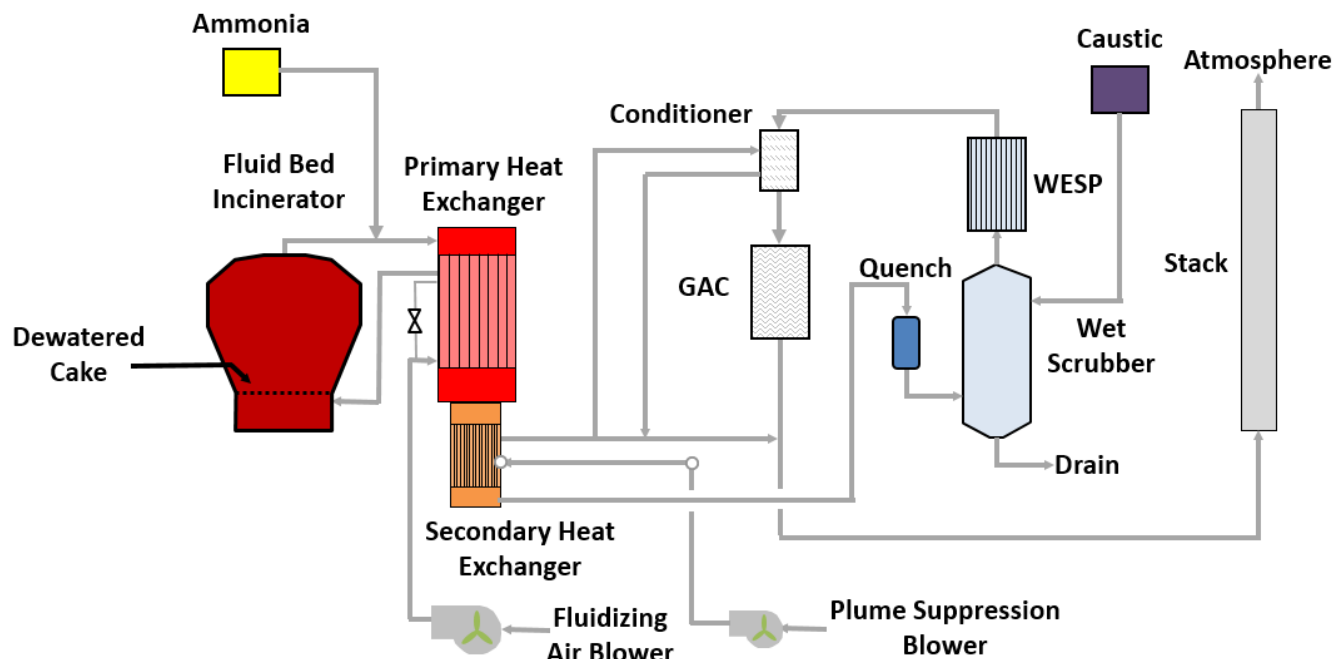
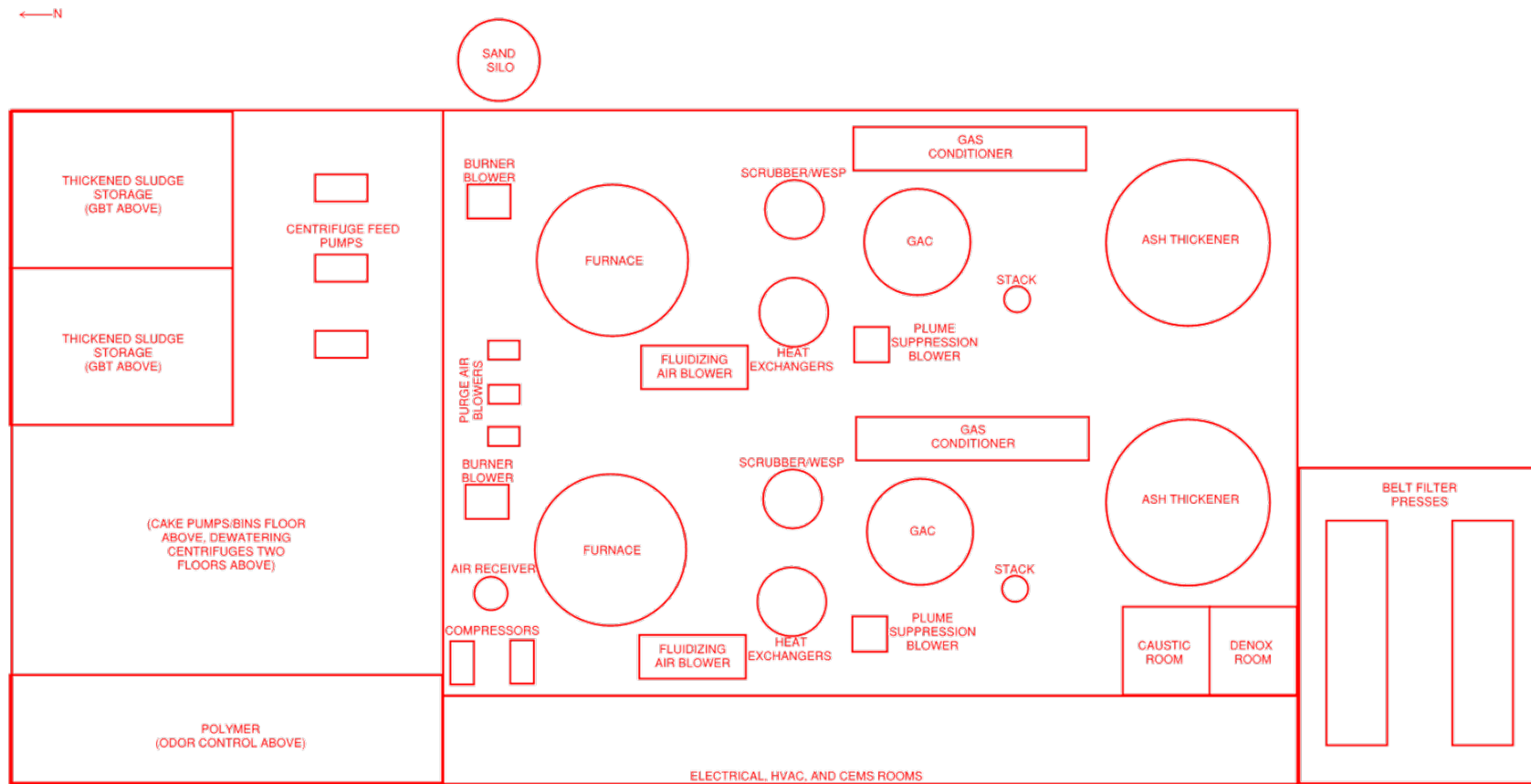


Figure 6-1. Base alternative FBI train schematic

This analysis locates the new FBI facility in the open space to the east of the administration building, as shown in the key plan of Figure 6-2. The general footprint of the incineration facility is 11,700 ft² with a floor-to-ceiling height of about 60 feet. The main equipment base floor typically is one level below grade.

The thickening and dewatering facilities are also shown attached to the incineration facility. These areas require 14,000 ft² of additional building space over two floors. Given the height of the building, the thickening and storage facility can be in the basement while the dewatering and cake pumping would reside on the upper level.



KEY PLAN

Figure 6-2. Base alternative FBI facility conceptual layout

6.1.2 WHB Alternative

The WHB alternative incorporates a WHB and steam power production system. The same equipment listed above for the base alternative is still required except as noted below:

- PHX and SHX are standalone units
- Plume suppression blowers not required
- Two ID fans
- Two WHBs with ash slurry system
- One steam system including the following major equipment:
 - One turbine/generator
 - One electrical switchgear
 - One main condenser
 - One auxiliary condenser
 - One condensate tank with two pumps
 - One de-aerator
 - Two WHB feedwater pumps
 - One reverse-osmosis skid
 - One ion exchange skid
 - WHB feedwater chemical systems
- Two plant water HEXs with closed-loop condenser cooling water system, includes two circulation pumps

This analysis assumes the plant water system has adequate capacity for cooling supply. Figure 6-3 presents the major FBI process train components for the WHB alternative. The train is basically the same as the base alternative except the WHB added between the PHX and SHX.

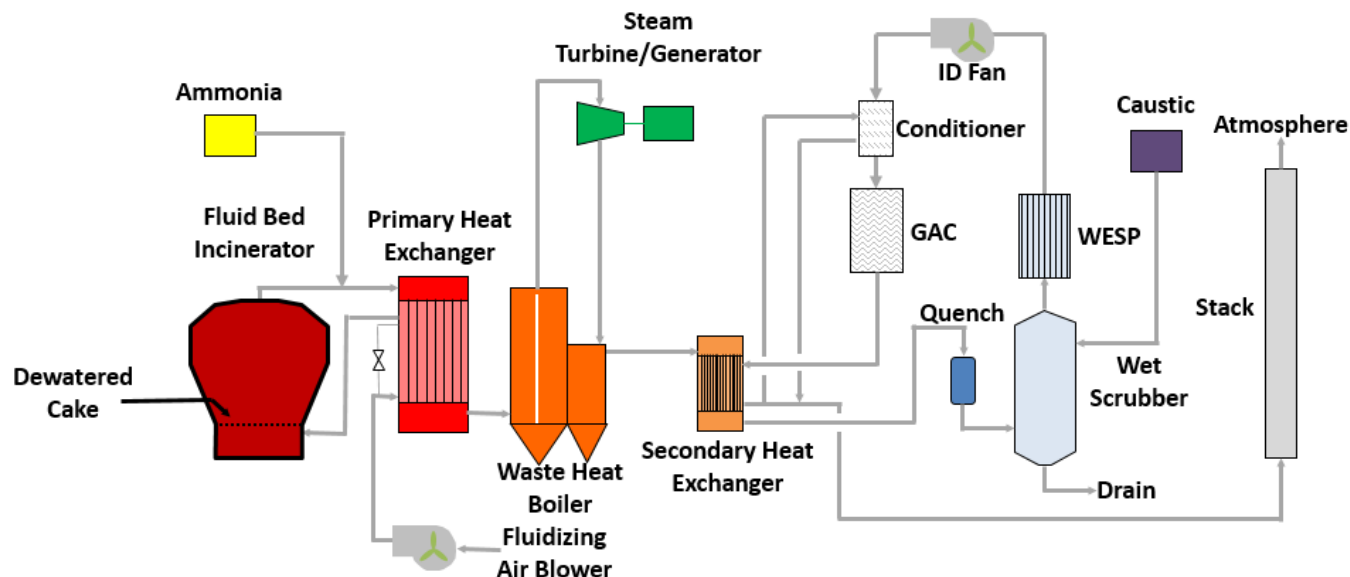


Figure 6-3. WHB alternative FBI train schematic

Figure 6-4 presents the conceptual layout for the WHB alternative. The WHBs require the building to expand (east/west) beyond the base alternative footprint. The WHB alternative requires approximately 14,300 ft²

and a floor-to-ceiling height of approximately 70 feet for the FBI trains. The footprint for the thickening and dewatering facility is the same as that for the base alternative.

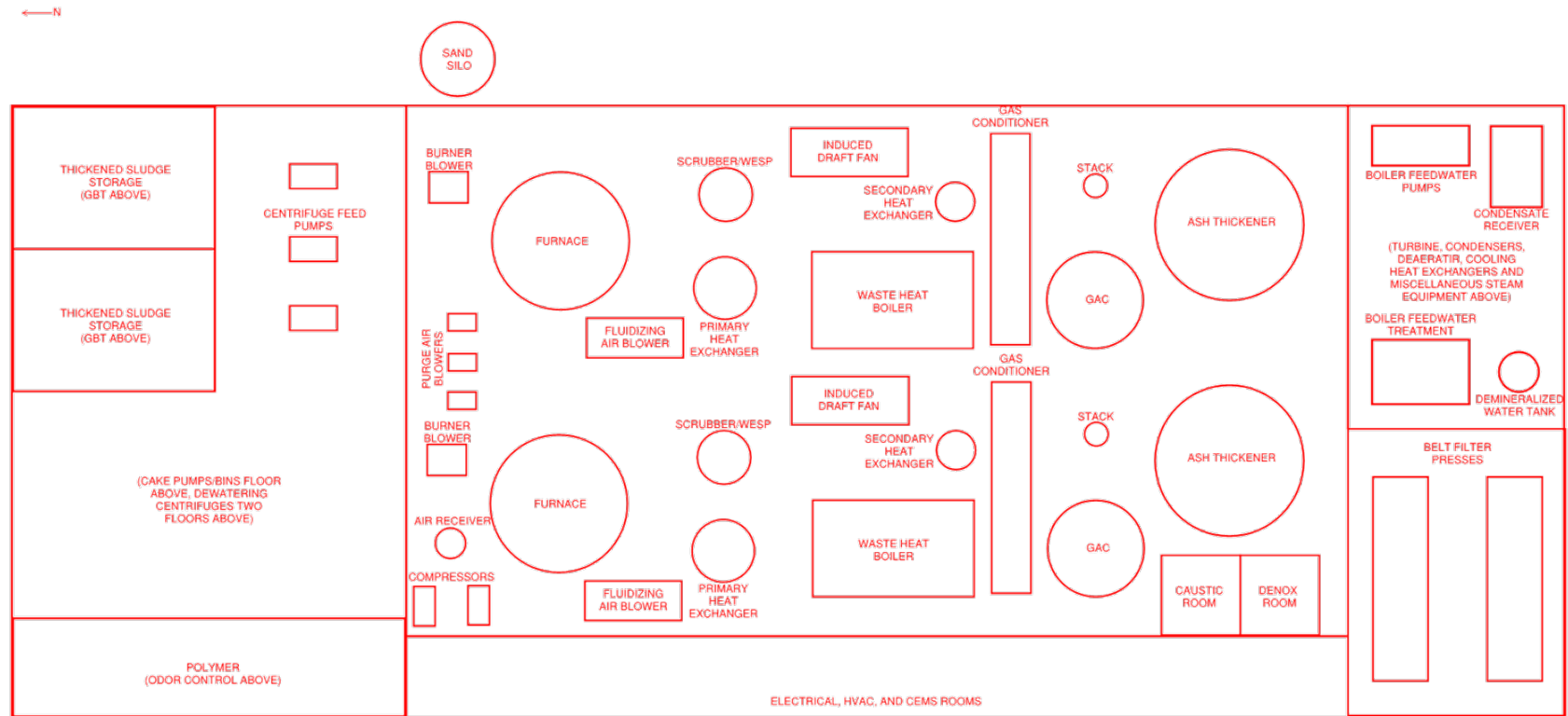


Figure 6-4. WHB alternative FBI facility conceptual layout

6.2 Opinion of Probable Construction Costs

Construction costs were estimated for the FBI alternatives to facilitate comparison to the digestion-based option. Table 6-1 summarizes assumptions used in the development of the construction costs. Estimates were developed to a Class 5 level as defined by the Association for the Advancement of Cost Engineering International (AACEI). Class 5 estimates have an expected accuracy range from -50 percent to +100 percent. In unusual circumstances, actual costs could exceed this range.

Table 6-1. Construction Costs Assumptions	
Item	Value
Net Cost Markups	
Labor	15%
Materials and process equipment	10%
Construction equipment	10%
Subcontractor	5%
Material shipping and handling	2%
Contractor general conditions	15%
Startup, training, and O&M	2%
Construction contingency	30%
Builders risk, liability, and auto insurance	2%
Performance and payment bonds	1.5%
Escalation to midpoint of construction	
Year	2023
Annual escalation rate	3%
Sales tax rate	8.7%

Table 6-2 describes the estimated construction costs for both incineration-based alternatives; refer to Attachment C for the full estimate details. The values include costs for a new integrated maintenance and administration building. This new facility is proposed for the digestion-based alternatives and therefore is included here to facilitate equal comparison between both alternatives.

Table 6-2. Construction Cost Estimates for Incineration Alternatives (2023 dollars)		
Item	Base Option Cost	Waste Heat Boiler Option Cost
Site work and yard piping	\$4,840,000	\$5,820,000
Sludge thickening/dewatering	\$16,250,000	\$16,250,000
Sludge storage tank	\$550,000	\$550,000
Fluidized-bed incinerator	\$24,640,000	\$24,640,000
Sand storage silo	\$370,000	\$370,000
Primary heat exchanger	\$2,930,000	\$2,930,000
Secondary heat exchanger	\$1,160,000	\$1,350,000
GAC equipment	\$10,290,000	\$10,290,000
Wet scrubber/WESP	\$4,900,000	\$4,900,000
Chemical feed system and piping	\$310,000	\$310,000
Stack	\$690,000	\$690,000
Ash thickening	\$1,050,000	\$1,050,000

Table 6-2. Construction Cost Estimates for Incineration Alternatives (2023 dollars)

Ash dewatering and loadout	\$3,450,000	\$3,450,000
Electrical and instrumentation	\$24,890,000	\$30,560,000
Waste heat boiler	-	\$9,620,000
Steam turbine generator	-	\$12,060,000
ID fan	-	\$500,000
Site remediation	\$4,410,000	\$4,410,000
Integrated maintenance building	\$26,560,000	\$26,560,000
Odor control	\$3,420,000	\$3,420,000
Demolition	\$1,270,000	\$1,270,000
Total	\$131,980,000	\$160,950,000

6.3 Life-Cycle Costs

In addition to estimating construction costs, the life-cycle costs for the incineration alternatives were estimated. The economic assumptions used to develop the life-cycle cost estimate are summarized in Table 6-3.

Table 6-3. Life-Cycle Cost Assumptions

Item	Value
Base year	2018
Construction	2022–24
Begin operation	2025
Planning period, years	20
Annual inflation (labor, electricity, construction)	3%
Discount rate	3.5%
Non-Construction Capital Costs	
Engineering, legal, and administration fees (percent of construction costs)	25%
Owner's reserve for change orders (percent of construction costs)	5%
Utility Costs	
Electricity (per kWh)	\$0.08
Natural gas (per therm)	\$1.70
Chemical Costs	
Polymer (per pound)	\$1.07
Caustic (per pound)	\$0.35
Ammonia (per pound)	\$0.15
Ash disposal (per wet ton)	\$90
Labor (percent of equipment costs)	3%
Materials (percent of material costs)	1.5%

In addition, the life-cycle cost analysis assumed that replacement of the PHX and instrumentation would be required during the life-cycle period at year 10 and year 15, respectively. Also included is replacement of GAC media on a 6-year cycle. The life-cycle cost model results are summarized in Table 6-4.

Table 6-4. Life-Cycle Cost Estimates for Incineration Alternatives (2018 dollars)		
Item	Base Option Cost	Waste Heat Boiler Option Cost
Capital costs	\$167,470,000	\$204,230,000
Labor	\$25,290,000	\$33,070,000
Chemicals	\$840,000	\$1,150,000
Electricity	\$5,010,000	\$2,440,000
Natural gas	\$240,000	\$240,000
Ash disposal	\$3,520,000	\$3,520,000
Materials	\$12,650,000	\$15,200,000
GAC media replacement	\$350,000	\$350,000
Equipment replacement costs	\$10,840,000	\$10,180,000
Total	\$226,210,000	\$270,370,000

Both net present value results are positive, which indicates a net expenditure over the life of both alternatives.

References

- CDM. 2008. *City of Bellingham: Biosolids Conversion Technology Evaluation*. December 31.
- CDM Smith. 2012. *Bellingham Post Point Wastewater Treatment Facility: Biosolids Business Case Evaluation*. December 4.
- Water Environment Federation (WEF). 1992. *Sludge Incineration: Thermal Destruction of Residues: Manual of Practice FD-19*.

Attachment A: Existing MHF Permit 287b

Northwest Clean Air Agency: revised January 25, 2018





1600 South Second Street
Mount Vernon, WA 98273-5202
ph 360-428-1617
fax 360-428-1620
info@nwcleanairwa.gov
www.nwcleanairwa.gov

Original Issuance: August 11, 1990

Revision a: December 13, 1990

Revision b: January 25, 2018

**Northwest Clean Air Agency (NWCAA) hereby issues
Order of Approval to Construct (OAC) 287b**

Project Summary: Construct and operate a second sewage sludge incinerator (Incinerator #2) and associated air pollution control equipment. The multi-hearth incinerator has a nominal design feed capacity of 1,950 pounds per hour, dry sewage sludge (permitted capacity 1,300 lb/hour). The incinerator construction is concurrent with a major upgrade to the municipal wastewater treatment plant including the addition of secondary treatment.

Approved Emission Unit:

- One (1) multi-hearth sewage sludge incinerator (Incinerator #2) with seven combustion hearths and an afterburner. Emissions controlled with a venturi wet scrubber, tray scrubber, mist eliminator and wet electrostatic precipitator (WESP).

Owner/Operator	Facility Name and Location
City of Bellingham Department Public Works and Operations 200 McKenzie Street Bellingham, WA 98225 Contact: Karl Lowry, Superintendent of Operations	Post Point Wastewater Treatment Plant 200 McKenzie Street Bellingham, WA 98225

Permit History

- As of the date of issuance, this Order supersedes NWCAA OAC 287 issued August 11, 1990 and OAC 287a issued December 13, 1990.

Note that in addition to other applicable rules and regulations, the approved emission unit is subject to applicable portions of the following federal regulations:

New Source Performance Standards (NSPS)

- 40 CFR 60 Subpart A - General Provisions
- 40 CFR 60 Subpart O – Standard of Performance for Sewage Treatment Plants

National Emission Standards for Hazardous Air Pollutants (NESHAP)

- 40 CFR 61 Subpart A – General Provisions
- 40 CFR 61 Subpart E – National Emission Standard for Mercury

Approval and Promulgation of State Plans for Designated Facilities and Pollutants

- 40 CFR 62 Subpart A – General Provisions
- 40 CFR 62 Subpart LLL – Federal Plan Requirements for Sewage Sludge Incineration Units Constructed on or Before October 14, 2010

Standards for the Use and Disposal of Sewage Sludge

- 40 CFR 503 Subpart A – General Provisions
- 40 CFR 503 Subpart E – Incineration

Issuance of this Order is authorized by Northwest Clean Air Agency Regulation Section 300. The Owner/Operator must comply with the following restrictions and conditions¹:

- (1) Particulate emissions from the Incinerator #2 stack shall not exceed 0.02 grains per dry standard cubic foot of exhaust gas corrected to seven percent oxygen (0.02 gr/dscf @ 7% O₂). Compliance shall be demonstrated using 40 CFR 60 Appendix A Method 5 each time the incinerator is required to be tested for particulate emissions under 40 CFR 62 Subpart LLL.
- (2) Visible emission from the Incinerator #2 stack shall not exceed an average of five percent (5%) opacity in any consecutive 6-minute period as determined by 40 CFR 60 Appendix A Method 9.
- (3) Nuisance odors from the facility are prohibited at or beyond the property boundary as determined by NWCAA staff.
- (4) The dry sewage sludge feed rate to Incinerator #2 shall not exceed 1,300 pounds per hour. Compliance with this condition shall be determined by monitoring the hourly dry sewage sludge feed rate to the incinerator. The monitoring system shall be installed, operated and calibrated in accordance with good industry practices. Monitoring records must be retained for at least five years from the date of generation.

for C.S. Christy
Daniel A. Mahar, P.E.
Environmental Engineer

Agata McIntyre P.E.
Agata McIntyre, P.E.
Engineering Manager

Revision a: Revise operating limit from 3,000 to 8,760 hours per year.

Revision b: Add a feed rate limit to enable appropriate 40 CFR 62 Subpart LLL performance testing. Remove the 8,760 hour per year operating limit and other administrative revisions to prepare the OAC for incorporation into the AOP.

¹ Nothing in this permit is intended to, or shall, alter or waive any applicable law [including but not limited to defenses, entitlements, challenges or clarifications related to the Credible Evidence Rule, 62 FR 8315 (Feb. 27, 1997)] concerning the use of data for any purpose under the Act, generated by the reference method specified herein or otherwise.

Pursuant to Section 300.10 of the NWCAA Regulation and ch 43.21B RCW, this Order may be appealed to the Pollution Control Hearings Board (PCHB). To appeal to the PCHB, a written notice of appeal must be filed with the PCHB and a copy served upon the NWCAA within 30 days of the date the applicant receives this Order. Additional information regarding appeal procedures can be found at: <http://www.eluho.wa.gov/> under PCHB.

Attachment B: Existing MHF Permit 442b

Northwest Clean Air Agency: revised January 25, 2018





1600 South Second Street
Mount Vernon, WA 98273-5202
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www.nwcleanairwa.gov

Original Issuance: June 23, 1993

Revision a: June 25, 2004

Revision b: January 25, 2018

**Northwest Clean Air Agency (NWCAA) hereby issues
Order of Approval to Construct (OAC) 442b**

Project Summary: Modify Incinerator #1 to increase its sludge feed rate capacity and modify its air pollution control equipment to meet 40 CFR 503 standards. Incinerator #1 was constructed in 1973 and the modification approved under this OAC was completed concurrent with a major upgrade to the wastewater treatment plant with the addition of secondary wastewater treatment. The modified Incinerator #1 has a nominal design feed capacity of 1,510 pounds per hour, dry sewage sludge (permitted capacity 1,250 lb/hour).

Approved Emission Unit:

- One (1) multi-hearth sewage sludge incinerator (Incinerator #1) with seven combustion hearths and an afterburner. Emissions controlled with a venturi wet scrubber, tray scrubber, mist eliminator and wet electrostatic precipitator (WESP).

Owner/Operator	Facility Name and Location
City of Bellingham Department Public Works and Operations 200 McKenzie Street Bellingham, WA 98225 Contact: Karl Lowry, Superintendent of Operations	Post Point Wastewater Treatment Plant 200 McKenzie Street Bellingham, WA 98225

Permit History

- As of the date of issuance, this Order supersedes NWCAA OAC 442 issued June 23, 1993 and OAC 442a issued June 25, 2004.

Note that in addition to other applicable rules and regulations, the approved emission unit is subject to applicable portions of the following federal regulations:

New Source Performance Standards (NSPS)

- 40 CFR 60 Subpart A - General Provisions
- 40 CFR 60 Subpart O - Standard of Performance for Sewage Treatment Plants

National Emission Standards for Hazardous Air Pollutants (NESHAP)

- 40 CFR 61 Subpart A - General Provisions
- 40 CFR 61 Subpart E - National Emission Standard for Mercury

Approval and Promulgation of State Plans for Designated Facilities and Pollutants

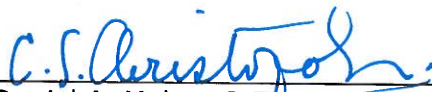
- 40 CFR 62 Subpart A - General Provisions
- 40 CFR 62 Subpart LLL - Federal Plan Requirements for Sewage Sludge Incineration Units Constructed on or Before October 14, 2010

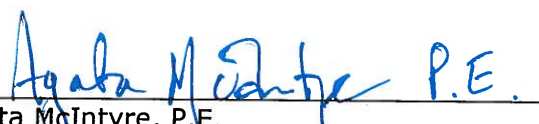
Standards for the Use and Disposal of Sewage Sludge

- 40 CFR 503 Subpart A – General Provisions
- 40 CFR 503 Subpart E – Incineration

Issuance of this Order is authorized by Northwest Clean Air Agency Regulation Section 300. The Owner/Operator must comply with the following restrictions and conditions¹:

- (1) Particulate emissions from the Incinerator #1 stack shall not exceed 0.02 grains per dry standard cubic foot of exhaust gas corrected to seven percent oxygen (0.02 gr/dscf @ 7% O₂). Compliance shall be demonstrated using 40 CFR 60 Appendix A Method 5 each time the incinerator is required to be tested for particulate emissions under 40 CFR 62 Subpart LLL.
- (2) Visible emission from the Incinerator #1 stack shall not exceed an average of five percent (5%) opacity in any consecutive 6-minute period as determined by 40 CFR 60 Appendix A Method 9.
- (3) Nuisance odors from the facility are prohibited at or beyond the property boundary as determined by NWCAA staff.
- (4) The dry sewage sludge feed rate to Incinerator #1 shall not exceed 1,250 pounds per hour. Compliance with this condition shall be determined by monitoring the hourly dry sewage sludge feed rate to the incinerator. The monitoring system shall be installed, operated and calibrated in accordance with good industry practices. Monitoring records must be retained for at least five years from the date of generation.


for Daniel A. Mahar, P.E.
Environmental Engineer

 P.E.
Agata McIntyre, P.E.
Engineering Manager

Revision a: Remove condition limiting the incinerator to 1,400 lb/day dry sludge.

Revision b: Add a feed rate limit to enable appropriate 40 CFR 62 Subpart LLL performance testing. Other administrative revisions to prepare the OAC for incorporation into the AOP.

¹ Nothing in this permit is intended to, or shall, alter or waive any applicable law [including but not limited to defenses, entitlements, challenges or clarifications related to the Credible Evidence Rule, 62 FR 8315 (Feb. 27, 1997)] concerning the use of data for any purpose under the Act, generated by the reference method specified herein or otherwise.

Pursuant to Section 300.10 of the NWCAA Regulation and ch 43.21B RCW, this Order may be appealed to the Pollution Control Hearings Board (PCHB). To appeal to the PCHB, a written notice of appeal must be filed with the PCHB and a copy served upon the NWCAA within 30 days of the date the applicant receives this Order. Additional information regarding appeal procedures can be found at: <http://www.eluho.wa.gov/> under PCHB.

Attachment C: Construction Cost Estimates





Memorandum

Date: August 14, 2018
To: Tadd Giesbrecht, Seattle
From: Dan Goodburn, Parker
Reviewed by: Bill Agster, Denver
Copy to: Ian Mckelvey, Seattle
Project No.: 150048.230.235
Subject: Post Point Biosolids Planning – Incineration Alternatives
BODR Design Completion
Basis of Estimate of Probable Construction Cost

The Basis of Estimate Report and supporting estimate reports for the subject project are attached. Please call me if you have questions or need additional information.

Enclosures (5):

1. Basis of Estimate Report
2. Base Summary Estimate
3. Base Detailed Estimate
4. Alternate Summary Estimate
5. Alternate Detailed Estimate

Basis of Estimate Report

Post Point Biosolids Planning – Incineration Alternatives

Introduction

Brown and Caldwell (BC) is pleased to present this opinion of probable construction cost (estimate) prepared for the Bellingham Biosolids Planning, Incineration Alternatives, in Bellingham, Washington.

Summary

This Basis of Estimate contains the following information:

- Scope of work
- Background of this estimate
- Class of estimate
- Estimating methodology
- Direct cost development
- Indirect cost development
- Bidding assumptions
- Estimating assumptions
- Estimating exclusions
- Allowances for known but undefined work
- Contractor and other estimate markups

Scope of Work

BC is the prime teamed with Carollo to do biosolids planning for Bellingham to assess replacing their sludge incineration system. This estimate provides costs for a similar incineration system. The estimate includes a base estimate and an alternate estimate that adds a waste heat boiler and steam turbine generator. Previous estimates provided costs for a digestion system, this estimate only includes the sludge incineration system.

The base estimate includes the following scope:

- Sludge thickening and dewatering
- Odor control
- Fluidized bed incinerator
- Primary and secondary heat exchangers
- Wet scrubber emission control system
- Granular activated carbon vessel

- Exhaust flue stack
- Continuous emissions monitoring system
- Ash slurry thickening and dewatering
- Chemical feed systems

The alternate estimate includes all the base scope above and adds the following:

- Waste heat boiler
- Induced draft fan
- Steam turbine generator
- Boiler feedwater treatment
- Effluent cooling system

Background of this Estimate

The attached estimate of probable construction cost is based on documents dated September, 2017, received by the Estimating and Scheduling Group (ESG). These documents are described as conceptual based on the current project progression, additional or updated scope and/or quantities, and ongoing discussions with the project team. Further information can be found in the detailed estimate reports.

Class of Estimate

In accordance with the Association for the Advancement of Cost Engineering International (AACE) criteria, this is a Class 5 estimate. A Class 5 estimate is defined as a Conceptual Level or Project Viability Estimate. Typically, engineering is from 0 to 2 percent complete. Class 5 estimates are used to prepare planning level cost scopes or evaluation of alternative schemes, long range capital outlay planning and can also form the base work for the Class 4 Planning Level or Design Technical Feasibility Estimate.

Expected accuracy for Class 5 estimates typically ranges from -50 to +100 percent, depending on the technological complexity of the project, appropriate reference information and the inclusion of an appropriate contingency determination. In unusual circumstances, ranges could exceed those shown.

Estimating Methodology

This estimate was prepared using quantity take-offs, vendor quotes and equipment pricing furnished either by the project team or by the estimator. The estimate includes direct labor costs and anticipated productivity adjustments to labor and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors have been identified.

Construction labor crew and equipment hours were calculated from production rates contained in documents and electronic databases published by R.S. Means, Mechanical Contractors Association (MCA), National Electrical Contractors Association (NECA), and Rental Rate Blue Book for Construction Equipment (Blue Book).

This estimate was prepared using BC's estimating system, which consists of Sage Construction and Real Estate 300 estimating software engine (formerly Timberline) using RS Means database, historical project data, the latest vendor and material cost information, and other costs specific to the project location.

Electrical estimates are performed using ConEst Intellibid electrical estimating software with database provided by Trade Services. The final number from the electrical estimate will be included in the Sage

estimate, usually as an “electrical subcontract” number. Clients will be provided the detailed electrical estimate along with the Sage estimate in their deliverable.

Direct Cost Development

Costs associated with the General Provisions and the Special Provisions of the construction documents, which are collectively referred to as Contractor General Conditions (CGC), were based on the estimator’s interpretation of the contract documents. The estimates for CGCs are divided into two groups: a time-related group (e.g., field personnel) and non-time-related group (e.g., bonds and insurance). Labor burdens such as health and welfare, vacation, union benefits, payroll taxes, and worker’s compensation insurance are included in the labor rates. No trade discounts were considered.

Indirect Cost Development

Excise sales tax has been applied to the total probable contract value. A percentage allowance for contractor’s home office expense has been included in the overall rate markups. The rate is standard for this type of heavy construction and is based on typical percentages outlined in Means Heavy Construction Cost Data.

The contractor’s cost for builder’s risk, general liability and vehicle insurance has been included in this estimate. Based on historical data, this is typically two to four percent of the overall construction contract amount. These indirect costs have been included in this estimate as a percentage of the gross cost and are added after the net markups have been applied to the appropriate items.

Bidding Assumptions

The following bidding assumptions were considered in the development of this estimate.

1. Bidders must hold a valid, current Contractor’s credentials, applicable to the type of project.
2. Bidders will develop estimates with a competitive approach to material pricing and labor productivity, and will not include allowances for changes, extra work, unforeseen conditions or any other unplanned costs.
3. Estimated costs are based on a minimum of four bidders. Actual bid prices may increase for fewer bidders or decrease for a greater number of bidders.
4. Bidders will account for General Provisions and Special Provisions of the contract documents and will perform all work except that which will be performed by traditional specialty subcontractors as identified here:
 - Waterproofing and lining
 - Coating systems
 - HVAC systems
 - Plumbing systems
 - Electrical and Instrumentation

Estimating Assumptions

As the design progresses through different completion stages, it is customary for the estimator to make assumptions to account for details that may not be evident from the documents. The following assumptions were used in the development of this estimate.

1. Contractor performs the work during normal daylight hours, nominally 7 a.m. to 5 p.m., Monday through Friday, in an 8-hour shift. No allowance has been made for additional shift work or weekend work.
2. Contractor has complete access for lay-down areas and mobile equipment.
3. Equipment rental rates are based on verifiable pricing from the local project area rental yards, Blue Book rates, and/or rates contained in the estimating database.
4. Contractor markup is based on conventionally accepted values that have been adjusted for project-area economic factors.
5. Major equipment costs are based on vendor supplied price quotes obtained by the project design team and/or estimators and on historical pricing of like equipment.
6. Process equipment vendor training using vendors' standard Operations and Maintenance (O&M) material is included in the purchase price of major equipment items where so stated in that quotation.
7. Bulk material quantities are based on manual quantity take-offs.
8. There is sufficient electrical power to feed the specified equipment. The local power company will supply power and transformers suitable for this facility.
9. Soils are of adequate nature to support the structures. No piles have been included in this estimate.
10. Demolition of existing private buildings at north end of site includes only the permanent structures and utilities. It is assumed that all temporary structures, trailers, equipment and materials inside buildings, etc. will be removed prior to demolition. All materials and equipment in yard areas will also be removed prior to construction.
11. The following assumptions were made for demolition of existing structures and handling of demolition waste:
 - a. Combination of masonry, wood, and steel construction.
 - b. Average structure height of 15 feet.
 - c. Volume of C&D debris conversion factor of 0.25 X building volume.
 - d. Tons of C&D debris per cubic yard factor of 0.5.
 - e. 65% recycle recovery factor, 35% hauled to landfill.
12. Existing solids handling facility demolition and gutting includes removal of process equipment, mechanical piping, and electrical systems associated with process treatment. Tankage and incinerator components that are permanently built into the structure are to remain. All mechanical, plumbing, and electrical systems associated with the building structure to remain.
13. Existing sludge pumping to sludge thickening and dewatering to be re-used. Piping will be tied-into existing piping near existing thickening facility.
14. Sludge thickening and dewatering building and sludge storage tank is constructed of concrete and masonry.
15. The incinerator building portion of facility is constructed of structural steel with metal siding.
16. All chemical feed storage systems are based on totes provided by chemical supplier.
17. Effluent cooling system for the steam condenser using plant effluent is similar to effluent cooling system included in the digestion system alternative. Effluent pumping station is within 600 lineal feet of the incineration facility.

Estimating Exclusions

The following estimating exclusions were assumed in the development of this estimate.

1. O&M costs for the project except for the vendor supplied O&M manuals.

2. Utility agency costs for incoming power modifications.
3. Permits beyond those normally needed for the type of project and project conditions.
4. Labor premiums, relocation costs, per diem, or other costs due to limited work force availability at the time of bid.
5. Modifications to existing primary and WAS pumping stations and sludge blending.
6. Air emission permit for incinerator.
7. Ash re-use processes.

Regarding 2018 Tariffs

Recent United States Federal policies and discussions surrounding tariffs on all imported steel, stainless steel, and aluminum and potentially other items can already have a potential impact on the costs of construction. Whether imported or US made products are being used, the discussion of, and imposition of, tariffs can impact pricing and availability of many construction components including, without limitation, pipes, electrical wiring and components, equipment, handrail/grating, as well as fees for equipment and materials rentals, and can also impact product lead times which may impact project schedules. In many cases, companies are already raising prices and increasing lead times to cover anticipated cost increases and material shortages.

While the above factors can have a substantial impact on project costs and project schedules, at this time, there is inadequate resolution of the issues and a lack of specific data to base a tariff-related contingency recommendation, and therefore none has been included in the cost estimate. Project owners, however, should consider their own separate contingency, both cost and time for their project, as they deem appropriate through internal consideration of these and other factors.

Allowances for Known but Undefined Work

The following allowances were made in the development of this estimate.

1. Yard piping equal to 3% of total direct project costs.
2. Site improvements equal to 2% of total direct project costs.
3. All new process treatment structures, maintenance, administration, and laboratory buildings on a per square foot basis.
4. Coating systems on lump sum basis.
5. Process equipment on lump sum basis per process area.
6. Process piping on lump sum basis per process area and service.
7. Electrical and instrumentation equal to 20% and 5% respectively of total direct project costs.
8. Startup and testing on markup basis.
9. General conditions requirements on markup basis.

Contractor and Other Estimate Markups

Contractor markup is based on conventionally accepted values which have been adjusted for project-area economic factors. Estimate markups are shown in Table 1.

Table 1. Estimate Markups	
Item	Rate (%)
Net Cost Markups	
Labor (employer payroll burden)	15
Materials and process equipment	10
Equipment (construction-related)	10
Subcontractor	5
Material Shipping and Handling	2
Gross Cost Markups	
Contractor General Conditions	15
Start-up, Training and O&M	2
Construction Contingency	30
Builders Risk, Liability and Auto Insurance	2
Performance and Payment Bonds	1.5
Escalation to Midpoint of Construction	19.4
Sales Tax (Excise-Gross Receipts-Contract Value)	8.7

Labor Markup

The labor rates used in the estimate were derived from RS Means latest national average wage rate tables and city cost indexes. These include base rate paid to the laborer plus fringes. A labor burden factor is applied to these such that the final rates include all employer paid taxes. These taxes are FICA (which covers social security plus Medicare), Workers Comp (which varies based on state, employer experience and history) and unemployment insurance. The result is fully loaded labor rates. In addition to the fully loaded labor rate, an overhead and profit markup is applied at the back end of the estimate. This covers payroll and accounting, estimator's wages, home office rent, advertising and owner profit.

Materials and Process Equipment Markup

This markup consists of the additional cost to the contractor beyond the raw dollar amount for material and process equipment. This includes shop drawing preparation, submittal and/or re-submittal cost, purchasing and scheduling materials and equipment, accounting charges including invoicing and payment, inspection of received goods, receiving, storage, overhead and profit.

Equipment (Construction) Markup

This markup consists of the costs associated with operating the construction equipment used in the project. Most GCs will rent rather than own the equipment and then charge each project for its equipment cost. The equipment rental cost does not include fuel, delivery and pick-up charges, additional insurance requirements on rental equipment, accounting costs related to home office receiving invoices and payment. However, the crew rates used in the estimate do account for the equipment rental cost. Occasionally, larger contractors will have some or all the equipment needed for the job, but to recoup their initial purchasing cost they will charge the project an internal rate for equipment use which is like the rental cost of equipment. The GC will apply an overhead and profit percentage to each individual piece of equipment whether rented or owned.

Subcontractor Markup

This markup consists of the GC's costs for subcontractors who perform work on the site. This includes costs associated with shop drawings, review of subcontractor's submittals, scheduling of subcontractor work, inspections, processing of payment requests, home office accounting, and overhead and profit on subcontracts.

Sales Tax (Excise-Gross Receipts-Contract Value)

This is the tax that the contractor must pay according to state and local taxation laws. The percentage is based on state, county and local rates in place at the time the estimate was prepared. The percentage is applied to the total anticipated contract value.

Contractor Startup, Training, and O&M Manuals

This cost markup is often confused with either vendor startup or owner startup. It is the cost the GC incurs on the project beyond the vendor startup and owner startup costs. The GC generally will have project personnel assigned to facilitate the installation, testing, startup and O&M manual preparation for equipment that is put into operation by either the vendor or owner. These project personnel often include an electrician, pipe fitter or millwright, and/or I&E technician. These personnel are not included in the basic crew makeup to install the equipment but are there to assist and troubleshoot the startup and proper running of the equipment. The GC also incurs a cost for startup for such things as consumables (oil, fuel, filters, etc.), startup drawings and schedules, startup meetings and coordination with the plant personnel in other areas of the plant operation.

Builders Risk, Liability, and Vehicle Insurance

This percentage comprises all three items. There are many factors which make up this percentage, including the contractor's track record for claims in each of the categories. Another factor affecting insurance rates has been a dramatic price increase across the country over the past several years due to domestic and foreign influences. Consequently, in the construction industry we have observed a range of 0.5 to 1 percent for Builders Risk Insurance, 1 to 1.25 percent for General Liability Insurance, and 0.85 to 1 percent for Vehicle Insurance. Many factors affect each area of insurance, including project complexity and contractor's requirements and history. Instead of using numbers from a select few contractors, we believe it is more prudent to use a combined 2 percent to better reflect the general costs across the country. Consequently, the actual cost could be higher or lower based on the bidder, region, insurance climate, and the contractor's insurability at the time the project is bid.

Material Shipping and Handling

This can range from 2 to 6 percent, and is based on the type of project, material makeup of the project, and the region and location of the project. Material shipping and handling covers delivery costs from vendors, unloading costs (and in some instances loading and shipment back to vendors for rebuilt equipment), site paper work, and inspection of materials prior to unloading at the project site. BC typically adjusts this percentage by the amount of materials and whether vendors have included shipping costs in the quotes that were used to prepare the estimate. This cost also includes the GC's cost to obtain local supplies, e.g., oil, gaskets and bolts that may be missing from the equipment or materials shipped.

Escalation to Midpoint for Labor, Materials and Subcontractors

In addition to contingency, it is customary for projects that will be built over several years to include an escalation to midpoint of anticipated construction to account for the future escalation of labor, material and

equipment costs beyond values at the time the estimate is prepared. For this project, the anticipated rate of escalation is 4 percent per annum.

The estimated construction time for this project is 48 months, exclusive of unusual weather or site conditions delays. Construction is anticipated to start December, 2020 and be completed by November, 2024. The escalation factors used in this estimate are calculated from the date of this estimate to the anticipated midpoint of construction which is approximately 53 months from the date of this estimate.

Undesigned/Undeveloped Contingency

The contingency factor covers unforeseen conditions, area economic factors, and general project complexity. This contingency is used to account for those factors that cannot be addressed in each of the labor and/or material installation costs. Based on industry standards, completeness of the project documents, project complexity, the current design stage and area factors, construction contingency can range from 10 to 50 percent.

Performance and Payment Bonds

Based on historical and industry data, this can range from 0.75 to 3 percent of the project total. There are several contributing factors including such items as size of the project, regional costs, contractor's historical record on similar projects, complexity and current bonding limits. BC uses 1.5 percent for bonds, which we have determined to be reasonable for most heavy construction projects.



Estimate Summary Report

8/15/2018 9:05 AM

Project Number: 150048-230-235
Estimate Issue Number: 1
Bid Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Base

City of Bellingham
Post Point Biosolids Planning - Incineration Base
BODR Conceptual Estimate AACEI Class 5

Estimator	D. Goodburn
BC Project Manager	Tadd Giesbrecht
BC Office	Seattle
Estimate Issue No.	1
QA/QC Reviewer	Bill Agster
QA/QC Review Date	7/24/2018
BC Estimate Number	150048-230-235

Notes PROCESS LOCATION/AREA INDEX

-
- 1 - Site Work and Yard Piping
 - 2 - Sludge Thickening/Dewatering
 - 3 - Sludge Storage Tank
 - 4 - Fluid Bed Incinerator
 - 5 - Sand Storage Silo
 - 6 - Primary Heat Exchanger
 - 7 - Secondary Heat Exchanger
 - 8 - GAC
 - 9 - Wet Scrubber/WESP
 - 10 - Chemical Feed Systems
 - 11 - Stack
 - 12 - Gravity Thickener
 - 13 - Ash Dewatering/Loadout
 - 14 - Electrical and Instrumentation
 - 15 - Not Used
 - 16 - Not Used



Estimate Summary Report

8/15/2018 9:05 AM

Project Number: 150048-230-235
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Post Point Biosolids Planning - Incineration Base

Notes	
	17 - Not Used
	18 - Site Remediation
	19 - Integrated Maintenance Building
	20 - Demo Admin/Shop/Storage Buildings
	21 - Odor Control
	22 - Gut Solids Handling Building



Estimate Summary Report

8/15/2018 9:05 AM

Project Number: 150048-230-235
Estimate Issue Number: 1
Bid Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Base

Estimate Breakdown	Gross Total Cost w/Markups
01 Total	
01 Site Work and Yard Piping	
01 Sitework Improvements	1,896,206
03 Yard Piping	2,942,220
01 Site Work and Yard Piping	4,838,426
 02 Sludge Thickening/Dewatering	
09 Transfer Piping	286,182
10 Cake Piping	228,496
11 Supernatant Piping	114,623
15 Process Water Piping	22,925
22 Thickening/Dewatering Equipment	10,220,144
25 Chemical Piping	137,547
31 Building	5,237,073
02 Sludge Thickening/Dewatering	16,246,989
 03 Sludge Storage Tank	
31 Building	546,590
03 Sludge Storage Tank	546,590
 04 Fluid Bed Incinerator	
12 Incineration Ducting	4,305,077
15 Process Water Piping	22,925
16 Misc Process Piping	126,085
23 Incinerator Equipment	15,506,833
31 Building	4,677,626
04 Fluid Bed Incinerator	24,638,545
 05 Sand Storage Silo	



Estimate Summary Report

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Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Base

Estimate Breakdown	Gross Total Cost w/Markups
14 Sand Piping	34,612
23 Incinerator Equipment	338,968
05 Sand Storage Silo	373,580
06 Primary Heat Exchanger	
23 Incinerator Equipment	2,934,420
06 Primary Heat Exchanger	2,934,420
07 Secondary Heat Exchanger	
23 Incinerator Equipment	1,160,248
07 Secondary Heat Exchanger	1,160,248
08 GAC	
32 Process Equipment	10,286,785
08 GAC	10,286,785
09 Wet Scrubber/WESP	
15 Process Water Piping	91,698
16 Misc Process Piping	550,190
32 Process Equipment	4,257,457
09 Wet Scrubber/WESP	4,899,345
10 Chemical Feed Systems	
25 Chemical Piping	110,038
26 Chemical Feed	201,808
10 Chemical Feed Systems	311,846
11 Stack	
13 Flue Gas Ducting	270,348



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Post Point Biosolids Planning - Incineration Base

Estimate Breakdown	Gross Total Cost w/Markups
32 Process Equipment	417,245
11 Stack	687,593
12 Gravity Thickener	
17 Cake Loadout	1,048,259
12 Gravity Thickener	1,048,259
13 Ash Dewatering/Loadout	
08 Thickened Ash Piping	91,698
10 Cake Piping	137,247
17 Cake Loadout	3,225,016
13 Ash Dewatering/Loadout	3,453,961
14 Electrical and Instrumentation	
35 Electrical	19,911,266
36 Instrumentation	4,977,817
14 Electrical and Instrumentation	24,889,083
18 Site Remediation	
01 Sitework Improvements	4,414,915
18 Site Remediation	4,414,915
19 Integrated Maintenance Building	
31 Building	26,562,043
19 Integrated Maintenance Building	26,562,043
20 Demo Admin/Shop/Storage Buildings	
34 Demolition Building	1,007,011
20 Demo Admin/Shop/Storage Buildings	1,007,011



Estimate Summary Report

8/15/2018 9:05 AM

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Bid Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Base

Estimate Breakdown	Gross Total Cost w/Markups
21 Odor Control	
24 Odor Control Equipment	3,421,003
21 Odor Control	3,421,003
22 Gut Solids Handling Building	
33 Demolition Process	261,943
22 Gut Solids Handling Building	261,943
01 Total	131,982,586



Post Point Biosolids Planning - Incineration Base

City of Bellingham
Post Point Biosolids Planning - Incineration Base
BODR Conceptual Estimate AACEI Class 5

Estimator	D. Goodburn
BC Project Manager	Tadd Giesbrecht
BC Office	Seattle
Estimate Issue No.	1
QA/QC Reviewer	Bill Agster
QA/QC Review Date	7/24/2018

Notes **PROCESS LOCATION/AREA INDEX**

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- 12 - Gravity Thickener
- 13 - Ash Dewatering/Loadout
- 14 - Electrical and Instrumentation
- 15 - Not Used
- 16 - Not Used
- 17 - Not Used
- 18 - Site Remediation
- 19 - Integrated Maintenance Building
- 20 - Demo Admin/Shop/Storage Buildings
- 21 - Odor Control
- 22 - Gut Solids Handling Building



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
01 Total										
01 Site Work and Yard Piping										
01 Sitework Improvements										
32999 Misc. Exterior Improvements										
32-00-00.01	BC-0001	Exterior Improvements, allowance (Based on 2% of project total)	1.0 ls	-	-	859,000.00	-	-	859,000.00 /ls	859,000
		Misc. Exterior Improvements	1.0 LS			859,000.00			859,000.00 /LS	859,000
		01 Sitework Improvements								859,000
03 Yard Piping										
33999 Misc. Utilities Work										
33-00-00.01	BC-0001	Utilities, yard piping allowance (Based on 3% of project total)	1.0 ls	430,000.00	430,000.00		430,000.00	-	1,290,000.00 /ls	1,290,000
		Misc. Utilities Work	1.0 LS	430,000.00	430,000.00		430,000.00		1,290,000.00 /LS	1,290,000
		03 Yard Piping								1,290,000
		01 Site Work and Yard Piping								2,149,000
02 Sludge Thickening/Dewatering										
09 Transfer Piping										
40120 Transfer Sludge Piping										
40-05-19.20	----	Process piping allowance	1.0 ls	50,000.00	75,000.00	-	-	-	125,000.00 /ls	125,000
		Transfer Sludge Piping	1.0 LS	50,000.00	75,000.00				125,000.00 /LS	125,000
		09 Transfer Piping								125,000
10 Cake Piping										
40120 Cake Piping										
40-05-19.20	----	Process piping allowance	1.0 ls	25,000.00	75,000.00	-	-	-	100,000.00 /ls	100,000
		Cake Piping	1.0 LS	25,000.00	75,000.00				100,000.00 /LS	100,000
		10 Cake Piping								100,000
11 Supernatant Piping										
40120 Supernatant Piping										
40-05-19.20	----	Process piping allowance	1.0 ls	25,000.00	25,000.00	-	-	-	50,000.00 /ls	50,000
		Supernatant Piping	1.0 LS	25,000.00	25,000.00				50,000.00 /LS	50,000
		11 Supernatant Piping								50,000
15 Process Water Piping										
40130 Process Water Piping										
40-05-17.00	----	Process piping allowance	1.0 ls	5,000.00	5,000.00	-	-	-	10,000.00 /ls	10,000
		Process Water Piping	1.0 LS	5,000.00	5,000.00				10,000.00 /LS	10,000
		15 Process Water Piping								10,000
22 Thickening/Dewatering Equipment										
46999 Process Equipment										
46-99-99.99	MISC	Gravity belt thickener, 2M	2.0 ea	43,384.85	190,500.00		3,162.00	-	237,046.85 /ea	474,094
46-06-00.00	----	Centrifuge, 36 dtpd, 250hp, incl. starter and control panels	2.0 ea	73,181.81	1,311,285.00	-	10,356.23	-	1,394,823.03 /ea	2,789,646
46-06-00.00	----	Cake pump, hydraulic piston, 23 gpm, incl. 10'X12' hopper and live bottom screw feeder, 100hp hydraulic power unit, control panel	2.0 ea	46,836.36	509,200.00	-	6,627.99	-	562,664.34 /ea	1,125,329
46-06-00.00	----	Thickened sludge pump, progressive cavity, allowance	2.0 ea	3,904.64	30,000.00	-	284.58	-	34,189.21 /ea	68,378
46-06-00.00	----	Washwater pump, centrifugal, allowance	2.0 ea	2,776.63	10,000.00	-	202.37	-	12,979.00 /ea	25,958
		Process Equipment	1.0 LS	340,168.57	4,101,970.00		41,266.32		4,483,404.89 /LS	4,483,405



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		22 Thickening/Dewatering Equipment								4,483,405
25 Chemical Piping										
40510 Piping - Polymer										
40-05-31.23	----	Process piping allowance	1.0 ls	30,000.00	30,000.00	-	-	-	60,000.00 /ls	60,000
		Piping - Polymer	1.0 LS	30,000.00	30,000.00				60,000.00 /LS	60,000
		25 Chemical Piping								60,000
31 Building										
13999 Thickening/Dewatering Building										
13-13-03.00	BC-0021	Incinerator Building, superstructure above slab at grade, allowance	14,400.0 sqft	40.00	60.00	-	25.00		125.00 /sqft	1,800,000
22-05-00.00	BC-0001	Allowance - Piping, Building Service/Domestic	14,400.0 sf	-	-	7.00	-	-	7.00 /sf	100,800
23-05-00.00	BC-0001	Allowance - HVAC	14,400.0 sqft	-	-	25.00	-	-	25.00 /sqft	360,000
09-99-99.99	MISC	Misc. Finishes, coating systems allowance	1.0 ls	-	-	50,000.00	-	-	50,000.00 /ls	50,000
		Thickening/Dewatering Building	7,175.0 sf	80.28	120.42	71.19	50.17		322.06 /sf	2,310,800
		31 Building	7,175.0 sf	80.28	120.42	71.19	50.17		322.06 /sf	2,310,800
		02 Sludge Thickening/Dewatering								7,139,205
03 Sludge Storage Tank										
31 Building										
03330 Slabs Sludge Storage Tank 35'X26.5'X24"										
31-23-16.16	6035	Strt excvt for minor strtr,bank measr,for sprd and mat ftngs,elvttr pits,and small bldng fndtns,common earth,3/4 cy bucket,machin excvtn,hydlrc backhoe	27.3 bcy	15.90	-	-	7.59	-	23.49 /bcy	642
31-23-23.18	0400	Hauling, excavated or borrow material, loose cubic yards, 1 mile round trip, 2.2 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	27.3 lcy	3.77	-	-	3.08	-	6.84 /lcy	187
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	103.3 sy	1.35	-	-	0.63	-	1.98 /sy	205
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	34.4 cy	-	35.03	-	-	-	35.03 /cy	1,206
03-11-13.65	3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	123.0 sfca	6.03	0.96	-	-	-	6.99 /sfca	860
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	123.0 lf	5.24	5.26	-	-	-	10.50 /lf	1,291
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	10.0 ea	13.62	38.06	-	-	-	51.68 /ea	517
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	2.8 ton	1,488.12	1,041.52	-	-	-	2,529.64 /ton	7,189
03-21-10.60	0605	Reinforcing, a615 60, sog, thickened edge, allow 28 lbs/cy, #3 to #7	0.6 ton	1,488.12	1,041.52	-	-	-	2,529.63 /ton	1,452
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	3.4 ton	57.80	-	-	6.03	-	63.82 /ton	218
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	3.4 ton	62.82	-	-	6.55	-	69.37 /ton	237
03-31-05.35	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	94.5 cy	-	122.75	-	-	-	122.75 /cy	11,602
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	94.5 cy	22.92	-	-	0.32	-	23.23 /cy	2,196
03-35-29.30	0100	Concrete finishing, floors, monolithic, screed and bull float(darby) finish	930.0 sf	0.50	-	-	-	-	0.50 /sf	463
03-39-13.50	0200	Curing, waterproof curing paper, 2 ply, reinforced	9.3 csf	17.44	26.02	-	-	-	43.46 /csf	404

Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Slabs Sludge Storage Tank 35'X26.5'X24"	92.7 cy	113.16	191.59		4.64		309.38 /cy	28,669
03345 Concrete Walls SST 15.5'HX16"T										
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	4,650.0 sfca	8.94	0.84	-	-	-	9.78 /sfca	45,488
03-11-13.85	0500	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	62.0 lf	15.18	2.49	-	-	-	17.67 /lf	1,096
03-15-13.50	3500	Waterstop, rubber, center bulb, split, 3/8" thick x 6" wide	62.0 lf	4.70	11.53	-	-	-	16.23 /lf	1,006
03-15-13.50	5205	Waterstop, rubber, field union, 3/8" x 6" wide, walls	5.0 ea	13.62	34.55	-	-	-	48.16 /ea	241
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	12.4 gal	-	24.01	-	-	-	24.01 /gal	298
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	10.0 ton	1,140.89	1,041.52	-	-	-	2,182.41 /ton	21,925
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	10.0 ton	57.80	-	-	6.02	-	63.82 /ton	641
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	10.0 ton	62.82	-	-	6.55	-	69.37 /ton	697
03-31-05.35	0320	Concrete, ready mix, regular weight, walls/cols/beams, 4000 psi	117.1 cy	-	122.75	-	-	-	122.75 /cy	14,375
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	117.1 cy	42.69	-	-	7.93	-	50.62 /cy	5,928
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	4,650.0 sf	1.28	0.03	-	-	-	1.31 /sf	6,078
22-11-19.34	0220	Sleeve, pipe, steel with water stop, 12" long, 12" diam. for 8" carrier pipe, includes link seal	8.0 ea	201.72	335.00	-	-	-	536.72 /ea	4,294
03-05-13.81	BC-0001	Membrane lining, T-lock liner (For Vaults and Manholes)	2,325.0 sqft	-	-	27.00	-	-	27.00 /sqft	62,775
		Concrete Walls SST 15.5'HX16"T	114.8 cy	593.12	286.67	546.75	9.19		1,435.72 /cy	164,842
03350 Elevated Slabs SST 35'X26.5'X12"										
03-11-13.35	1150	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	930.0 sf	7.18	1.39	-	-	-	8.58 /sf	7,976
03-11-13.35	7000	C.I.P. concrete forms, elevated slab, edge forms, to 6" high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	123.0 lf	5.25	0.23	-	-	-	5.48 /lf	674
03-11-13.35	8000	C.I.P. concrete forms, elevated slab, perimeter deck and rail, straight, includes shoring, erecting, bracing, stripping and cleaning	88.0 lf	29.15	15.05	-	-	-	44.19 /lf	3,889
03-15-05.70	1550	Shores, reshoring at elevated decks, allow	186.0 sf	0.97	0.71	-	-	-	1.69 /sf	314
03-21-10.60	0400	Reinforcing steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.8 ton	1,180.23	1,041.52	-	-	-	2,221.75 /ton	3,904
03-21-10.60	2050	Reinforcing in place, unloading & sorting, add to above - decks	0.0 ton	58.00	-	-	6.00	-	63.89 /ton	1
03-21-10.60	2220	Reinforcing steel, crane cost for handling, maximum, add	0.0 ton	165.00	-	-	17.00	-	182.22 /ton	3
03-31-05.35	0325	Concrete, ready mix, regular weight, elevated decks, 4000 psi	35.1 cy	-	122.75	-	-	-	122.75 /cy	4,313
03-31-05.70	1600	Structural concrete, placing, elevated slab, pumped, over 10" thick, includes vibrating, excludes material	35.1 cy	28.46	-	-	5.29	-	33.75 /cy	1,186



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03350 Elevated Slabs SST 35'X26.5'X12"										
03-35-29.30	0020	Concrete finishing, floors, monolithic, screed finish	930.0 sf	0.42	-	-	-	-	0.42 /sf	386
03-39-13.50	0310	Curing, sprayed membrane curing compound, elevated decks	9.3 csf	12.85	12.47	-	-	-	25.32 /csf	235
03-05-13.81	BC-0001	Membrane lining, T-lock liner (For Vaults and Manholes)	930.0 sqft	-	-	27.00	-	-	27.00 /sqft	25,110
		Elevated Slabs SST 35'X26.5'X12"	34.4 cy	396.42	262.45	729.01	5.40		1,393.28 /cy	47,990
		31 Building	930.0 sf	99.18	64.20	94.50	1.80		259.68 /sf	241,501
		03 Sludge Storage Tank								241,501

04 Fluid Bed Incinerator

12 Incineration Ducting

40170 46" Duct, PHX to SHX

40-05-24.10	A481002	Pipe Plain End-CS A53/A106-ERW Grade B-Std 48 Inch (1200mm)	10.0 lf	-	507.14	-	-	-	507.14 /lf	5,071
40-05-24.10	A482421	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Cls 150 (PN20)-Std 48 Inch (1200mm)	4.0 ea	-	6,183.28	-	-	-	6,183.28 /ea	24,733
40-05-05.00	L483466	Pipe Erection-Handle Fittings-Metal-Std 48 Inch (1200mm)	4.0 ea	386.60	-	-	-	-	386.60 /ea	1,546
40-05-24.10	L484002	Pipe Erection-Straight Run-CS A53/A106-Std 48 Inch (1200mm)	20.0 lf	138.30	-	-	-	-	138.30 /lf	2,766
40-05-24.10	L485102	Field Butt Weld-CS A53/A106-Std 48 Inch (1200mm)	6.0 ea	965.18	31.11	-	207.51	-	1,203.80 /ea	7,223
40-05-05.00	A483400	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 48 Inch (1200mm)	4.0 ea	486.29	2,648.57	-	-	-	3,134.85 /ea	12,539
40-05-05.00	L489048	Field Testing-Hydrotest-Non-Specific 48 Inch (1200mm)	20.0 lf	202.69	-	-	-	-	202.69 /lf	4,054
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	251.3 sqft	0.90	0.83	-	-	-	1.72 /sqft	433
23-07-16.10	2400	Insulation, calcium silicate block, on irregular surfaces, valves and fittings, + 200Deg.F to + 1200Deg.F, 3" thick	502.4 sf	73.43	5.91	-	-	-	79.34 /sf	39,861
		46" Duct, PHX to SHX	10.0 lf	5,321.90	4,376.29		124.51		9,822.70 /lf	98,227

40170 38" Duct, FBI to PHX

40-05-24.10	A401002	Pipe Plain End-CS A53/A106-ERW Grade B-Std 40 Inch (1000mm)	47.2 lf	-	421.95	-	-	-	421.95 /lf	19,916
40-05-24.10	A402112	Fitting Butt Weld-CS A53/A106-El90-Std 40 Inch (1000mm)	4.0 ea	-	7,685.63	-	-	-	7,685.63 /ea	30,743
40-05-24.10	A402421	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Non-Specific-Non-Specific 40 Inch (1000mm)	6.0 ea	-	6,502.49	-	-	-	6,502.49 /ea	39,015
40-05-05.00	L403466	Pipe Erection-Handle Fittings-Metal-Std 40 Inch (1000mm)	10.0 ea	328.24	-	-	-	-	328.24 /ea	3,282
40-05-24.10	L404002	Pipe Erection-Straight Run-CS A53/A106-Std 40 Inch (1000mm)	110.0 lf	114.96	-	-	-	-	114.96 /lf	12,645
40-05-24.10	L405102	Field Butt Weld-CS A53/A106-Std 40 Inch (1000mm)	20.0 ea	829.80	25.92	-	178.40	-	1,034.13 /ea	20,683
40-05-05.00	A403400	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 40 Inch (1000mm)	6.0 ea	291.77	1,958.54	-	-	-	2,250.31 /ea	13,502
40-05-07.00	A406044	Pipe Support 40 Inch (1000mm)	2.0 ea	243.15	513.00	-	-	-	756.15 /ea	1,512
40-05-07.00	A406045	Hanger Rod 40 Inch (1000mm)	2.0 ea	145.89	718.20	-	-	-	864.09 /ea	1,728
40-05-07.00	A406043	Hilti-Chemical Anchor - Pipe Support Size 40 Inch (1000mm)	4.0 ea	48.63	71.82	-	-	-	120.45 /ea	482



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40170 38" Duct, FBI to PHX										
40-05-05.00	L409048 000000	Field Testing-Hydrotest-Non-Specific 40 Inch (1000mm)	110.0 lf	141.02	-	-	-	-	141.02 /lf	15,513
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	1,151.9 sqft	0.90	0.83	-	-	-	1.72 /sqft	1,984
23-07-16.10	2400	Insulation, calcium silicate block, on irregular surfaces, valves and fittings, + 200Deg.F to + 1200Deg.F, 3" thick	2,303.8 sf	73.43	5.91	-	-	-	79.34 /sf	182,790
		38" Duct, FBI to PHX	80.0 lf	2,762.04	1,490.80		44.60		4,297.44 /lf	343,795
40170 46" Duct, SHX to Scrubber										
40-05-24.10	A481002 0100EB	Pipe Plain End-CS A53/A106-ERW Grade B-Std 48 Inch (1200mm)	10.0 lf	-	507.14	-	-	-	507.14 /lf	5,071
40-05-24.10	A482112 010000	Fitting Butt Weld-CS A53/A106-ElI90-Std 48 Inch (1200mm)	2.0 ea	-	11,231.07	-	-	-	11,231.07 /ea	22,462
40-05-24.10	A482421 016200	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Cls 150 (PN20)-Std 48 Inch (1200mm)	6.0 ea	-	6,183.28	-	-	-	6,183.28 /ea	37,100
40-05-05.00	L483466 010000	Pipe Erection-Handle Fittings-Metal-Std 48 Inch (1200mm)	8.0 ea	386.60	-	-	-	-	386.60 /ea	3,093
40-05-24.10	L484002 0100P1	Pipe Erection-Straight Run-CS A53/A106-Std 48 Inch (1200mm)	60.0 lf	138.30	-	-	-	-	138.30 /lf	8,298
40-05-24.10	L485102 010000	Field Butt Weld-CS A53/A106-Std 48 Inch (1200mm)	14.0 ea	965.18	31.11	-	207.51	-	1,203.80 /ea	16,853
40-05-05.00	A483400 006200	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 48 Inch (1200mm)	6.0 ea	486.29	2,648.57	-	-	-	3,134.85 /ea	18,809
40-05-05.00	L489048 000000	Field Testing-Hydrotest-Non-Specific 48 Inch (1200mm)	60.0 lf	202.69	-	-	-	-	202.69 /lf	12,161
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	754.0 sqft	0.90	0.83	-	-	-	1.72 /sqft	1,299
23-07-16.10	2400	Insulation, calcium silicate block, on irregular surfaces, valves and fittings, + 200Deg.F to + 1200Deg.F, 3" thick	1,508.0 sf	73.43	5.91	-	-	-	79.34 /sf	119,644
		46" Duct, SHX to Scrubber	10.0 lf	15,138.82	9,049.72		290.52		24,479.05 /lf	244,790
40170 58" Duct, FBI to PHX										
40-05-24.10	A601002 0000EB	Pipe Plain End-CS A53/A106-ERW Grade B-Non-Specific 60 Inch (1500mm)	40.0 lf	-	952.27	-	-	-	952.27 /lf	38,091
40-05-24.10	A602112 000000	Fitting Butt Weld-CS A53/A106-ElI90-Non-Specific 60 Inch (1500mm)	4.0 ea	-	26,362.46	-	-	-	26,362.46 /ea	105,450
40-05-24.10	A602421 000000	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Non-Specific-Non-Specific 60 Inch (1500mm)	12.0 ea	-	15,021.13	-	-	-	15,021.13 /ea	180,254
40-05-05.00	L603466 010000	Pipe Erection-Handle Fittings-Metal-Std 60 Inch (1500mm)	16.0 ea	474.13	-	-	-	-	474.13 /ea	7,586
40-05-24.10	L604002 0000P1	Pipe Erection-Straight Run-CS A53/A106-Non-Specific 60 Inch (1500mm)	160.0 lf	259.97	-	-	-	-	259.97 /lf	41,595
40-05-24.10	L605102 000000	Field Butt Weld-CS A53/A106-Non-Specific 60 Inch (1500mm)	28.0 ea	1,733.13	58.32	-	372.62	-	2,164.06 /ea	60,594
40-05-05.00	A603400 006200	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 60 Inch (1500mm)	12.0 ea	486.29	4,886.65	-	-	-	5,372.94 /ea	64,475
40-05-07.00	A606043 000000	Hilti-Chemical Anchor - Pipe Support Size 60 Inch (1500mm)	8.0 ea	48.63	76.95	-	-	-	125.58 /ea	1,005
40-05-05.00	L609048 000000	Field Testing-Hydrotest-Non-Specific 60 Inch (1500mm)	160.0 lf	189.65	-	-	-	-	189.65 /lf	30,344
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	2,513.3 sqft	0.90	0.83	-	-	-	1.72 /sqft	4,330



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40170 58" Duct, FBI to PHX										
23-07-16.10	2400	Insulation, calcium silicate block, on irregular surfaces, valves and fittings, + 200Deg.F to + 1200Deg.F, 3" thick	2,513.3 sf	73.43	5.91	-	-	-	79.34 /sf	199,407
		58" Duct, FBI to PHX	40.0 lf	8,027.06	10,040.36		260.83		18,328.25 /lf	733,130
40170 Blower Ducting, Allowance each blower										
40-05-24.10	A211002 0100EB	Pipe Plain End-CS A53/A106-ERW Grade B-Std 18 Inch (450mm)	10.3 lf	-	187.68	-	-	-	187.68 /lf	1,939
40-05-24.10	A212112 010000	Fitting Butt Weld-CS A53/A106-ElI90-Std (450mm) 18 Inch	49.0 ea	-	1,328.16	-	-	-	1,328.16 /ea	65,080
40-05-24.10	A212114 010000	Fitting Butt Weld-CS A53/A106-Tee-Std (450mm) 18 Inch	14.0 ea	-	2,270.79	-	-	-	2,270.79 /ea	31,791
40-05-24.10	A212421 016200	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Cls 150 (PN20)-Std 18 Inch (450mm)	28.0 ea	-	777.36	-	-	-	777.36 /ea	21,766
40-05-05.00	L213466 010000	Pipe Erection-Handle Fittings-Metal-Std (450mm) 18 Inch	91.0 ea	167.77	-	-	-	-	167.77 /ea	15,267
40-05-64.00	A216434 016200	Valve Flanged & Bolted-Cast Steel-Butterfly-Cls 150 (PN20) 18 Inch (450mm)	14.0 ea	-	1,513.63	-	-	-	1,513.63 /ea	21,191
40-05-65.23	A216435 016200	Valve Flanged & Bolted-Cast Steel-Check-Cls 150 (PN20) 18 Inch (450mm)	7.0 ea	-	16,436.59	-	-	-	16,436.59 /ea	115,056
40-05-51.00	L214062 006200	Pipe Erection-Handle Valves-Metal-Cls 150 (PN20) 18 Inch (450mm)	21.0 ea	375.80	-	-	-	-	375.80 /ea	7,892
40-05-24.10	L214002 0100P1	Pipe Erection-Straight Run-CS A53/A106-Std 18 Inch (450mm)	350.0 lf	50.19	-	-	-	-	50.19 /lf	17,565
40-05-24.10	L215102 010000	Field Butt Weld-CS A53/A106-Std 18 Inch (450mm)	189.0 ea	417.24	11.66	-	89.70	-	518.60 /ea	98,016
40-05-05.00	A213400 006200	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 18 Inch (450mm)	28.0 ea	97.26	314.51	-	-	-	411.77 /ea	11,529
40-05-07.00	A216044 000000	Pipe Support 18 Inch (450mm)	7.0 ea	121.57	51.30	-	-	-	172.87 /ea	1,210
40-05-07.00	A216045 000000	Hanger Rod 18 Inch (450mm)	7.0 ea	58.35	359.10	-	-	-	417.45 /ea	2,922
40-05-07.00	A216043 000000	Hilti-Chemical Anchor - Pipe Support Size (450mm) 18 Inch	14.0 ea	48.63	46.17	-	-	-	94.80 /ea	1,327
40-42-13.00	A210091 7409	Insulation-Urethane Foam Aluminum Jacket 18 Inch (450mm) Dia 2 Inch (50mm) Thk	350.0 lf	54.26	48.54	-	-	-	102.79 /lf	35,977
40-05-05.00	L219048 000000	Field Testing-Hydrotest-Non-Specific (450mm) 18 Inch	350.0 lf	29.37	-	-	-	-	29.37 /lf	10,280
		Blower Ducting, Allowance each blower	7.0 ea	21,930.58	41,191.39		2,422.01		65,543.98 /ea	458,808
		12 Incineration Ducting								1,878,750
15 Process Water Piping										
40130 Process Water Piping										
40-05-17.00	----	Process piping allowance	1.0 ls	5,000.00	5,000.00	-	-	-	10,000.00 /ls	10,000
		Process Water Piping	1.0 LS	5,000.00	5,000.00				10,000.00 /LS	10,000
		15 Process Water Piping								10,000
16 Misc Process Piping										
40140 Purge Air Piping										
40-05-24.10	----	Process piping allowance	1.0 ls	12,500.00	12,500.00	-	-	-	25,000.00 /ls	25,000
		Purge Air Piping	1.0 LS	12,500.00	12,500.00				25,000.00 /LS	25,000
40370 Natural Gas/Fuel Oil Piping										
40-05-23.20	----	Process piping allowance	1.0 ls	5,000.00	5,000.00	-	-	-	10,000.00 /ls	10,000

Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Natural Gas/Fuel Oil Piping	1.0 LS	5,000.00	5,000.00				10,000.00 /LS	10,000
40390	Instrument Air Piping									
40-05-23.20	----	Process piping allowance	1.0 ls	10,000.00	10,000.00	-	-	-	20,000.00 /ls	20,000
		Instrument Air Piping	1.0 LS	10,000.00	10,000.00				20,000.00 /LS	20,000
		16 Misc Process Piping								55,000
23	Incinerator Equipment									
46999	Process Equipment									
46-06-04.00	BC-1430	Fluidized Bed Incinerator Reactors, with roof platform, safety screens, duct supports. Quote by Suez 6/8/2018, includes install of reactor and dome.	2.0 ea	14,165.24	2,866,784.00	-	2,000.00		2,882,949.23 /ea	5,765,898
46-06-04.00	BC-1440	FBI roof platform, safety screens, duct supports. Provided with FBI by Suez, install only.	2.0 ea	28,330.47		-	8,000.00		36,330.47 /ea	72,661
46-06-04.00	BC-1430	Preheat Burner System, allowance	2.0 ea	7,082.62	50,000.00	-	280.00		57,362.62 /ea	114,725
46-06-00.00	BC-0331	Burner Combustion Blower, centrifugal blower, with valves, mtr., control panel	2.0 ea	2,833.05	15,000.00	-		-	17,833.04 /ea	35,666
33-51-33.10	0115	Natural Gas Train, 3" dia.	2.0 ea	2,134.33	7,000.00	-	379.44	-	9,513.77 /ea	19,028
46-06-00.00	BC-0331	Purge Air Blowers, centrifugal blower, with valves, mtr., control panel, 400 scfm	2.0 ea	2,833.05	15,000.00	-		-	17,833.04 /ea	35,666
46-06-00.00	BC-0336	Fluidizing Air Blower, 300 hp with accessories. Quote Continental 6/19/18 plus \$20,000 for submittal, startup, training.	2.0 ea	5,311.97	143,750.00	-	210.00	-	149,271.96 /ea	298,544
46-06-00.00	BC-0326	NOx Removal. Quote Suez 7/9/18 plus \$20,000 for startup, training	2.0 ea	28,330.47	167,000.00	-	8,000.00	-	203,330.47 /ea	406,661
22-15-19.10	6220	Compressor, air, reciprocating, tank mounted, heavy duty, oil-less, 2 stage, 3 phase, capacity rated at 175 PSIG, 18.2 SCFM, 7.5 H.P., 120 gallon tank	2.0 ea	1,996.38	17,500.00	-	-	-	19,496.38 /ea	38,993
22-11-23.13	0460	Pump, pressure booster system, 5 HP pump, includes diaphragm tank, control and pressure switch	2.0 ea	1,492.47	7,925.00	-	-	-	9,417.47 /ea	18,835
		Process Equipment	2.0 LS	94,510.01	3,289,959.00		18,869.44		3,403,338.46 /LS	6,806,677
		23 Incinerator Equipment								6,806,677
31	Building									
03330	Basement Slab, 94.5' x 74.5' x 24" thick									
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	338.0 lf	5.24	5.26	-	-	-	10.50 /lf	3,547
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	28.0 ea	13.62	38.06	-	-	-	51.68 /ea	1,447
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	44.0 ton	1,488.12	1,041.52	-	-	-	2,529.64 /ton	111,309
03-21-10.60	2410	Reinforcing steel, in place, dowels, deformed, 2' long, #4, A615, grade 60	676.0 ea	3.57	0.77	-	-	-	4.33 /ea	2,927
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	44.0 ton	57.80	-	-	6.02	-	63.82 /ton	2,808
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	44.0 ton	62.82	-	-	6.55	-	69.37 /ton	3,052
03-31-05.35	0405	Concrete, ready mix, regular weight, slabs/mats, 5000 psi	521.5 cy	-	128.64	-	-	-	128.64 /cy	67,087
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	521.5 cy	22.92	-	-	0.32	-	23.23 /cy	12,116
03-35-29.30	0150	Concrete finishing, floors, monolithic, screed, float and broom finish	7,040.3 sf	1.08	-	-	-	-	1.08 /sf	7,575

Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Basement Slab, 94.5' x 74.5' x 24" thick	521.5 cy	181.93	222.96		1.38		406.27 /cy	211,869
03330	Slab on Grade, Ash Dewatering, 35' x 25' x 18" thick									
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	3.8 ton	1,488.12	1,041.52	-	-	-	2,529.64 /ton	9,519
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	3.8 ton	57.80	-	-	6.02	-	63.82 /ton	240
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	3.8 ton	62.82	-	-	6.55	-	69.37 /ton	261
03-31-05.35	0405	Concrete, ready mix, regular weight, slabs/mats, 5000 psi	48.6 cy	-	128.64	-	-	-	128.64 /cy	6,253
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	48.6 cy	22.92	-	-	0.32	-	23.23 /cy	1,129
03-35-29.30	0150	Concrete finishing, floors, monolithic, screed, float and broom finish	875.0 sf	1.08	-	-	-	-	1.08 /sf	941
		Slab on Grade, Ash Dewatering, 35' x 25' x 18" thick	48.6 cy	166.82	209.27		1.29		377.37 /cy	18,345
03345	Basement Walls, 338 lf x 23' tall x 20" thick									
03-11-13.85	9460	Cip concret forms,walls,steel framed plywd,over 16'20'h,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	15,548.0 sfca	10.06	0.84	-	-	-	10.90 /sfca	169,466
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	41.5 gal	-	24.01	-	-	-	24.01 /gal	995
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	48.6 ton	1,140.89	1,041.52	-	-	-	2,182.41 /ton	106,039
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	48.6 ton	57.80	-	-	6.02	-	63.82 /ton	3,101
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	48.6 ton	62.82	-	-	6.55	-	69.37 /ton	3,371
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	479.9 cy	-	128.64	-	-	-	128.64 /cy	61,732
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	479.9 cy	42.69	-	-	7.93	-	50.62 /cy	24,293
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	15,548.0 sf	1.28	0.03	-	-	-	1.31 /sf	20,322
		Basement Walls, 338 lf x 23' tall x 20" thick	479.9 cy	537.67	264.42		9.20		811.29 /cy	389,319
03350	Ground Floor Elevated Slab, Incinerator Area, 94.5' x 74.5' x 12" thic									
03-11-13.35	1150	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	7,040.3 sf	7.18	1.39	-	-	-	8.58 /sf	60,376
03-21-10.60	0400	Reinforcing steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.1 ton	1,180.23	1,041.52	-	-	-	2,221.75 /ton	2,491
03-21-10.60	2050	Reinforcing in place, unloading & sorting, add to above - decks	0.1 ton	57.80	-	-	6.00	-	63.80 /ton	8
03-21-10.60	2220	Reinforcing steel, crane cost for handling, maximum, add	0.1 ton	165.15	-	-	17.20	-	182.40 /ton	24
03-31-05.35	0402	Concrete, ready mix, regular weight, elevated decks, 5000 psi	260.8 cy	-	128.64	-	-	-	128.64 /cy	33,543
03-31-05.70	1600	Structural concrete, placing, elevated slab, pumped, over 10" thick, includes vibrating, excludes material	260.8 cy	28.46	-	-	5.29	-	33.75 /cy	8,800



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03350 Ground Floor Elevated Slab, Incinerator Area, 94.5' x 74.5' x 12" thic										
03-35-29.30	0225	Finishing elev slab, manual screed, bull float, manual float & steel trowel	7,040.3 sf	1.57	-	-	-	-	1.57 /sf	11,079
03-39-13.50	0310	Curing, sprayed membrane curing compound, elevated decks	70.4 csf	12.85	12.47	-	-	-	25.32 /csf	1,782
		Ground Floor Elevated Slab, Incinerator Area, 94.5' x 74.5' x 12" thic	260.8 cy	273.55	174.10		5.30		452.94 /cy	118,104
13999 Incinerator and Ash Dewatering Building										
13-13-03.00	BC-0021	Incinerator Building, superstructure above slab at grade, steel frame with steel siding, allowance	7,915.0 sqft	37.50	75.00	-	12.50		125.00 /sqft	989,375
22-05-00.00	BC-0001	Allowance - Piping, Building Service/Domestic	7,915.0 sf	-	-	7.00	-	-	7.00 /sf	55,405
23-05-00.00	BC-0001	Allowance - HVAC	7,915.0 sqft	-	-	25.00	-	-	25.00 /sqft	197,875
09-99-99.99	MISC	Misc. Finishes, coating systems allowance	1.0 ls	-	-	75,000.00	-	-	75,000.00 /ls	75,000
		Incinerator and Ash Dewatering Building	7,915.0 sf	37.50	75.00	41.48	12.50		166.48 /sf	1,317,655
		31 Building	7,915.0 sf	92.12	112.74	41.48	13.33		259.67 /sf	2,055,293
		04 Fluid Bed Incinerator								10,805,720
05 Sand Storage Silo										
14 Sand Piping										
40170 Sand Piping										
40-05-24.10	----	Process piping, install only allowance	1.0 ls	15,000.00		-	-	-	15,000.00 /ls	15,000
		Sand Piping	1.0 LS	15,000.00					15,000.00 /LS	15,000
		14 Sand Piping								15,000
23 Incinerator Equipment										
46999 Sand Silo										
46-06-00.00	----	Misc. process equipment, sand silo, transporter, incl. piping to FBI	1.0 ls	17,353.94	130,000.00	-	1,264.80	-	148,618.74 /ls	148,619
		Sand Silo	1.0 LS	17,353.94	130,000.00		1,264.80		148,618.74 /LS	148,619
		23 Incinerator Equipment								148,619
		05 Sand Storage Silo								163,619
06 Primary Heat Exchanger										
23 Incinerator Equipment										
46999 Process Equipment										
23-57-19.16	----	Primary heat exchanger, 25,500lb/hr, 7' diam., 32'H	2.0 ea	38,252.81	600,000.00	-	5,523.32	-	643,776.13 /ea	1,287,552
		Process Equipment	2.0 ea	38,252.81	600,000.00		5,523.32		643,776.13 /ea	1,287,552
		23 Incinerator Equipment								1,287,552
		06 Primary Heat Exchanger								1,287,552
07 Secondary Heat Exchanger										
23 Incinerator Equipment										
46999 Process Equipment										
23-57-19.16	----	Secondary heat exchanger, 9,200lb/hr, 7' diam., 16'H	2.0 ea	19,126.40	210,000.00	-	2,761.66	-	231,888.06 /ea	463,776
46-06-00.00	----	Plume suppression blower, 1200 scfm, 10hp, allowance	2.0 ea	2,478.92	20,000.00	-	98.00	-	22,576.92 /ea	45,154
		Process Equipment	2.0 ea	21,605.31	230,000.00		2,859.66		254,464.98 /ea	508,930
		23 Incinerator Equipment								508,930
		07 Secondary Heat Exchanger								508,930
08 GAC										
32 Process Equipment										
46999 Process Equipment										



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
46999 Process Equipment										
46-06-00.00	----	Granular Activated Carbon(GAC) vessel, 12' diam., 20'H, adsorber, droplet separator, start-up heater, carbon	2.0 ea	43,384.85	2,150,000.00	-	3,162.00	-	2,196,546.85 /ea	4,393,094
46-06-00.00	----	Gas conditioner, allowance	2.0 ea	10,412.37	50,000.00	-	758.88	-	61,171.25 /ea	122,342
		Process Equipment	2.0 LS	53,797.21	2,200,000.00		3,920.88		2,257,718.10 /LS	4,515,436
		32 Process Equipment								4,515,436
		08 GAC								4,515,436
09 Wet Scrubber/WESP										
15 Process Water Piping										
40170 Process Water Piping										
40-05-24.10	----	Process piping allowance	1.0 ls	20,000.00	20,000.00	-	-	-	40,000.00 /ls	40,000
		Process Water Piping	1.0 LS	20,000.00	20,000.00				40,000.00 /LS	40,000
		15 Process Water Piping								40,000
16 Misc Process Piping										
40170 Drain and Recycle Piping										
40-05-24.10	----	Process piping allowance	1.0 ls	40,000.00	40,000.00	-	-	-	80,000.00 /ls	80,000
		Drain and Recycle Piping	1.0 LS	40,000.00	40,000.00				80,000.00 /LS	80,000
40170 Ash Slurry Piping										
40-05-24.10	----	Process piping allowance	1.0 ls	30,000.00	30,000.00	-	-	-	60,000.00 /ls	60,000
		Ash Slurry Piping	1.0 LS	30,000.00	30,000.00				60,000.00 /LS	60,000
40370 Scrubber Exhaust Piping										
40-05-23.20	----	Process piping allowance	1.0 ls	50,000.00	50,000.00	-	-	-	100,000.00 /ls	100,000
		Scrubber Exhaust Piping	1.0 LS	50,000.00	50,000.00				100,000.00 /LS	100,000
		16 Misc Process Piping								240,000
32 Process Equipment										
46999 Process Equipment										
46-06-00.00	----	Wet scrubber, 25,000 acfm, incl quench vessel, water booster pumps, purge air fan, WESP, control panel	2.0 ea	41,649.46	865,250.00	-	3,035.52	-	909,934.97 /ea	1,819,870
46-06-18.00	----	Ash slurry pump, centrifugal, allowance	2.0 ea	3,904.64	20,000.00	-	284.58	-	24,189.22 /ea	48,378
		Process Equipment	2.0 ea	45,554.09	885,250.00		3,320.10		934,124.19 /ea	1,868,248
		32 Process Equipment								1,868,248
		09 Wet Scrubber/WESP								2,148,248
10 Chemical Feed Systems										
25 Chemical Piping										
40500 Sulfuric Acid Piping										
40-05-31.13	----	Sulfuric acid piping allowance	1.0 ls	6,000.00	6,000.00	-	-	-	12,000.00 /ls	12,000
		Sulfuric Acid Piping	1.0 LS	6,000.00	6,000.00				12,000.00 /LS	12,000
40500 Polymer Piping										
40-05-31.13	----	Polymer piping allowance	1.0 ls	6,000.00	6,000.00	-	-	-	12,000.00 /ls	12,000
		Polymer Piping	1.0 LS	6,000.00	6,000.00				12,000.00 /LS	12,000
40500 Ammonia Piping										
40-05-31.13	----	Ammonia piping allowance	1.0 ls	6,000.00	6,000.00	-	-	-	12,000.00 /ls	12,000
		Ammonia Piping	1.0 LS	6,000.00	6,000.00				12,000.00 /LS	12,000
40500 Sodium Hydroxide Piping										



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40500 Sodium Hydroxide Piping										
40-05-31.13	----	Sodium Hydroxide piping allowance	1.0 ls	6,000.00	6,000.00	-	-	-	12,000.00 /ls	12,000
		Sodium Hydroxide Piping	1.0 LS	6,000.00	6,000.00				12,000.00 /LS	12,000
		25 Chemical Piping								48,000
26 Chemical Feed										
46999 Chemical Feed Systems										
46-06-16.00	BC-0061	Chemical metering pump, sulfuric acid	2.0 ea	1,062.40	10,000.00	-	-	-	11,062.40 /ea	22,125
46-06-16.00	BC-0061	Chemical metering pump, polymer	2.0 ea	1,062.40	10,000.00	-	-	-	11,062.40 /ea	22,125
46-06-16.00	BC-0061	Chemical metering pump, ammonia	2.0 ea	1,062.40	10,000.00	-	-	-	11,062.40 /ea	22,125
46-06-16.00	BC-0061	Chemical metering pump, sodium hydroxide	2.0 ea	1,062.40	10,000.00	-	-	-	11,062.40 /ea	22,125
		Chemical Feed Systems	1.0 LS	8,499.16	80,000.00				88,499.16 /LS	88,499
		26 Chemical Feed								88,499
		10 Chemical Feed Systems								136,499
11 Stack										
13 Flue Gas Ducting										
05122 Stack Bracing Tower, 8' x 8' x 25' tall										
05-12-23.75	0102	Structural steel beam or girder, 100-ton project, 1 to 2 story building, W6x9, A992 steel, shop fabricated, incl shop primer, bolted connections	384.0 lf	8.94	13.64	-	2.87	-	25.44 /lf	9,769
05-53-13.50	0020	Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	64.0 lf	11.89	3.41	-	-	-	15.30 /lf	979
05-53-13.10	0132	Floor grating, aluminum, 1-1/2" x 3/16" bearing bars @ 1-3/16" O.C., cross bars @ 4" O.C., up to 300 S.F., field fabricated from panels	128.0 sf	4.81	31.00	-	0.14	-	35.95 /sf	4,602
05-52-13.50	0210	Railing, pipe, aluminum, clear finish, 3 rails, 3'-6" high, posts @ 5' O.C., 1-1/2" dia, shop fabricated	48.0 lf	24.58	91.50	-	0.73	-	116.81 /lf	5,607
05-12-23.40	0476	Angle framing, structural steel, 3"x3"x3/8", field fabricated, incl cutting & welding	144.0 lf	43.30	5.93	-	1.76	-	50.98 /lf	7,342
05-05-21.90	1800	Welding structural steel in field, 3 passes, 0.5 lb/LF, 3/8" thick, continuous fillet, down welding, type 6011	64.0 lf	28.31	1.24	-	3.35	-	32.89 /lf	2,105
05-12-23.65	0300	Steel plate, structural, for connections & stiffeners, 3/8" T, shop fabricated, incl shop primer	144.0 sf	-	20.98	-	-	-	20.98 /sf	3,021
09-91-06.41	BC-0021	Coatings & paints, B & C coating system E-2 (Epoxy, metal tanks, structures)	512.0 sqft	0.74	1.52	-	-	-	2.26 /sqft	1,156
05-51-33.13	0400	Ladder, shop fabricated, aluminum, 20" W, bolted to concrete, excl cage	50.0 vlf	39.61	51.00	-	1.18	-	91.79 /vlf	4,590
05-05-19.20	8250	Wedge anchor, carbon steel, 1/2" dia x 2-3/4" L, in concrete, brick or stone, excl layout & drilling	144.0 ea	4.55	1.10	-	-	-	5.65 /ea	813
03-82-16.10	0700	Concrete impact drilling, for anchors, to 4" d, 1" dia, in concrete or brick walls and floors, includes bit cost, layout and set up time, excl anchor	144.0 ea	17.44	0.15	-	-	-	17.59 /ea	2,532
		Stack Bracing Tower, 8' x 8' x 25' tall	128.0 sf	152.82	166.21		13.14		332.16 /sf	42,516
40310 24" Stack, 316SS										
40-05-23.10	A241002 1600W	Pipe Plain End-Stainless 304/304L-Welded (ERW, CW, DSAW)-Sch 10S 24 Inch (600mm)	187.0 lf	-	119.36	-	-	-	119.36 /lf	22,314
40-05-23.10	A242421 176200	Fitting Flanged & Bolted-Stainless 304/304L-Flange WN-Cls 150-Sch 40S 24 Inch (600mm)	6.0 ea	-	673.07	-	-	-	673.07 /ea	4,038
40-05-05.00	L243466 050000	Pipe Erection-Handle Fittings-Metal-Sch 10 24 Inch (600mm)	6.0 ea	141.02	-	-	-	-	141.02 /ea	846
40-05-23.10	L244002 1600P1	Pipe Erection-Straight Run-Stainless 304/304L-Sch 10S 24 Inch (600mm)	200.0 lf	70.76	-	-	-	-	70.76 /lf	14,151



Estimate Detail Report

8/15/2018 9:04 AM

Project Number: 150048-230-235
Estimate Issue: 1
Due Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40310 24" Stack, 316SS										
40-05-23.10	L245102 160000	Field Butt Weld-Stainless 304/304L-Sch 10S 24 Inch (600mm)	16.0 ea	828.77	3.00	-	106.91	-	938.68 /ea	15,019
40-05-05.00	A243400 006200	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 24 Inch (600mm)	6.0 ea	97.26	551.92	-	-	-	649.18 /ea	3,895
40-05-07.00	A246044 000000	Pipe Support 24 Inch (600mm)	2.0 ea	175.07	76.95	-	-	-	252.02 /ea	504
40-05-07.00	A246045 000000	Hanger Rod 24 Inch (600mm)	2.0 ea	97.26	513.00	-	-	-	610.26 /ea	1,221
40-05-07.00	A246043 000000	Hilti-Chemical Anchor - Pipe Support Size (600mm) 24 Inch	8.0 ea	48.63	56.43	-	-	-	105.06 /ea	840
40-05-05.00	L249048 000000	Field Testing-Hydrotest-Non-Specific (600mm) 24 Inch	200.0 lf	51.35	-	-	-	-	51.35 /lf	10,270
40-05-23.10	A042171 017000	Fitting Butt Weld-Stainless 304/304L-Fitting Weldolet-Cls 2000-Std/Sch 40 1/2 Inch (13mm)	8.0 ea	-	11.03	-	-	-	11.03 /ea	88
40-05-23.10	A132171 017000	Fitting Butt Weld-Stainless 304/304L-Fitting Weldolet-Cls 2000-Std/Sch 40 4 Inch (100mm)	8.0 ea	-	52.35	-	-	-	52.35 /ea	419
40-05-05.00	L043466 080000	Pipe Erection-Handle Fittings-Metal-Sch 40 1/2 Inch (13mm)	8.0 ea	12.35	-	-	-	-	12.35 /ea	99
40-05-05.00	L133466 010000	Pipe Erection-Handle Fittings-Metal-Std (100mm) 4 Inch	8.0 ea	43.77	-	-	-	-	43.77 /ea	350
40-05-23.10	A132421 176200	Fitting Flanged & Bolted-Stainless 304/304L-Flange WN-Cls 150-Sch 40S/Std 4 Inch (100mm)	8.0 ea	-	26.59	-	-	-	26.59 /ea	213
40-05-23.10	L045102 170000	Field Butt Weld-Stainless 304/304L-Sch 40S/Std 1/2 Inch (13mm)	8.0 ea	32.13	0.03	-	4.15	-	36.30 /ea	290
40-05-23.10	L135102 170000	Field Butt Weld-Stainless 304/304L-Sch 40S/Std 4 Inch (100mm)	8.0 ea	94.65	0.38	-	12.21	-	107.25 /ea	858
24" Stack, 316SS			200.0 lf	207.54	160.33		9.21		377.08 /lf	75,416
13 Flue Gas Ducting										117,932
32 Process Equipment										
46999 Process Equipment										
46-06-04.00	BC-1430	CEMS Continuous Emission Monitoring System. Quote Emerson 2/2018 includes 4 days startup	2.0 ea	2,833.05	87,940.00	-	800.00		91,573.04 /ea	183,146
Process Equipment			1.0 LS	5,666.09	175,880.00		1,600.00		183,146.09 /LS	183,146
32 Process Equipment										183,146
11 Stack										301,079
12 Gravity Thickener										
17 Cake Loadout										
46999 Ash Dewatering Equipment										
46-06-00.00	----	Gravity thickener, allowance	2.0 ls	27,766.31	200,000.00	-	2,023.68	-	229,789.98 /ls	459,580
Ash Dewatering Equipment			2.0 LS	27,766.31	200,000.00		2,023.68		229,789.98 /LS	459,580
17 Cake Loadout										459,580
12 Gravity Thickener										459,580
13 Ash Dewatering/Loadout										
08 Thickened Ash Piping										
40120 Thickened Ash Piping										
40-05-19.20	----	Thickened ash piping allowance	1.0 ls	20,000.00	20,000.00	-	-	-	40,000.00 /ls	40,000
Thickened Ash Piping			1.0 LS	20,000.00	20,000.00				40,000.00 /LS	40,000
08 Thickened Ash Piping										40,000

10 Cake Piping
40120 Cake Piping



Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40120 Cake Piping										
40-05-19.20	----	Process piping allowance	1.0 ls	20,000.00	40,000.00	-	-	-	60,000.00 /ls	60,000
		Cake Piping	1.0 LS	20,000.00	40,000.00				60,000.00 /LS	60,000
		10 Cake Piping								60,000
17 Cake Loadout										
03305 Truck Scale Footings										
03-30-53.40	----	Footings, slabs, walls, truck scale, allowance	1.0 ls	80,475.00	75,000.00	-	-	-	155,475.00 /ls	155,475
		Truck Scale Footings	2.0 LS	40,237.50	37,500.00				77,737.50 /LS	155,475
11999 Truck Scale										
10-88-05.10	1680	Scales, truck type, digital, electronic, steel deck, 100 ton capacity, 70' x 10' platform, incl. steel weigh bridge, excl. foundation, pits	2.0 ea	20,385.06	54,000.00	-	-	-	74,385.05 /ea	148,770
		Truck Scale	2.0 LS	20,385.06	54,000.00				74,385.05 /LS	148,770
46999 Ash Dewatering Equipment										
46-06-00.00	----	Belt filter press, 1M, incl. pc sludge feed pumps, wash water booster pump, polymer feed pump, HPU, control panel	2.0 ea	52,061.82	498,600.00	-	3,794.40	-	554,456.22 /ea	1,108,912
		Ash Dewatering Equipment	2.0 LS	52,061.82	498,600.00		3,794.40		554,456.22 /LS	1,108,912
		17 Cake Loadout								1,413,158
		13 Ash Dewatering/Loadout								1,513,158
14 Electrical and Instrumentation										
35 Electrical										
26001 Electrical and Instrumentation										
26-00-00.02	FACTOR	Electrical (This is based on 20% of the Total Project Costs)	1.0 LS	-	-	9,020,000.00	-	-	9,020,000.00 /LS	9,020,000
	ED	Electrical and Instrumentation	1.0 LS			9,020,000.00			9,020,000.00 /LS	9,020,000
		35 Electrical								9,020,000
36 Instrumentation										
26001 Electrical and Instrumentation										
27-20-00.01	FACTOR	Instrumentation (This is based on 5% of the Total Project Costs)	1.0 LS	-	-	2,255,000.00	-	-	2,255,000.00 /LS	2,255,000
	ED	Electrical and Instrumentation	1.0 LS			2,255,000.00			2,255,000.00 /LS	2,255,000
		36 Instrumentation								2,255,000
		14 Electrical and Instrumentation								11,275,000
18 Site Remediation										
01 Sitework Improvements										
31999 Site Remediation										
31-00-00.05	BC-0001	Allowance - Site Work	1.0 ls	-	-	2,000,000.00	-	-	2,000,000.00 /ls	2,000,000
		Site Remediation	1.0 LS			2,000,000.00			2,000,000.00 /LS	2,000,000
		01 Sitework Improvements								2,000,000
		18 Site Remediation								2,000,000
19 Integrated Maintenance Building										
31 Building										
13999 Integrated Maintenance Building										
13-13-03.00	BC-0006	Administration/Laboratory/Maintenance Building, allowance	37,660.0 sqft	50.00	200.00	-	40.00	-	290.00 /sqft	10,921,400
22-05-00.00	BC-0001	Allowance - Piping, Building Service/Domestic	37,660.0 sqft	-	-	8.00	-	-	8.00 /sqft	301,280
23-05-00.00	BC-0001	Allowance - HVAC	37,660.0 sqft	-	-	12.00	-	-	12.00 /sqft	451,920

Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Integrated Maintenance Building	37,660.0 sf	50.00	200.00	20.00	40.00		310.00 /sf	11,674,600
		31 Building							/sf	11,674,600
		19 Integrated Maintenance Building								11,674,600
20	Demo Admin/Shop/Storage Buildings									
34	Demolition Building									
02220	Building Gross Demolition									
02-41-16.13	0650	Building demolition,small buildings single buildings,masonry,elevated slabs,includes 20 mile haul,excludes salvage,foundation demolition dump fees	246,000.0 cf	0.27	-	-	0.16	-	0.43 /cf	106,227
02-41-16.13	0500	Building demolition, small buildings or single buildings, steel, includes 20 mile haul, excludes salvage, foundation demolition or dump fees	277,000.0 cf	0.27	-	-	0.16	-	0.43 /cf	119,613
02-41-16.13	0700	Building demolition, small buildings single buildings, wood, elevated slabs, includes 20 mile haul, excludes salvage, foundation demolition dump fees	57,000.0 cf	0.27	-	-	0.16	-	0.43 /cf	24,614
02-22-03.30	BC-0006	Dump Charge, typical urban city, fees only, bldg constr mat'ls	1,626.0 ton	-	-	-	-	33.00	33.00 /ton	53,658
02-41-13.23	----	Remove buried utilities, allowance	1.0 ls	16,770.00	-	-	15,000.00	-	31,770.00 /ls	31,770
02-41-13.62	0400	Selective demolition, chain link fences & gates, gates, 20' width	5.0 ea	200.64	-	-	31.86	-	232.51 /ea	1,163
02-41-13.60	1700	Fencing demolition, remove chain link posts & fabric, 8' to 10' high	1,500.0 lf	4.51	-	-	0.72	-	5.23 /lf	7,837
02-41-16.17	0440	Building footings and foundations demolition, floors, concrete slab grade, concrete, rod reinforced, 6" thick, excludes disposal costs and dump fees	39,000.0 sf	0.44	-	-	0.56	-	0.99 /sf	38,715
02-41-16.17	1120	Building footings and foundations demolition, remove concrete footing, 1'-6" thick, 3' wide, excludes disposal costs and dump fees	2,700.0 lf	7.89	-	-	9.98	-	17.87 /lf	48,253
02-41-16.17	2500	Building footings and foundations demolition, remove concrete walls, plain concrete, 12" thick, excludes disposal costs and dump fees	8,100.0 sf	0.63	-	-	0.80	-	1.43 /sf	11,581
		Building Gross Demolition	580,000.0 cf	0.39			0.28	0.09	0.77 /cf	443,430
		34 Demolition Building								443,430
		20 Demo Admin/Shop/Storage Buildings								443,430
21	Odor Control									
24	Odor Control Equipment									
03330	Slabs (On Grade & Mat)									
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	111.1 sy	1.35	-	-	0.63	-	1.98 /sy	220
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	37.0 cy	-	35.03	-	-	-	35.03 /cy	1,297
03-11-13.65	3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	130.0 sfca	6.03	0.96	-	-	-	6.99 /sfca	909
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4.1 ton	1,488.12	1,108.00	-	-	-	2,596.12 /ton	10,577
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	4.1 ton	57.80	-	-	6.02	-	63.82 /ton	260
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	4.1 ton	62.82	-	-	6.55	-	69.37 /ton	283
03-31-05.35	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	75.6 cy	-	135.00	-	-	-	135.00 /cy	10,200

Post Point Biosolids Planning - Incineration Base

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03330 Slabs (On Grade & Mat)										
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	75.6 cy	22.92	-	-	0.32	-	23.23 /cy	1,755
03-35-29.30	0150	Concrete finishing, floors, monolithic, screed, float and broom finish	1,000.0 sf	1.08	-	-	-	-	1.08 /sf	1,076
03-39-13.50	0300	Curing, sprayed membrane curing compound	10.0 csf	12.85	12.47	-	-	-	25.32 /csf	253
		Slabs (On Grade & Mat)	222.2 cy	46.91	73.17		0.65		120.74 /cy	26,830
40555 Odor Control Ductwork										
40-05-36.00	----	Process ductwork, allowance	1.0 ls	100,000.00	100,000.00	-	-	-	200,000.00 /ls	200,000
		Odor Control Ductwork	1.0 LS	100,000.00	100,000.00				200,000.00 /LS	200,000
46999 Odor Control Equipment										
46-06-00.00	----	Odor control, chemical air scrubbers for GBT area, allowance	1.0 ls	39,030.30	800,000.00	-	5,523.32	-	844,553.62 /ls	844,554
46-06-00.00	----	Odor control, activated carbon towers for centrifuge area, allowance	1.0 ls	24,979.39	400,000.00	-	3,534.92	-	428,514.31 /ls	428,514
		Odor Control Equipment	1.0 LS	64,009.69	1,200,000.00		9,058.24		1,273,067.93 /LS	1,273,068
		24 Odor Control Equipment								1,499,898
		21 Odor Control								1,499,898
22 Gut Solids Handling Building										
33 Demolition Process										
02228 Selective Demolition - MP&E										
02-22-04.50	----	Gut interior process equipment, piping, electrical, misc ancillary	1.0 ls	50,200.00		-	50,000.00	-	100,200.00 /ls	100,200
02-22-03.30	BC-0006	Dump Charge, typical urban city, fees only, bldg constr mat'ls	100.0 ton	-	-	-	-	33.00	33.00 /ton	3,300
31-23-23.19	BC-0001	Loading Trucks, Skip Box & 25T Cherry Picker	200.0 ea	26.83	-	-	21.59	-	48.43 /ea	9,685
31-23-23.20	3498	Cycle hng(,load,travel,unload dump&retrn) time per cycle,excvtld borrow,loose cubic yards,25 min ld/wt/,16.5 truck,cycle 20 miles,45 mph,loadng eqpmnt	200.0 lcy	4.55	-	-	4.17	-	8.72 /lcy	1,744
		Selective Demolition - MP&E	1.0 LS	56,477.31			55,152.50	3,300.00	114,929.81 /LS	114,930
		33 Demolition Process								114,930
		22 Gut Solids Handling Building								114,930
		01 Total								58,377,384

Post Point Biosolids Planning - Incineration Base

Estimate Totals

Description	Rate	Hours	Amount	Totals
Labor		31,924 hrs	6,676,101	
Material			33,036,115	
Subcontract			15,814,165	
Equipment		5,991 hrs	2,794,045	
Other			56,958	
			58,377,384	58,377,384
Labor Mark-up	15.000 %		1,001,415	
Material Mark-up	10.000 %		3,303,611	
Subcontractor Mark-up	5.000 %		790,708	
Construction Equipment Mark-up	10.000 %		279,405	
Material Shipping & Handling	2.000 %		660,722	
Net Markups			6,035,861	64,413,245
Contractor General Conditions	15.000 %		9,661,987	
			9,661,987	74,075,232
Start-Up, Training, O&M	2.000 %		1,481,505	
			1,481,505	75,556,737
Undesign/Undevelop Contingency	30.000 %		22,667,021	
			22,667,021	98,223,758
Bldg Risk, Liability Auto Ins	2.000 %		1,964,475	
			1,964,475	100,188,233
Payment and Performance Bonds	1.500 %		1,502,824	
			1,502,824	101,691,057
Escalation to Midpoint (ALL)	19.400 %		19,728,065	
			19,728,065	121,419,122
Gross Receipts Tax	8.700 %		10,563,464	
Gross Markups			10,563,464	131,982,586
Total				131,982,586



Estimate Summary Report

8/15/2018 9:13 AM

Project Number: 150048-230-235
Estimate Issue Number: 1
Bid Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Alternate

City of Bellingham
Post Point Biosolids Planning - Incineration Alternate
BODR Conceptual Estimate AACEI Class 5

Estimator	D. Goodburn
BC Project Manager	Tadd Giesbrecht
BC Office	Seattle
Estimate Issue No.	1
QA/QC Reviewer	Bill Agster
QA/QC Review Date	7/24/2018
BC Estimate Number	150048-230-235

Notes	PROCESS LOCATION/AREA INDEX
-------	-----------------------------

-
- 1 - Site Work and Yard Piping
 - 2 - Sludge Thickening/Dewatering
 - 3 - Sludge Storage Tank
 - 4 - Fluid Bed Incinerator
 - 5 - Sand Storage Silo
 - 6 - Primary Heat Exchanger
 - 7 - Secondary Heat Exchanger
 - 8 - GAC
 - 9 - Wet Scrubber/WESP
 - 10 - Chemical Feed Systems
 - 11 - Stack
 - 12 - Gravity Thickener
 - 13 - Ash Dewatering/Loadout
 - 14 - Electrical and Instrumentation
 - 15 - Waste Heat Boiler
 - 16 - Steam Turbine Generator



Estimate Summary Report

8/15/2018 9:13 AM

Project Number: 150048-230-235
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Post Point Biosolids Planning - Incineration Alternate

Notes	
	17 - ID Fan
	18 - Site Remediation
	19 - Integrated Maintenance Building
	20 - Demo Admin/Shop/Storage Buildings
	21 - Odor Control
	22 - Gut Solids Handling Building



Estimate Summary Report

8/15/2018 9:13 AM

Project Number: 150048-230-235
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Bid Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Alternate

Estimate Breakdown	Gross Total Cost w/Markups
01 Total	
01 Site Work and Yard Piping	
01 Sitework Improvements	2,327,687
03 Yard Piping	3,492,634
01 Site Work and Yard Piping	5,820,321
 02 Sludge Thickening/Dewatering	
09 Transfer Piping	286,042
10 Cake Piping	228,384
11 Supernatant Piping	114,417
15 Process Water Piping	22,913
22 Thickening/Dewatering Equipment	10,215,127
25 Chemical Piping	137,480
31 Building	5,234,487
02 Sludge Thickening/Dewatering	16,238,851
 03 Sludge Storage Tank	
31 Building	546,320
03 Sludge Storage Tank	546,320
 04 Fluid Bed Incinerator	
12 Incineration Ducting	4,302,974
15 Process Water Piping	22,913
16 Misc Process Piping	126,024
23 Incinerator Equipment	15,499,217
31 Building	4,675,326
04 Fluid Bed Incinerator	24,626,455
 05 Sand Storage Silo	



Estimate Summary Report

8/15/2018 9:13 AM

Project Number: 150048-230-235
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Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Alternate

Estimate Breakdown	Gross Total Cost w/Markups
14 Sand Piping	34,595
23 Incinerator Equipment	338,802
05 Sand Storage Silo	373,397
06 Primary Heat Exchanger	
23 Incinerator Equipment	2,932,979
06 Primary Heat Exchanger	2,932,979
07 Secondary Heat Exchanger	
23 Incinerator Equipment	1,350,046
07 Secondary Heat Exchanger	1,350,046
08 GAC	
32 Process Equipment	10,281,733
08 GAC	10,281,733
09 Wet Scrubber/WESP	
15 Process Water Piping	91,654
16 Misc Process Piping	549,921
32 Process Equipment	4,255,366
09 Wet Scrubber/WESP	4,896,941
10 Chemical Feed Systems	
25 Chemical Piping	109,984
26 Chemical Feed	201,709
10 Chemical Feed Systems	311,693
11 Stack	
13 Flue Gas Piping	270,216



Estimate Summary Report

8/15/2018 9:13 AM

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Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Alternate

Estimate Breakdown	Gross Total Cost w/Markups
32 Process Equipment	417,040
11 Stack	687,256
12 Gravity Thickener	
17 Cake Loadout	1,047,745
12 Gravity Thickener	1,047,745
13 Ash Dewatering/Loadout	
08 Thickened Ash Piping	91,654
10 Cake Piping	137,180
17 Cake Loadout	3,223,434
13 Ash Dewatering/Loadout	3,452,268
14 Electrical and Instrumentation	
35 Electrical	24,448,438
36 Instrumentation	6,111,558
14 Electrical and Instrumentation	30,559,996
15 Waste Heat Boiler	
06 Water Treatment	743,531
07 Steam Piping	456,768
13 Flue Gas Piping	513,676
16 Misc Process Piping	45,827
32 Process Equipment	7,856,553
15 Waste Heat Boiler	9,616,354
16 Steam Turbine Generator	
04 Cooling	1,412,521
05 Effluent Cooling	1,153,554



Estimate Summary Report

8/15/2018 9:13 AM

Project Number: 150048-230-235
Estimate Issue Number: 1
Bid Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Alternate

Estimate Breakdown	Gross Total Cost w/Markups
06 Water Treatment	4,776,985
32 Process Equipment	4,713,571
16 Steam Turbine Generator	12,056,632
17 ID Fan	
32 Process Equipment	499,894
17 ID Fan	499,894
18 Site Remediation	
01 Sitework Improvements	4,412,677
18 Site Remediation	4,412,677
19 Integrated Maintenance Building	
31 Building	26,548,980
19 Integrated Maintenance Building	26,548,980
20 Demo Admin/Shop/Storage Buildings	
34 Demolition Building	1,006,515
20 Demo Admin/Shop/Storage Buildings	1,006,515
21 Odor Control	
24 Odor Control Equipment	3,419,324
21 Odor Control	3,419,324
22 Gut Solids Handling Building	
33 Demolition Process	261,814
22 Gut Solids Handling Building	261,814
01 Total	160,948,192

Post Point Biosolids Planning - Incineration Alternate

**City of Bellingham
 Post Point Biosolids Planning - Incineration Alternate
 BODR Conceptual Estimate AACEI Class 5**

Estimator	D. Goodburn
BC Project Manager	Tadd Giesbrecht
BC Office	Seattle
Estimate Issue No.	1
QA/QC Reviewer	Bill Agster
QA/QC Review Date	7/24/2018

Notes PROCESS LOCATION/AREA INDEX

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 - 10 - Chemical Feed Systems
 - 11 - Stack
 - 12 - Gravity Thickener
 - 13 - Ash Dewatering/Loadout
 - 14 - Electrical and Instrumentation
 - 15 - Waste Heat Boiler
 - 16 - Steam Turbine Generator
 - 17 - ID Fan
 - 18 - Site Remediation
 - 19 - Integrated Maintenance Building
 - 20 - Demo Admin/Shop/Storage Buildings
 - 21 - Odor Control
 - 22 - Gut Solids Handling Building



Estimate Detail Report

8/15/2018 9:14 AM

Project Number: 150048-230-235
Estimate Issue: 1
Due Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
01 Total										
01 Site Work and Yard Piping										
01 Sitework Improvements										
32999 Misc. Exterior Improvements										
32-00-00.01	BC-0001	Exterior Improvements, allowance (Based on 2% of project total)	1.0 ls	-	-	1,055,000.00	-	-	1,055,000.00 /ls	1,055,000
		Misc. Exterior Improvements	1.0 LS			1,055,000.00			1,055,000.00 /LS	1,055,000
		01 Sitework Improvements								1,055,000
03 Yard Piping										
33999 Yard Piping										
33-00-00.01	BC-0001	Utilities, yard piping allowance (Based on 3% of project total)	1.0 ls	-	-	1,583,000.00	-	-	1,583,000.00 /ls	1,583,000
		Yard Piping	1.0 LS			1,583,000.00			1,583,000.00 /LS	1,583,000
		03 Yard Piping								1,583,000
		01 Site Work and Yard Piping								2,638,000
02 Sludge Thickening/Dewatering										
09 Transfer Piping										
40120 Transfer Sludge Piping										
40-05-19.20	----	Process piping allowance	1.0 ls	50,000.00	75,000.00	-	-	-	125,000.00 /ls	125,000
		Transfer Sludge Piping	1.0 LS	50,000.00	75,000.00				125,000.00 /LS	125,000
		09 Transfer Piping								125,000
10 Cake Piping										
40120 Cake Piping										
40-05-19.20	----	Process piping allowance	1.0 ls	25,000.00	75,000.00	-	-	-	100,000.00 /ls	100,000
		Cake Piping	1.0 LS	25,000.00	75,000.00				100,000.00 /LS	100,000
		10 Cake Piping								100,000
11 Supernatant Piping										
40120 Supernatant Piping										
40-05-19.20	----	Process piping allowance	1.0 ls	20,000.00	30,000.00	-	-	-	50,000.00 /ls	50,000
		Supernatant Piping	1.0 LS	20,000.00	30,000.00				50,000.00 /LS	50,000
		11 Supernatant Piping								50,000
15 Process Water Piping										
40130 Process Water Piping										
40-05-17.00	----	Process piping allowance	1.0 ls	5,000.00	5,000.00	-	-	-	10,000.00 /ls	10,000
		Process Water Piping	1.0 LS	5,000.00	5,000.00				10,000.00 /LS	10,000
		15 Process Water Piping								10,000
22 Thickening/Dewatering Equipment										
46999 Process Equipment										
46-99-99.99	MISC	Misc. process equipment, gravity belt thickener, 2M	2.0 ea	43,384.85	190,500.00		3,162.00	-	237,046.85 /ea	474,094
46-06-00.00	----	Cake pump, hydraulic piston, 23 gpm, incl. 10'X12' hopper and live bottom screw feeder, 100hp hydraulic power unit, control panel	2.0 ea	46,836.36	509,200.00	-	6,627.99	-	562,664.34 /ea	1,125,329
46-06-00.00	----	Thickened sludge pump, progressive cavity, allowance	2.0 ea	3,904.64	30,000.00	-	284.58	-	34,189.21 /ea	68,378
46-06-00.00	----	Washwater pump, centrifugal, allowance	2.0 ea	2,776.63	10,000.00	-	202.37	-	12,979.00 /ea	25,958
46-06-00.00	----	Centrifuge, 36 dtpd, 250hp, incl. starter and control panels	2.0 ea	73,181.81	1,311,285.00	-	10,356.23	-	1,394,823.03 /ea	2,789,646
		Process Equipment	1.0 LS	340,168.57	4,101,970.00		41,266.32		4,483,404.89 /LS	4,483,405



Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		22 Thickening/Dewatering Equipment								4,483,405
25 Chemical Piping										
40510 Piping - Polymer										
40-05-31.23	----	Process piping allowance	1.0 ls	30,000.00	30,000.00	-	-	-	60,000.00 /ls	60,000
		Piping - Polymer	1.0 LS	30,000.00	30,000.00				60,000.00 /LS	60,000
		25 Chemical Piping								60,000
31 Building										
13999 Thickening/Dewatering Building										
13-13-03.00	BC-0021	Treatment Building, sludge thickening and dewatering, allowance	14,400.0 sqft	40.00	60.00	-	25.00		125.00 /sqft	1,800,000
22-05-00.00	BC-0001	Allowance - Piping, Building Service/Domestic	14,400.0 sf	-	-	7.00	-	-	7.00 /sf	100,800
23-05-00.00	BC-0001	Allowance - HVAC	14,400.0 sqft	-	-	25.00	-	-	25.00 /sqft	360,000
09-99-99.99	MISC	Misc. Finishes, coating systems allowance	1.0 ls	-	-	50,000.00	-	-	50,000.00 /ls	50,000
		Thickening/Dewatering Building	14,400.0 sf	40.00	60.00	35.47	25.00		160.47 /sf	2,310,800
		31 Building	14,400.0 sf	40.00	60.00	35.47	25.00		160.47 /sf	2,310,800
		02 Sludge Thickening/Dewatering								7,139,205
03 Sludge Storage Tank										
31 Building										
03330 Slabs Sludge Storage Tank 35'X26.5'X24"										
31-23-16.16	6035	Strt excvt for minor strtr,bank measr,for sprd and mat ftngs,elvttr pits,and small bldng fndtns,common earth,3/4 cy bucket,machin excvtn,hydlrc backhoe	27.3 bcy	15.90	-	-	7.59	-	23.49 /bcy	642
31-23-23.18	0400	Hauling, excavated or borrow material, loose cubic yards, 1 mile round trip, 2.2 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	27.3 lcy	3.77	-	-	3.08	-	6.84 /lcy	187
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	103.3 sy	1.35	-	-	0.63	-	1.98 /sy	205
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	34.4 cy	-	35.03	-	-	-	35.03 /cy	1,206
03-11-13.65	3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	123.0 sfca	6.03	0.96	-	-	-	6.99 /sfca	860
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	123.0 lf	5.24	5.26	-	-	-	10.50 /lf	1,291
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	10.0 ea	13.62	38.06	-	-	-	51.68 /ea	517
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	2.8 ton	1,488.12	1,041.52	-	-	-	2,529.64 /ton	7,189
03-21-10.60	0605	Reinforcing, a615 60, sog, thickened edge, allow 28 lbs/cy, #3 to #7	0.6 ton	1,488.12	1,041.52	-	-	-	2,529.63 /ton	1,452
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	3.4 ton	57.80	-	-	6.03	-	63.82 /ton	218
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	3.4 ton	62.82	-	-	6.55	-	69.37 /ton	237
03-31-05.35	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	94.5 cy	-	122.75	-	-	-	122.75 /cy	11,602
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	94.5 cy	22.92	-	-	0.32	-	23.23 /cy	2,196
03-35-29.30	0100	Concrete finishing, floors, monolithic, screed and bull float(darby) finish	930.0 sf	0.50	-	-	-	-	0.50 /sf	463
03-39-13.50	0200	Curing, waterproof curing paper, 2 ply, reinforced	9.3 csf	17.44	26.02	-	-	-	43.46 /csf	404

Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Slabs Sludge Storage Tank 35'X26.5'X24"	92.7 cy	113.16	191.59		4.64		309.38 /cy	28,669
03345 Concrete Walls SST 15.5'HX16"T										
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	4,650.0 sfca	8.94	0.84	-	-	-	9.78 /sfca	45,488
03-11-13.85	0500	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	62.0 lf	15.18	2.49	-	-	-	17.67 /lf	1,096
03-15-13.50	3500	Waterstop, rubber, center bulb, split, 3/8" thick x 6" wide	62.0 lf	4.70	11.53	-	-	-	16.23 /lf	1,006
03-15-13.50	5205	Waterstop, rubber, field union, 3/8" x 6" wide, walls	5.0 ea	13.62	34.55	-	-	-	48.16 /ea	241
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	12.4 gal	-	24.01	-	-	-	24.01 /gal	298
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	10.0 ton	1,140.89	1,041.52	-	-	-	2,182.41 /ton	21,925
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	10.0 ton	57.80	-	-	6.02	-	63.82 /ton	641
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	10.0 ton	62.82	-	-	6.55	-	69.37 /ton	697
03-31-05.35	0320	Concrete, ready mix, regular weight, walls/cols/beams, 4000 psi	117.1 cy	-	122.75	-	-	-	122.75 /cy	14,375
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	117.1 cy	42.69	-	-	7.93	-	50.62 /cy	5,928
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	4,650.0 sf	1.28	0.03	-	-	-	1.31 /sf	6,078
22-11-19.34	0220	Sleeve, pipe, steel with water stop, 12" long, 12" diam. for 8" carrier pipe, includes link seal	8.0 ea	201.72	335.00	-	-	-	536.72 /ea	4,294
03-05-13.81	BC-0001	Membrane lining, T-lock liner (For Vaults and Manholes)	2,325.0 sqft	-	-	27.00	-	-	27.00 /sqft	62,775
		Concrete Walls SST 15.5'HX16"T	114.8 cy	593.12	286.67	546.75	9.19		1,435.72 /cy	164,842
03350 Elevated Slabs SST 35'X26.5'X12"										
03-11-13.35	1150	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	930.0 sf	7.18	1.39	-	-	-	8.58 /sf	7,976
03-11-13.35	7000	C.I.P. concrete forms, elevated slab, edge forms, to 6" high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	123.0 lf	5.25	0.23	-	-	-	5.48 /lf	674
03-11-13.35	8000	C.I.P. concrete forms, elevated slab, perimeter deck and rail, straight, includes shoring, erecting, bracing, stripping and cleaning	88.0 lf	29.15	15.05	-	-	-	44.19 /lf	3,889
03-15-05.70	1550	Shores, reshoring at elevated decks, allow	186.0 sf	0.97	0.71	-	-	-	1.69 /sf	314
03-21-10.60	0400	Reinforcing steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.8 ton	1,180.23	1,041.52	-	-	-	2,221.75 /ton	3,904
03-21-10.60	2050	Reinforcing in place, unloading & sorting, add to above - decks	0.0 ton	58.00	-	-	6.00	-	63.89 /ton	1
03-21-10.60	2220	Reinforcing steel, crane cost for handling, maximum, add	0.0 ton	165.00	-	-	17.00	-	182.22 /ton	3
03-31-05.35	0325	Concrete, ready mix, regular weight, elevated decks, 4000 psi	35.1 cy	-	122.75	-	-	-	122.75 /cy	4,313
03-31-05.70	1600	Structural concrete, placing, elevated slab, pumped, over 10" thick, includes vibrating, excludes material	35.1 cy	28.46	-	-	5.29	-	33.75 /cy	1,186



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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03350 Elevated Slabs SST 35'X26.5'X12"										
03-35-29.30	0020	Concrete finishing, floors, monolithic, screed finish	930.0 sf	0.42	-	-	-	-	0.42 /sf	386
03-39-13.50	0310	Curing, sprayed membrane curing compound, elevated decks	9.3 csf	12.85	12.47	-	-	-	25.32 /csf	235
03-05-13.81	BC-0001	Membrane lining, T-lock liner (For Vaults and Manholes)	930.0 sqft	-	-	27.00	-	-	27.00 /sqft	25,110
		Elevated Slabs SST 35'X26.5'X12"	34.4 cy	396.42	262.45	729.01	5.40		1,393.28 /cy	47,990
		31 Building	930.0 sf	99.18	64.20	94.50	1.80		259.68 /sf	241,501
		03 Sludge Storage Tank								241,501
04 Fluid Bed Incinerator										
12 Incineration Ducting										
40170 46" Duct, PHX to SHX										
40-05-24.10	A481002	Pipe Plain End-CS A53/A106-ERW Grade B-Std 48 Inch (1200mm)	10.0 lf	-	507.14	-	-	-	507.14 /lf	5,071
40-05-24.10	A482421	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Cls 150 (PN20)-Std 48 Inch (1200mm)	4.0 ea	-	6,183.28	-	-	-	6,183.28 /ea	24,733
40-05-05.00	L483466	Pipe Erection-Handle Fittings-Metal-Std 48 Inch (1200mm)	4.0 ea	386.60	-	-	-	-	386.60 /ea	1,546
40-05-24.10	L484002	Pipe Erection-Straight Run-CS A53/A106-Std 48 Inch (1200mm)	20.0 lf	138.30	-	-	-	-	138.30 /lf	2,766
40-05-24.10	L485102	Field Butt Weld-CS A53/A106-Std 48 Inch (1200mm)	6.0 ea	965.18	31.11	-	207.51	-	1,203.80 /ea	7,223
40-05-05.00	A483400	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 48 Inch (1200mm)	4.0 ea	486.29	2,648.57	-	-	-	3,134.85 /ea	12,539
40-05-05.00	L489048	Field Testing-Hydrotest-Non-Specific 48 Inch (1200mm)	20.0 lf	202.69	-	-	-	-	202.69 /lf	4,054
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	251.3 sqft	0.90	0.83	-	-	-	1.72 /sqft	433
23-07-16.10	2400	Insulation, calcium silicate block, on irregular surfaces, valves and fittings, + 200Deg.F to + 1200Deg.F, 3" thick	502.4 sf	73.43	5.91	-	-	-	79.34 /sf	39,861
		46" Duct, PHX to SHX	10.0 lf	5,321.90	4,376.29		124.51		9,822.70 /lf	98,227
40170 38" Duct, FBI to PHX										
40-05-24.10	A401002	Pipe Plain End-CS A53/A106-ERW Grade B-Std 40 Inch (1000mm)	47.2 lf	-	421.95	-	-	-	421.95 /lf	19,916
40-05-24.10	A402112	Fitting Butt Weld-CS A53/A106-El90-Std 40 Inch (1000mm)	4.0 ea	-	7,685.63	-	-	-	7,685.63 /ea	30,743
40-05-24.10	A402421	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Non-Specific-Non-Specific 40 Inch (1000mm)	6.0 ea	-	6,502.49	-	-	-	6,502.49 /ea	39,015
40-05-05.00	L403466	Pipe Erection-Handle Fittings-Metal-Std 40 Inch (1000mm)	10.0 ea	328.24	-	-	-	-	328.24 /ea	3,282
40-05-24.10	L404002	Pipe Erection-Straight Run-CS A53/A106-Std 40 Inch (1000mm)	110.0 lf	114.96	-	-	-	-	114.96 /lf	12,645
40-05-24.10	L405102	Field Butt Weld-CS A53/A106-Std 40 Inch (1000mm)	20.0 ea	829.80	25.92	-	178.40	-	1,034.13 /ea	20,683
40-05-05.00	A403400	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 40 Inch (1000mm)	6.0 ea	291.77	1,958.54	-	-	-	2,250.31 /ea	13,502
40-05-07.00	A406044	Pipe Support 40 Inch (1000mm)	2.0 ea	243.15	513.00	-	-	-	756.15 /ea	1,512
40-05-07.00	A406045	Hanger Rod 40 Inch (1000mm)	2.0 ea	145.89	718.20	-	-	-	864.09 /ea	1,728
40-05-07.00	A406043	Hilti-Chemical Anchor - Pipe Support Size 40 Inch (1000mm)	4.0 ea	48.63	71.82	-	-	-	120.45 /ea	482



Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40170 38" Duct, FBI to PHX										
40-05-05.00	L409048 000000	Field Testing-Hydrotest-Non-Specific 40 Inch (1000mm)	110.0 lf	141.02	-	-	-	-	141.02 /lf	15,513
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	1,151.9 sqft	0.90	0.83	-	-	-	1.72 /sqft	1,984
23-07-16.10	2400	Insulation, calcium silicate block, on irregular surfaces, valves and fittings, + 200Deg.F to + 1200Deg.F, 3" thick	2,303.8 sf	73.43	5.91	-	-	-	79.34 /sf	182,790
		38" Duct, FBI to PHX	80.0 lf	2,762.04	1,490.80		44.60		4,297.44 /lf	343,795
40170 46" Duct, SHX to Scrubber										
40-05-24.10	A481002 0100EB	Pipe Plain End-CS A53/A106-ERW Grade B-Std 48 Inch (1200mm)	10.0 lf	-	507.14	-	-	-	507.14 /lf	5,071
40-05-24.10	A482112 010000	Fitting Butt Weld-CS A53/A106-ElI90-Std 48 Inch (1200mm)	2.0 ea	-	11,231.07	-	-	-	11,231.07 /ea	22,462
40-05-24.10	A482421 016200	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Cls 150 (PN20)-Std 48 Inch (1200mm)	6.0 ea	-	6,183.28	-	-	-	6,183.28 /ea	37,100
40-05-05.00	L483466 010000	Pipe Erection-Handle Fittings-Metal-Std 48 Inch (1200mm)	8.0 ea	386.60	-	-	-	-	386.60 /ea	3,093
40-05-24.10	L484002 0100P1	Pipe Erection-Straight Run-CS A53/A106-Std 48 Inch (1200mm)	60.0 lf	138.30	-	-	-	-	138.30 /lf	8,298
40-05-24.10	L485102 010000	Field Butt Weld-CS A53/A106-Std 48 Inch (1200mm)	14.0 ea	965.18	31.11	-	207.51	-	1,203.80 /ea	16,853
40-05-05.00	A483400 006200	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 48 Inch (1200mm)	6.0 ea	486.29	2,648.57	-	-	-	3,134.85 /ea	18,809
40-05-05.00	L489048 000000	Field Testing-Hydrotest-Non-Specific 48 Inch (1200mm)	60.0 lf	202.69	-	-	-	-	202.69 /lf	12,161
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	754.0 sqft	0.90	0.83	-	-	-	1.72 /sqft	1,299
23-07-16.10	2400	Insulation, calcium silicate block, on irregular surfaces, valves and fittings, + 200Deg.F to + 1200Deg.F, 3" thick	1,508.0 sf	73.43	5.91	-	-	-	79.34 /sf	119,644
		46" Duct, SHX to Scrubber	10.0 lf	15,138.82	9,049.72		290.52		24,479.05 /lf	244,790
40170 58" Duct, FBI to PHX										
40-05-24.10	A601002 0000EB	Pipe Plain End-CS A53/A106-ERW Grade B-Non-Specific 60 Inch (1500mm)	40.0 lf	-	952.27	-	-	-	952.27 /lf	38,091
40-05-24.10	A602112 000000	Fitting Butt Weld-CS A53/A106-ElI90-Non-Specific 60 Inch (1500mm)	4.0 ea	-	26,362.46	-	-	-	26,362.46 /ea	105,450
40-05-24.10	A602421 000000	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Non-Specific-Non-Specific 60 Inch (1500mm)	12.0 ea	-	15,021.13	-	-	-	15,021.13 /ea	180,254
40-05-05.00	L603466 010000	Pipe Erection-Handle Fittings-Metal-Std 60 Inch (1500mm)	16.0 ea	474.13	-	-	-	-	474.13 /ea	7,586
40-05-24.10	L604002 0000P1	Pipe Erection-Straight Run-CS A53/A106-Non-Specific 60 Inch (1500mm)	160.0 lf	259.97	-	-	-	-	259.97 /lf	41,595
40-05-24.10	L605102 000000	Field Butt Weld-CS A53/A106-Non-Specific 60 Inch (1500mm)	28.0 ea	1,733.13	58.32	-	372.62	-	2,164.06 /ea	60,594
40-05-05.00	A603400 006200	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 60 Inch (1500mm)	12.0 ea	486.29	4,886.65	-	-	-	5,372.94 /ea	64,475
40-05-07.00	A606043 000000	Hilti-Chemical Anchor - Pipe Support Size 60 Inch (1500mm)	8.0 ea	48.63	76.95	-	-	-	125.58 /ea	1,005
40-05-05.00	L609048 000000	Field Testing-Hydrotest-Non-Specific 60 Inch (1500mm)	160.0 lf	189.65	-	-	-	-	189.65 /lf	30,344
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	2,513.3 sqft	0.90	0.83	-	-	-	1.72 /sqft	4,330



Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40170 58" Duct, FBI to PHX										
23-07-16.10	2400	Insulation, calcium silicate block, on irregular surfaces, valves and fittings, + 200Deg.F to + 1200Deg.F, 3" thick	2,513.3 sf	73.43	5.91	-	-	-	79.34 /sf	199,407
		58" Duct, FBI to PHX	40.0 lf	8,027.06	10,040.36		260.83		18,328.25 /lf	733,130
40170 Blower Ducting, Allowance each blower										
40-05-24.10	A211002	Pipe Plain End-CS A53/A106-ERW Grade B-Std 18 Inch (450mm)	10.3 lf	-	187.68	-	-	-	187.68 /lf	1,939
40-05-24.10	A212112	Fitting Butt Weld-CS A53/A106-ElI90-Std 18 Inch (450mm)	49.0 ea	-	1,328.16	-	-	-	1,328.16 /ea	65,080
40-05-24.10	A212114	Fitting Butt Weld-CS A53/A106-Tee-Std 18 Inch (450mm)	14.0 ea	-	2,270.79	-	-	-	2,270.79 /ea	31,791
40-05-24.10	A212421	Fitting Flanged & Bolted-CS A53/A106-Flange WN-Cls 150 (PN20)-Std 18 Inch (450mm)	28.0 ea	-	777.36	-	-	-	777.36 /ea	21,766
40-05-05.00	L213466	Pipe Erection-Handle Fittings-Metal-Std 18 Inch (450mm)	91.0 ea	167.77	-	-	-	-	167.77 /ea	15,267
40-05-64.00	A216434	Valve Flanged & Bolted-Cast Steel-Butterfly-Cls 150 (PN20) 18 Inch (450mm)	14.0 ea	-	1,513.63	-	-	-	1,513.63 /ea	21,191
40-05-65.23	A216435	Valve Flanged & Bolted-Cast Steel-Check-Cls 150 (PN20) 18 Inch (450mm)	7.0 ea	-	16,436.59	-	-	-	16,436.59 /ea	115,056
40-05-51.00	L214062	Pipe Erection-Handle Valves-Metal-Cls 150 (PN20) 18 Inch (450mm)	21.0 ea	375.80	-	-	-	-	375.80 /ea	7,892
40-05-24.10	L214002	Pipe Erection-Straight Run-CS A53/A106-Std 18 Inch (450mm)	350.0 lf	50.19	-	-	-	-	50.19 /lf	17,565
40-05-24.10	L215102	Field Butt Weld-CS A53/A106-Std 18 Inch (450mm)	189.0 ea	417.24	11.66	-	89.70	-	518.60 /ea	98,016
40-05-05.00	A213400	Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch Rubber Gasket-Cls 150 (PN20) 18 Inch (450mm)	28.0 ea	97.26	314.51	-	-	-	411.77 /ea	11,529
40-05-07.00	A216044	Pipe Support 18 Inch (450mm)	7.0 ea	121.57	51.30	-	-	-	172.87 /ea	1,210
40-05-07.00	A216045	Hanger Rod 18 Inch (450mm)	7.0 ea	58.35	359.10	-	-	-	417.45 /ea	2,922
40-05-07.00	A216043	Hilti-Chemical Anchor - Pipe Support Size 18 Inch (450mm)	14.0 ea	48.63	46.17	-	-	-	94.80 /ea	1,327
40-42-13.00	A210091	Insulation-Urethane Foam Aluminum Jacket 18 Inch (450mm) Dia 2 Inch (50mm) Thk	350.0 lf	54.26	48.54	-	-	-	102.79 /lf	35,977
40-05-05.00	L219048	Field Testing-Hydrotest-Non-Specific 18 Inch (450mm)	350.0 lf	29.37	-	-	-	-	29.37 /lf	10,280
		Blower Ducting, Allowance each blower	7.0 ea	21,930.58	41,191.39		2,422.01		65,543.98 /ea	458,808
		12 Incineration Ducting								1,878,750
15 Process Water Piping										
40130 Process Water Piping										
40-05-17.00	----	Process piping allowance	1.0 ls	5,000.00	5,000.00	-	-	-	10,000.00 /ls	10,000
		Process Water Piping	1.0 LS	5,000.00	5,000.00				10,000.00 /LS	10,000
		15 Process Water Piping								10,000
16 Misc Process Piping										
40140 Purge Air Piping										
40-05-24.10	----	Process piping allowance	1.0 ls	12,500.00	12,500.00	-	-	-	25,000.00 /ls	25,000
		Purge Air Piping	1.0 LS	12,500.00	12,500.00				25,000.00 /LS	25,000
40370 Natural Gas/Fuel Oil Piping										
40-05-23.20	----	Process piping allowance	1.0 ls	5,000.00	5,000.00	-	-	-	10,000.00 /ls	10,000



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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Natural Gas/Fuel Oil Piping	1.0 LS	5,000.00	5,000.00				10,000.00 /LS	10,000
40390	Instrument Air Piping									
40-05-23.20	----	Process piping allowance	1.0 ls	10,000.00	10,000.00	-	-	-	20,000.00 /ls	20,000
		Instrument Air Piping	1.0 LS	10,000.00	10,000.00				20,000.00 /LS	20,000
		16 Misc Process Piping								55,000
23	Incinerator Equipment									
46999	Process Equipment									
46-06-04.00	BC-1430	Fluidized Bed Incinerator Reactors, with roof platform, safety screens, duct supports. Quote by Suez 6/8/2018, includes install of reactor and dome.	2.0 ea	14,165.24	2,866,784.00	-	2,000.00		2,882,949.23 /ea	5,765,898
46-06-04.00	BC-1440	FBI roof platform, safety screens, duct supports. Provided with FBI by Suez, install only.	2.0 ea	28,330.47		-	8,000.00		36,330.47 /ea	72,661
46-06-04.00	BC-1430	Preheat Burner System, allowance	2.0 ea	7,082.62	50,000.00	-	280.00		57,362.62 /ea	114,725
46-06-00.00	BC-0331	Burner Combustion Blower, centrifugal blower, with valves, mtr., control panel	2.0 ea	2,833.05	15,000.00	-		-	17,833.04 /ea	35,666
33-51-33.10	0115	Natural Gas Train, 3" dia.	2.0 ea	2,134.33	7,000.00	-	379.44	-	9,513.77 /ea	19,028
46-06-00.00	BC-0331	Purge Air Blowers, centrifugal blower, with valves, mtr., control panel, 400 scfm	2.0 ea	2,833.05	15,000.00	-		-	17,833.04 /ea	35,666
46-06-00.00	BC-0336	Fluidizing Air Blower, 300 hp with accessories. Quote Continental 6/19/18 plus \$20,000 for submittal, startup, training.	2.0 ea	5,311.97	143,750.00	-	210.00	-	149,271.96 /ea	298,544
46-06-00.00	BC-0326	NOx Removal. Quote Suez 7/9/18 plus \$20,000 for startup, training	2.0 ea	28,330.47	167,000.00	-	8,000.00	-	203,330.47 /ea	406,661
22-15-19.10	6220	Compressor, air, reciprocating, tank mounted, heavy duty, oil-less, 2 stage, 3 phase, capacity rated at 175 PSIG, 18.2 SCFM, 7.5 H.P., 120 gallon tank	2.0 ea	1,996.38	17,500.00	-	-	-	19,496.38 /ea	38,993
22-11-23.13	0460	Pump, pressure booster system, 5 HP pump, includes diaphragm tank, control and pressure switch	2.0 ea	1,492.47	7,925.00	-	-	-	9,417.47 /ea	18,835
		Process Equipment	2.0 LS	94,510.01	3,289,959.00		18,869.44		3,403,338.46 /LS	6,806,677
		23 Incinerator Equipment								6,806,677
31	Building									
03330	Basement Slab, 94.5' x 74.5' x 24" thick									
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	338.0 lf	5.24	5.26	-	-	-	10.50 /lf	3,547
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	28.0 ea	13.62	38.06	-	-	-	51.68 /ea	1,447
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	44.0 ton	1,488.12	1,041.52	-	-	-	2,529.64 /ton	111,309
03-21-10.60	2410	Reinforcing steel, in place, dowels, deformed, 2' long, #4, A615, grade 60	676.0 ea	3.57	0.77	-	-	-	4.33 /ea	2,927
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	44.0 ton	57.80	-	-	6.02	-	63.82 /ton	2,808
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	44.0 ton	62.82	-	-	6.55	-	69.37 /ton	3,052
03-31-05.35	0405	Concrete, ready mix, regular weight, slabs/mats, 5000 psi	521.5 cy	-	128.64	-	-	-	128.64 /cy	67,087
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	521.5 cy	22.92	-	-	0.32	-	23.23 /cy	12,116
03-35-29.30	0150	Concrete finishing, floors, monolithic, screed, float and broom finish	7,040.3 sf	1.08	-	-	-	-	1.08 /sf	7,575

Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Basement Slab, 94.5' x 74.5' x 24" thick	521.5 cy	181.93	222.96		1.38		406.27 /cy	211,869
03330	Slab on Grade, Ash Dewatering, 35' x 25' x 18" thick									
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	3.8 ton	1,488.12	1,041.52	-	-	-	2,529.64 /ton	9,519
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	3.8 ton	57.80	-	-	6.02	-	63.82 /ton	240
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	3.8 ton	62.82	-	-	6.55	-	69.37 /ton	261
03-31-05.35	0405	Concrete, ready mix, regular weight, slabs/mats, 5000 psi	48.6 cy	-	128.64	-	-	-	128.64 /cy	6,253
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	48.6 cy	22.92	-	-	0.32	-	23.23 /cy	1,129
03-35-29.30	0150	Concrete finishing, floors, monolithic, screed, float and broom finish	875.0 sf	1.08	-	-	-	-	1.08 /sf	941
		Slab on Grade, Ash Dewatering, 35' x 25' x 18" thick	48.6 cy	166.82	209.27		1.29		377.37 /cy	18,345
03345	Basement Walls, 338 lf x 23' tall x 20" thick									
03-11-13.85	9460	Cip concret forms,walls,steel framed plywd,over 16'20'h,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	15,548.0 sfca	10.06	0.84	-	-	-	10.90 /sfca	169,466
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	41.5 gal	-	24.01	-	-	-	24.01 /gal	995
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	48.6 ton	1,140.89	1,041.52	-	-	-	2,182.41 /ton	106,039
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	48.6 ton	57.80	-	-	6.02	-	63.82 /ton	3,101
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	48.6 ton	62.82	-	-	6.55	-	69.37 /ton	3,371
03-31-05.35	0407	Concrete, ready mix, regular weight, walls/cols/beams, 5000 psi	479.9 cy	-	128.64	-	-	-	128.64 /cy	61,732
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	479.9 cy	42.69	-	-	7.93	-	50.62 /cy	24,293
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	15,548.0 sf	1.28	0.03	-	-	-	1.31 /sf	20,322
		Basement Walls, 338 lf x 23' tall x 20" thick	479.9 cy	537.67	264.42		9.20		811.29 /cy	389,319
03350	Ground Floor Elevated Slab, Incinerator Area, 94.5' x 74.5' x 12" thic									
03-11-13.35	1150	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	7,040.3 sf	7.18	1.39	-	-	-	8.58 /sf	60,376
03-21-10.60	0400	Reinforcing steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.1 ton	1,180.23	1,041.52	-	-	-	2,221.75 /ton	2,491
03-21-10.60	2050	Reinforcing in place, unloading & sorting, add to above - decks	0.1 ton	57.80	-	-	6.00	-	63.80 /ton	8
03-21-10.60	2220	Reinforcing steel, crane cost for handling, maximum, add	0.1 ton	165.15	-	-	17.20	-	182.40 /ton	24
03-31-05.35	0402	Concrete, ready mix, regular weight, elevated decks, 5000 psi	260.8 cy	-	128.64	-	-	-	128.64 /cy	33,543
03-31-05.70	1600	Structural concrete, placing, elevated slab, pumped, over 10" thick, includes vibrating, excludes material	260.8 cy	28.46	-	-	5.29	-	33.75 /cy	8,800

Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03350 Ground Floor Elevated Slab, Incinerator Area, 94.5' x 74.5' x 12" thic										
03-35-29.30	0225	Finishing elev slab, manual screed, bull float, manual float & steel trowel	7,040.3 sf	1.57	-	-	-	-	1.57 /sf	11,079
03-39-13.50	0310	Curing, sprayed membrane curing compound, elevated decks	70.4 csf	12.85	12.47	-	-	-	25.32 /csf	1,782
		Ground Floor Elevated Slab, Incinerator Area, 94.5' x 74.5' x 12" thic	260.8 cy	273.55	174.10		5.30		452.94 /cy	118,104
13999 Incinerator and Ash Dewatering Building										
13-13-03.00	BC-0021	Incinerator Building, superstructure above slab at grade, steel frame with steel siding, allowance	7,915.0 sqft	37.50	75.00	-	12.50		125.00 /sqft	989,375
22-05-00.00	BC-0001	Allowance - Piping, Building Service/Domestic	7,915.0 sf	-	-	7.00	-	-	7.00 /sf	55,405
23-05-00.00	BC-0001	Allowance - HVAC	7,915.0 sqft	-	-	25.00	-	-	25.00 /sqft	197,875
09-99-99.99	MISC	Misc. Finishes, coating systems allowance	1.0 ls	-	-	75,000.00	-	-	75,000.00 /ls	75,000
		Incinerator and Ash Dewatering Building	7,915.0 sf	37.50	75.00	41.48	12.50		166.48 /sf	1,317,655
		31 Building	7,915.0 sf	92.12	112.74	41.48	13.33		259.67 /sf	2,055,293
		04 Fluid Bed Incinerator								10,805,720
05 Sand Storage Silo										
14 Sand Piping										
40170 Sand Piping										
40-05-24.10	----	Process piping, install only allowance	1.0 ls	15,000.00		-	-	-	15,000.00 /ls	15,000
		Sand Piping	1.0 LS	15,000.00					15,000.00 /LS	15,000
		14 Sand Piping								15,000
23 Incinerator Equipment										
46999 Sand Silo										
46-06-00.00	----	Misc. process equipment, sand silo, transporter, incl. piping to FBI	1.0 ls	17,353.94	130,000.00	-	1,264.80	-	148,618.74 /ls	148,619
		Sand Silo	1.0 ea	17,353.94	130,000.00		1,264.80		148,618.74 /ea	148,619
		23 Incinerator Equipment								148,619
		05 Sand Storage Silo								163,619
06 Primary Heat Exchanger										
23 Incinerator Equipment										
46999 Process Equipment										
23-57-19.16	----	Primary heat exchanger, 25,500lb/hr, 7' diam., 32'H	2.0 ea	38,252.81	600,000.00	-	5,523.32	-	643,776.13 /ea	1,287,552
		Process Equipment	2.0 ea	38,252.81	600,000.00		5,523.32		643,776.13 /ea	1,287,552
		23 Incinerator Equipment								1,287,552
		06 Primary Heat Exchanger								1,287,552
07 Secondary Heat Exchanger										
23 Incinerator Equipment										
46999 Process Equipment										
23-57-19.16	----	Secondary heat exchanger, 9,200lb/hr, 7' diam., 16'H	2.0 ea	22,951.68	270,000.00	-	3,313.99	-	296,265.67 /ea	592,531
		Process Equipment	2.0 ea	22,951.68	270,000.00		3,313.99		296,265.67 /ea	592,531
		23 Incinerator Equipment								592,531
		07 Secondary Heat Exchanger								592,531
08 GAC										
32 Process Equipment										
46999 Process Equipment										
46-06-00.00	----	Granular Activated Carbon(GAC) vessel, 12' diam., 20'H, adsorber, droplet separator, start-up heater, carbon	2.0 ea	43,384.85	2,150,000.00	-	3,162.00	-	2,196,546.85 /ea	4,393,094



Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
46999	Process Equipment									
46-06-00.00	----	Gas conditioner, allowance	2.0 ea	10,412.37	50,000.00	-	758.88	-	61,171.25 /ea	122,342
		Process Equipment	2.0 LS	53,797.21	2,200,000.00		3,920.88		2,257,718.10 /LS	4,515,436
		32 Process Equipment								4,515,436
		08 GAC								4,515,436
09	Wet Scrubber/WESP									
15	Process Water Piping									
40170	Process Water Piping									
40-05-24.10	----	Process piping allowance	1.0 ls	20,000.00	20,000.00	-	-	-	40,000.00 /ls	40,000
		Process Water Piping	1.0 LS	20,000.00	20,000.00				40,000.00 /LS	40,000
		15 Process Water Piping								40,000
16	Misc Process Piping									
40170	Drain and Recycle Piping									
40-05-24.10	----	Process piping allowance	1.0 ls	40,000.00	40,000.00	-	-	-	80,000.00 /ls	80,000
		Drain and Recycle Piping	1.0 LS	40,000.00	40,000.00				80,000.00 /LS	80,000
40170	Ash Slurry Piping									
40-05-24.10	----	Process piping allowance	1.0 ls	30,000.00	30,000.00	-	-	-	60,000.00 /ls	60,000
		Ash Slurry Piping	1.0 LS	30,000.00	30,000.00				60,000.00 /LS	60,000
40370	Scrubber Exhaust Piping									
40-05-23.20	----	Process piping allowance	1.0 ls	50,000.00	50,000.00	-	-	-	100,000.00 /ls	100,000
		Scrubber Exhaust Piping	1.0 LS	50,000.00	50,000.00				100,000.00 /LS	100,000
		16 Misc Process Piping								240,000
32	Process Equipment									
46999	Process Equipment									
46-06-00.00	----	Wet scrubber, 25,000 acfm, incl quench vessel, water booster pumps, purge air fan, WESP, control panel	2.0 ea	41,649.46	865,250.00	-	3,035.52	-	909,934.97 /ea	1,819,870
46-06-18.00	----	Ash slurry pump, centrifugal, allowance	2.0 ea	3,904.64	20,000.00	-	284.58	-	24,189.22 /ea	48,378
		Process Equipment	2.0 ea	45,554.09	885,250.00		3,320.10		934,124.19 /ea	1,868,248
		32 Process Equipment								1,868,248
		09 Wet Scrubber/WESP								2,148,248
10	Chemical Feed Systems									
25	Chemical Piping									
40500	Sulfuric Acid Piping									
40-05-31.13	----	Sulfuric acid piping allowance	1.0 ls	6,000.00	6,000.00	-	-	-	12,000.00 /ls	12,000
		Sulfuric Acid Piping	1.0 LS	6,000.00	6,000.00				12,000.00 /LS	12,000
40500	Polymer Piping									
40-05-31.13	----	Polymer piping allowance	1.0 ls	6,000.00	6,000.00	-	-	-	12,000.00 /ls	12,000
		Polymer Piping	1.0 LS	6,000.00	6,000.00				12,000.00 /LS	12,000
40500	Ammonia Piping									
40-05-31.13	----	Ammonia piping allowance	1.0 ls	6,000.00	6,000.00	-	-	-	12,000.00 /ls	12,000
		Ammonia Piping	1.0 LS	6,000.00	6,000.00				12,000.00 /LS	12,000
40500	Sodium Hydroxide Piping									
40-05-31.13	----	Sodium Hydroxide piping allowance	1.0 ls	6,000.00	6,000.00	-	-	-	12,000.00 /ls	12,000
		Sodium Hydroxide Piping	1.0 LS	6,000.00	6,000.00				12,000.00 /LS	12,000



Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		25 Chemical Piping								48,000
		26 Chemical Feed								
		46999 Chemical Feed Systems								
	46-06-16.00	BC-0061 Chemical metering pump, sulfuric acid	2.0 ea	1,062.40	10,000.00	-	-	-	11,062.40 /ea	22,125
	46-06-16.00	BC-0061 Chemical metering pump, polymer	2.0 ea	1,062.40	10,000.00	-	-	-	11,062.40 /ea	22,125
	46-06-16.00	BC-0061 Chemical metering pump, ammonia	2.0 ea	1,062.40	10,000.00	-	-	-	11,062.40 /ea	22,125
	46-06-16.00	BC-0061 Chemical metering pump, sodium hydroxide	2.0 ea	1,062.40	10,000.00	-	-	-	11,062.40 /ea	22,125
		Chemical Feed Systems	1.0 LS	8,499.16	80,000.00				88,499.16 /LS	88,499
		26 Chemical Feed								88,499
		10 Chemical Feed Systems								136,499
		11 Stack								
		13 Flue Gas Piping								
		05122 Stack Bracing Tower, 8' x 8' x 25' tall								
	05-12-23.75	0102 Structural steel beam or girder, 100-ton project, 1 to 2 story building, W6x9, A992 steel, shop fabricated, incl shop primer, bolted connections	384.0 lf	8.94	13.64	-	2.87	-	25.44 /lf	9,769
	05-53-13.50	0020 Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	64.0 lf	11.89	3.41	-	-	-	15.30 /lf	979
	05-53-13.10	0132 Floor grating, aluminum, 1-1/2" x 3/16" bearing bars @ 1-3/16" O.C., cross bars @ 4" O.C., up to 300 S.F., field fabricated from panels	128.0 sf	4.81	31.00	-	0.14	-	35.95 /sf	4,602
	05-52-13.50	0210 Railing, pipe, aluminum, clear finish, 3 rails, 3'-6" high, posts @ 5' O.C., 1-1/2" dia, shop fabricated	48.0 lf	24.58	91.50	-	0.73	-	116.81 /lf	5,607
	05-12-23.40	0476 Angle framing, structural steel, 3"x3"x3/8", field fabricated, incl cutting & welding	144.0 lf	43.30	5.93	-	1.76	-	50.98 /lf	7,342
	05-05-21.90	1800 Welding structural steel in field, 3 passes, 0.5 lb/LF, 3/8" thick, continuous fillet, down welding, type 6011	64.0 lf	28.31	1.24	-	3.35	-	32.89 /lf	2,105
	05-12-23.65	0300 Steel plate, structural, for connections & stiffeners, 3/8" T, shop fabricated, incl shop primer	144.0 sf	-	20.98	-	-	-	20.98 /sf	3,021
	09-91-06.41	BC-0021 Coatings & paints, B & C coating system E-2 (Epoxy, metal tanks, structures)	512.0 sqft	0.74	1.52	-	-	-	2.26 /sqft	1,156
	05-51-33.13	0400 Ladder, shop fabricated, aluminum, 20" W, bolted to concrete, excl cage	50.0 vlf	39.61	51.00	-	1.18	-	91.79 /vlf	4,590
	05-05-19.20	8250 Wedge anchor, carbon steel, 1/2" dia x 2-3/4" L, in concrete, brick or stone, excl layout & drilling	144.0 ea	4.55	1.10	-	-	-	5.65 /ea	813
	03-82-16.10	0700 Concrete impact drilling, for anchors, to 4" d, 1" dia, in concrete or brick walls and floors, includes bit cost, layout and set up time, excl anchor	144.0 ea	17.44	0.15	-	-	-	17.59 /ea	2,532
		Stack Bracing Tower, 8' x 8' x 25' tall	128.0 sf	152.82	166.21		13.14		332.16 /sf	42,516
		40310 24" Stack, 316SS								
	40-05-23.10	A241002 Pipe Plain End-Stainless 304/304L-Welded (ERW, 1600W CW, DSAW)-Sch 10S 24 Inch (600mm)	187.0 lf	-	119.36	-	-	-	119.36 /lf	22,314
	40-05-23.10	A242421 Fitting Flanged & Bolted-Stainless 304/304L-Flange 176200 WN-Cls 150-Sch 40S 24 Inch (600mm)	6.0 ea	-	673.07	-	-	-	673.07 /ea	4,038
	40-05-05.00	L243466 Pipe Erection-Handle Fittings-Metal-Sch 10 24 Inch (600mm)	6.0 ea	141.02	-	-	-	-	141.02 /ea	846
	40-05-23.10	L244002 Pipe Erection-Straight Run-Stainless 304/304L-Sch 1600P1 10S 24 Inch (600mm)	200.0 lf	70.76	-	-	-	-	70.76 /lf	14,151
	40-05-23.10	L245102 Field Butt Weld-Stainless 304/304L-Sch 10S 24 Inch (600mm)	16.0 ea	828.77	3.00	-	106.91	-	938.68 /ea	15,019
	40-05-05.00	A243400 Make Up Bolted Joint incl B-7 Nuts, Bolts, 1/16 Inch 006200 Rubber Gasket-Cls 150 (PN20) 24 Inch (600mm)	6.0 ea	97.26	551.92	-	-	-	649.18 /ea	3,895



Estimate Detail Report

8/15/2018 9:14 AM

Project Number: 150048-230-235
Estimate Issue: 1
Due Date: 8/14/2018
Estimator: D. Goodburn

Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40310 24" Stack, 316SS										
40-05-07.00	A246044 000000	Pipe Support 24 Inch (600mm)	2.0 ea	175.07	76.95	-	-	-	252.02 /ea	504
40-05-07.00	A246045 000000	Hanger Rod 24 Inch (600mm)	2.0 ea	97.26	513.00	-	-	-	610.26 /ea	1,221
40-05-07.00	A246043 000000	Hilti-Chemical Anchor - Pipe Support Size 24 Inch (600mm)	8.0 ea	48.63	56.43	-	-	-	105.06 /ea	840
40-05-05.00	L249048 000000	Field Testing-Hydrotest-Non-Specific 24 Inch (600mm)	200.0 lf	51.35	-	-	-	-	51.35 /lf	10,270
40-05-23.10	A042171 017000	Fitting Butt Weld-Stainless 304/304L-Fitting Weldolet-Cls 2000-Std/Sch 40 1/2 Inch (13mm)	8.0 ea	-	11.03	-	-	-	11.03 /ea	88
40-05-23.10	A132171 017000	Fitting Butt Weld-Stainless 304/304L-Fitting Weldolet-Cls 2000-Std/Sch 40 4 Inch (100mm)	8.0 ea	-	52.35	-	-	-	52.35 /ea	419
40-05-05.00	L043466 080000	Pipe Erection-Handle Fittings-Metal-Sch 40 1/2 Inch (13mm)	8.0 ea	12.35	-	-	-	-	12.35 /ea	99
40-05-05.00	L133466 010000	Pipe Erection-Handle Fittings-Metal-Std 4 Inch (100mm)	8.0 ea	43.77	-	-	-	-	43.77 /ea	350
40-05-23.10	A132421 176200	Fitting Flanged & Bolted-Stainless 304/304L-Flange WN-Cls 150-Sch 40S/Std 4 Inch (100mm)	8.0 ea	-	26.59	-	-	-	26.59 /ea	213
40-05-23.10	L045102 170000	Field Butt Weld-Stainless 304/304L-Sch 40S/Std 1/2 Inch (13mm)	8.0 ea	32.13	0.03	-	4.15	-	36.30 /ea	290
40-05-23.10	L135102 170000	Field Butt Weld-Stainless 304/304L-Sch 40S/Std 4 Inch (100mm)	8.0 ea	94.65	0.38	-	12.21	-	107.25 /ea	858
24" Stack, 316SS			200.0 lf	207.54	160.33		9.21		377.08 /lf	75,416
13 Flue Gas Piping										117,932
32 Process Equipment										
46999 Process Equipment										
46-06-04.00	BC-1430	CEMS Continuous Emission Monitoring System. Quote Emerson 2/2018 includes 4 days startup	2.0 ea	2,833.05	87,940.00	-	800.00		91,573.04 /ea	183,146
Process Equipment			2.0 LS	2,833.05	87,940.00		800.00		91,573.04 /LS	183,146
32 Process Equipment										183,146
11 Stack										301,079
12 Gravity Thickener										
17 Cake Loadout										
46999 Ash Dewatering Equipment										
46-06-00.00	----	Gravity thickener, allowance	2.0 ea	27,766.31	200,000.00	-	2,023.68	-	229,789.98 /ea	459,580
Ash Dewatering Equipment			2.0 LS	27,766.31	200,000.00		2,023.68		229,789.98 /LS	459,580
17 Cake Loadout										459,580
12 Gravity Thickener										459,580
13 Ash Dewatering/Loadout										
08 Thickened Ash Piping										
40120 Thickened Ash Piping										
40-05-19.20	----	Thickened Ash piping allowance	1.0 ls	20,000.00	20,000.00	-	-	-	40,000.00 /ls	40,000
Thickened Ash Piping			1.0 LS	20,000.00	20,000.00				40,000.00 /LS	40,000
08 Thickened Ash Piping										40,000
10 Cake Piping										
40120 Cake Piping										
40-05-19.20	----	Process piping allowance	1.0 ls	20,000.00	40,000.00	-	-	-	60,000.00 /ls	60,000
Cake Piping			1.0 LS	20,000.00	40,000.00				60,000.00 /LS	60,000
10 Cake Piping										60,000



Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
17 Cake Loadout										
03305 Truck Scale Footings										
03-30-53.40	----	Footings, slabs, walls, truck scale, allowance	1.0 ls	80,475.00	75,000.00	-	-	-	155,475.00 /ls	155,475
		Truck Scale Footings	2.0 LS	40,237.50	37,500.00				77,737.50 /LS	155,475
11999 Truck Scale										
10-88-05.10	1680	Scales, truck type, digital, electronic, steel deck, 100 ton capacity, 70' x 10' platform, incl. steel weigh bridge, excl. foundation, pits	2.0 ea	20,385.06	54,000.00	-	-	-	74,385.05 /ea	148,770
		Truck Scale	2.0 LS	20,385.06	54,000.00				74,385.05 /LS	148,770
46999 Ash Dewatering Equipment										
46-06-00.00	----	Belt filter press, 1M, incl. pc sludge feed pumps, wash water booster pump, polymer feed pump, HPU, control panel	2.0 ea	52,061.82	498,600.00	-	3,794.40	-	554,456.22 /ea	1,108,912
		Ash Dewatering Equipment	2.0 LS	52,061.82	498,600.00		3,794.40		554,456.22 /LS	1,108,912
		17 Cake Loadout								1,413,158
		13 Ash Dewatering/Loadout								1,513,158
14 Electrical and Instrumentation										
35 Electrical										
26001 Electrical and Instrumentation										
26-00-00.02	FACTOR	Electrical (This is based on 20% of the Total Project Costs)	1.0 LS	-	-	11,081,000.00	-	-	11,081,000.00 /LS	11,081,000
	ED	Electrical and Instrumentation	1.0 LS			11,081,000.00			11,081,000.00 /LS	11,081,000
		35 Electrical								11,081,000
36 Instrumentation										
26001 Electrical and Instrumentation										
27-20-00.01	FACTOR	Instrumentation (This is based on 5% of the Total Project Costs)	1.0 LS	-	-	2,770,000.00	-	-	2,770,000.00 /LS	2,770,000
	ED	Electrical and Instrumentation	1.0 LS			2,770,000.00			2,770,000.00 /LS	2,770,000
		36 Instrumentation								2,770,000
		14 Electrical and Instrumentation								13,851,000
15 Waste Heat Boiler										
06 Water Treatment										
40180 Feedwater Piping										
40-05-24.10	----	Misc. process piping, boiler feedwater, allowance	1.0 ls	20,000.00	30,000.00	-	-	-	50,000.00 /ls	50,000
		Feedwater Piping	1.0 LS	20,000.00	30,000.00				50,000.00 /LS	50,000
46999 Boiler										
46-06-00.00	----	Misc. process equipment, boiler feedwater equipment and treatment, allowance	1.0 ls	24,295.51	250,000.00	-	1,770.72	-	276,066.23 /ls	276,066
		Boiler	2.0 LS	12,147.76	125,000.00		885.36		138,033.11 /LS	276,066
		06 Water Treatment								326,066
07 Steam Piping										
40170 Steam Piping										
40-05-24.10	----	Steam piping allowance	1.0 ls	50,000.00	150,000.00	-	-	-	200,000.00 /ls	200,000
		Steam Piping	1.0 LS	50,000.00	150,000.00				200,000.00 /LS	200,000
		07 Steam Piping								200,000
13 Flue Gas Piping										



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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
40310	Flue Gas Piping									
40-05-23.10	----	Misc. process piping, flue gas, allowance	1.0 ls	50,000.00	175,000.00	-	-	-	225,000.00 /ls	225,000
		Flue Gas Piping	1.0 LS	50,000.00	175,000.00				225,000.00 /LS	225,000
		13 Flue Gas Piping								225,000
16	Misc Process Piping									
40170	Ash Slurry Piping									
40-05-24.10	----	Process piping allowance	1.0 ls	10,000.00	10,000.00	-	-	-	20,000.00 /ls	20,000
		Ash Slurry Piping	1.0 LS	10,000.00	10,000.00				20,000.00 /LS	20,000
		16 Misc Process Piping								20,000
32	Process Equipment									
46999	Boiler									
46-06-00.00	----	Misc. process equipment, waste heat boiler, steam, 7,000 lb/hr	2.0 ls	43,384.85	1,600,000.00	-	3,162.00	-	1,646,546.85 /ls	3,293,094
23-52-00.00	----	Misc. process equipment, deaerator, allowance	1.0 ls	9,563.20	100,000.00	-	1,380.83	-	110,944.03 /ls	110,944
40-05-24.10	----	Misc. process piping, boiler	2.0 ls	5,000.00	5,000.00	-	-	-	10,000.00 /ls	20,000
		Boiler	2.0 LS	53,166.45	1,655,000.00		3,852.42		1,712,018.86 /LS	3,424,038
46999	Process Equipment									
46-06-18.00	----	Ash slurry pump, centrifugal, allowance	2.0 ea	2,776.63	10,000.00	-	202.37	-	12,979.00 /ea	25,958
		Process Equipment	2.0 LS	2,776.63	10,000.00		202.37		12,979.00 /LS	25,958
		32 Process Equipment								3,449,996
		15 Waste Heat Boiler								4,221,062
16	Steam Turbine Generator									
04	Cooling									
03330	Slabs									
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	222.2 sy	1.35	-	-	0.63	-	1.98 /sy	440
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	74.1 cy	-	33.62	-	-	-	33.62 /cy	2,491
03-11-13.65	3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	180.0 sfca	6.03	0.97	-	-	-	7.00 /sfca	1,260
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	6.7 ton	1,488.12	1,108.00	-	-	-	2,596.12 /ton	17,308
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	6.7 ton	57.80	-	-	6.02	-	63.82 /ton	425
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	6.7 ton	62.82	-	-	6.55	-	69.37 /ton	463
03-31-05.35	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	113.3 cy	-	135.00	-	-	-	135.00 /cy	15,300
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	113.3 cy	22.92	-	-	0.32	-	23.23 /cy	2,633
03-35-29.30	0150	Concrete finishing, floors, monolithic, screed, float and broom finish	2,000.0 sf	1.08	-	-	-	-	1.08 /sf	2,152
03-39-13.50	0300	Curing, sprayed membrane curing compound	20.0 csf	12.85	12.47	-	-	-	25.32 /csf	506
03-15-05.25	5500	Sawcut control joints, slab on grade	160.0 lf	0.80	0.52	-	0.27	-	1.58 /lf	252
		Slabs	111.1 cy	155.20	231.16		2.73		389.08 /cy	43,231
09999	Coatings									
09-00-00.01	BC-0001	Finishes allowance	1.0 ls	-	-	20,000.00	-	-	20,000.00 /ls	20,000

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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Coatings	1.0 LS			20,000.00			20,000.00 /LS	20,000
40120	Piping - HEX Cooling Water									
40-05-19.20	----	Process piping allowance	1.0 ls	35,095.51	75,000.00	-	-	-	110,095.51 /ls	110,096
		Piping - HEX Cooling Water	1.0 LS	35,095.51	75,000.00				110,095.51 /LS	110,096
46999	Process Equipment									
46-99-99.99	MISC	Misc. Process equipment, cooling HEX	1.0 LS	24,989.67	420,000.00		1,821.31	-	446,810.98 /LS	446,811
		Process Equipment	1.0 LS	24,989.67	420,000.00		1,821.31		446,810.98 /LS	446,811
		04 Cooling								620,138
05	Effluent Cooling									
03330	Slabs									
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	27.8 sy	1.35	-	-	0.63	-	1.98 /sy	55
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	9.3 cy	-	33.62	-	-	-	33.62 /cy	311
03-11-13.65	3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	65.0 sfca	6.03	0.97	-	-	-	7.00 /sfca	455
03-15-13.50	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	65.0 lf	5.24	5.13	-	-	-	10.37 /lf	674
03-15-13.50	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	5.0 ea	13.62	44.50	-	-	-	58.11 /ea	291
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.7 ton	1,488.12	1,108.00	-	-	-	2,596.13 /ton	4,328
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	1.7 ton	57.80	-	-	6.02	-	63.82 /ton	106
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	1.7 ton	62.83	-	-	6.55	-	69.38 /ton	116
03-31-05.35	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	28.3 cy	-	135.00	-	-	-	135.00 /cy	3,825
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	28.3 cy	22.92	-	-	0.32	-	23.23 /cy	658
03-35-29.30	0100	Concrete finishing, floors, monolithic, screed and bull float(darby) finish	250.0 sf	0.50	-	-	-	-	0.50 /sf	124
03-39-13.50	0300	Curing, sprayed membrane curing compound	2.5 csf	12.85	12.47	-	-	-	25.32 /csf	63
		Slabs	27.7 cy	155.97	239.19		1.71		396.86 /cy	11,007
03330	Slabs									
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	41.7 sy	1.35	-	-	0.63	-	1.98 /sy	83
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	13.9 cy	-	33.62	-	-	-	33.62 /cy	467
03-11-13.65	3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	80.0 sfca	6.03	0.97	-	-	-	7.00 /sfca	560
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	2.5 ton	1,488.12	1,108.00	-	-	-	2,596.12 /ton	6,490
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	2.5 ton	57.80	-	-	6.02	-	63.82 /ton	160
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	2.5 ton	62.82	-	-	6.55	-	69.37 /ton	173
03-31-05.35	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	42.5 cy	-	135.00	-	-	-	135.00 /cy	5,738

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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03330 Slabs										
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	42.5 cy	22.92	-	-	0.32	-	23.23 /cy	987
03-35-29.30	0100	Concrete finishing, floors, monolithic, screed and bull float(darby) finish	375.0 sf	0.50	-	-	-	-	0.50 /sf	187
03-39-13.50	0300	Curing, sprayed membrane curing compound	3.8 csf	12.85	12.47	-	-	-	25.32 /csf	95
		Slabs	41.6 cy	138.61	218.61		1.71		358.93 /cy	14,940
03345 Concrete Walls										
03-11-13.85	9260	Cip concret forms,walls,steel framed plywd,over 8'16"hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	1,350.0 sfca	8.94	0.84	-	-	-	9.78 /sfca	13,206
03-15-05.95	3050	Form oil, up to 800 S.F. per gallon, coverage, includes material only	3.6 gal	-	24.01	-	-	-	24.01 /gal	86
03-21-10.60	0700	Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	3.2 ton	1,140.89	1,108.00	-	-	-	2,248.89 /ton	7,169
03-21-10.60	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	3.2 ton	57.80	-	-	6.03	-	63.82 /ton	203
03-21-10.60	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	3.2 ton	62.82	-	-	6.55	-	69.37 /ton	221
03-31-05.35	0320	Concrete, ready mix, regular weight, walls/cols/beams, 4000 psi	38.3 cy	-	135.00	-	-	-	135.00 /cy	5,164
03-31-05.70	5350	Structural concrete, placing, walls, pumped, 15" thick, includes vibrating, excludes material	38.3 cy	42.69	-	-	7.93	-	50.62 /cy	1,936
03-35-29.60	0010	Finishing: break ties & patch voids (walls, cols or beams)	1,350.0 sf	1.28	0.03	-	-	-	1.31 /sf	1,765
		Concrete Walls	37.5 cy	518.62	265.59		9.16		793.37 /cy	29,751
03350 Elevated Slabs										
03-11-13.35	1150	C.I.P. concrete forms, elevated slab, flat plate, plywood, to 15' high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	250.0 sf	7.18	1.43	-	-	-	8.61 /sf	2,153
03-11-13.35	7000	C.I.P. concrete forms, elevated slab, edge forms, to 6" high, 4 use, includes shoring, erecting, bracing, stripping and cleaning	65.0 lf	5.25	0.23	-	-	-	5.48 /lf	356
03-21-10.60	0400	Reinforcing steel, in place, elevated slabs, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.5 ton	1,180.23	1,108.00	-	-	-	2,288.23 /ton	1,188
03-21-10.60	2050	Reinforcing in place, unloading & sorting, add to above - decks	2.5 ton	57.80	-	-	6.02	-	63.82 /ton	161
03-21-10.60	2220	Reinforcing steel, crane cost for handling, maximum, add	2.5 ton	165.13	-	-	17.21	-	182.34 /ton	460
03-31-05.35	0325	Concrete, ready mix, regular weight, elevated decks, 4000 psi	9.4 cy	-	135.00	-	-	-	135.00 /cy	1,275
03-31-05.70	1650	Structural concrete, placing, elevated slab, with crane and bucket, over 10" thick, includes vibrating, excludes material	9.4 cy	44.61	-	-	8.39	-	53.00 /cy	501
03-35-29.30	0225	Finishing elev slab, manual screed, bull float, manual float & steel trowel	250.0 sf	1.57	-	-	-	-	1.57 /sf	393
03-39-13.50	0310	Curing, sprayed membrane curing compound, elevated decks	2.5 csf	12.85	10.85	-	-	-	23.70 /csf	59
03-35-29.30	5000	Finishing, underside elevated decks, break ties and patch voids	390.0 sf	1.28	0.04	-	-	-	1.32 /sf	514

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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		Elevated Slabs	9.3 cy	502.95	244.60		14.89		762.44 /cy	7,059
03999 Precast Roof Tee										
03-41-33.60	2400	Precast tees, double, roof, 50' span, 24" x 8' wide, prestressed	2.0 ea	429.94	2,390.40	-	128.59	-	2,948.93 /ea	5,898
		Precast Roof Tee	4.0 EA	214.97	1,195.20		64.29		1,474.46 /EA	5,898
04220 Exterior Masonry Walls										
04-22-10.28	0350	Concr block,high strngt,hollow,3500 psi,12"8"16",inclds mortar and horzntl joint rnfrng every other course,excluds scffldn,grout and verticl rnfrng	1,458.0 sf	14.62	5.56	-	-	-	20.18 /sf	29,422
04-05-19.26	0020	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed horizontally, ASTM A615	583.2 lb	0.83	0.49	-	-	-	1.33 /lb	774
04-05-19.26	0060	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed vertically, ASTM A615	583.2 lb	1.03	0.49	-	-	-	1.52 /lb	886
04-05-16.30	2000	Grout, for bond beams, lintels and concrete masonry unit (CMU) cores, C476, includes material only	583.2 cf	7.01	4.74	-	0.38	-	12.13 /cf	7,072
04-05-16.30	0800	Grout, door frames, 3' x 7' opening, 2.5 CF per opening	1.0 opng	40.90	11.83	-	2.19	-	54.92 /opng	55
04-05-16.30	0850	Grout, door frames, 6' x 7' opening, 3.5 CF per opening	1.0 opng	54.53	16.59	-	2.92	-	74.04 /opng	74
07-19-19.10	0300	Silicone water repellants, sprayed on CMU, 2 coat	2,916.0 sf	0.23	0.81	-	-	-	1.05 /sf	3,051
		Exterior Masonry Walls	1,458.0 sf	18.70	9.50		0.15		28.35 /sf	41,333
07500 Roofing - Membrane, w/ Sheet Metal (Includes Deckcoating)										
07-53-23.20	4800	Ethylene-propylene-diene-monomer roofing, (EPDM), 0.40 psf, fully adhered with adhesive, 60 mils	6.3 sq	127.70	144.33	-	7.10	-	279.12 /sq	1,745
07-51-13.50	0300	Walkways for built-up roofs, concrete patio blocks, natural, 2" thick	15.0 sf	5.11	3.99	-	-	-	9.10 /sf	137
07-65-10.10	9920	Coping, aluminum to .019", duranodic finish, 12" wall	75.0 lf	9.75	7.85	-	-	-	17.60 /lf	1,320
		Roofing - Membrane, w/ Sheet Metal (Includes Deckcoating)	6.3 unit	256.92	248.10		7.10		512.12 /unit	3,201
09999 Coatings										
09-00-00.01	BC-0001	Finishes allowance	1.0 ls	-	-	15,000.00	-	-	15,000.00 /ls	15,000
		Coatings	1.0 LS			15,000.00			15,000.00 /LS	15,000
22999 Plumbing										
22-05-00.00	BC-0001	Allowance - Piping, Building Service/Domestic	625.0 sf	-	-	10.00	-	-	10.00 /sf	6,250
		Plumbing	1,250.0 sf			5.00			5.00 /sf	6,250
23999 HVAC										
23-05-00.00	BC-0001	Allowance - HVAC	625.0 sqft	-	-	10.00	-	-	10.00 /sqft	6,250
		HVAC	1,250.0 sf			5.00			5.00 /sf	6,250
31240 Dewatering Systems										
01-54-33.70	1100	Rent wellpoint 25' long w/fittings & riser pipe 1-1/2" or 2" diameter	120.0 day	-	-	-	3.05	-	3.05 /day	366
01-54-33.70	0500	Rent wellpoint header pipe, 6" diameter, 400 gpm	30.0 day	-	-	-	0.45	-	0.45 /day	14
01-54-33.70	1300	Rent wellpoint pump, diesel, 30 HP, 6" suction	60.0 day	-	-	-	222.55	-	222.55 /day	13,353
01-54-33.70	0300	Rent 8" diam wellpoint discharge pipe	200.0 day	-	-	-	0.40	-	0.40 /day	80
31-23-19.40	0110	Wellpoints, single stage system, 0.75 labor hours per LF, installation and removal	30.0 hdr	59.69	-	-	-	-	59.69 /hdr	1,791



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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
31240 Dewatering Systems										
31-23-19.40	0410	Wellpoints, pump operation, 4 @ 6 hour shifts, per 24 hour day	7.5 day	2,324.66	-	-	-	-	2,324.66 /day	17,435
		Dewatering Systems	1.0 unit	19,419.81			13,952.02		33,371.83 /unit	33,038
31250 Shoring Systems										
31-41-16.10	1600	Sheet piling, steel, 27 psf, 20' excavation, per S.F., drive, extract and salvage, excludes wales	1,300.0 sf	25.37	14.06	-	14.98	-	54.41 /sf	70,730
31-41-16.10	2500	Sheet piling, wales, connections and struts, 2/3 salvage	1.3 ton	-	442.22	-	-	-	442.22 /ton	575
		Shoring Systems	1.0 LS	32,982.24	18,850.42		19,471.90		71,304.56 /LS	71,305
31999 Ex, Bed, Bkfl, Haul - Eff Cooling WW										
31-23-16.42	4400	Excavating, bulk bank measure, in sheeting or cofferdam, with all other equipment, minimum	350.0 bcy	8.95	-	-	8.92	-	17.86 /bcy	6,251
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	9.5 ecy	3.19	-	-	0.16	-	3.36 /ecy	32
31-23-23.16	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	22.5 lcy	13.44	25.42	-	2.12	-	40.98 /lcy	922
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	19.5 ecy	3.19	-	-	0.16	-	3.36 /ecy	65
31-23-23.14	5420	Backfill, structural, common earth, 300 H.P. dozer, 300' haul, from existing stockpile, excludes compaction	199.0 lcy	0.80	-	-	1.38	-	2.19 /lcy	435
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	175.0 ecy	3.19	-	-	0.16	-	3.36 /ecy	587
02-31-54.92	BC-0006	Loading Trucks, F.E. Loader, 3 C.Y.	243.5 cuyd	0.99	-	-	0.94	-	1.94 /cuyd	472
31-23-23.20	9498	Cycl hln(.load,trl,unld dump&rt) time per cycl,excv borw,loose cubic yards,25 min ld/w/,18 cy 8 wheel truck,cycle 20 miles,45 mph,exclld lng eqpmnt	243.5 lcy	4.19	-	-	4.45	-	8.63 /lcy	2,102
		Ex, Bed, Bkfl, Haul - Eff Cooling WW	1.0 LS	5,506.03	572.00		4,788.94		10,866.97 /LS	10,867
31999 10" EFF Cooling - Buried										
31-23-16.13	0510	Excavating, trench or continuous footing, common earth, 1 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	261.5 bcy	3.58	-	-	1.89	-	5.47 /bcy	1,431
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	21.0 ecy	3.19	-	-	0.16	-	3.36 /ecy	70
31-23-23.16	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	127.0 lcy	13.44	25.42	-	2.12	-	40.98 /lcy	5,205
31-23-23.23	7000	Compaction, around structures and trenches, 2 passes, 18" wide, 6" lifts, walk behind, vibrating plate	109.0 ecy	3.19	-	-	0.16	-	3.36 /ecy	366
31-23-23.13	2200	Backfill, trench, 6" to 12" lifts, dozer backfilling, compaction with vibrating roller	141.5 ecy	1.55	-	-	2.47	-	4.02 /ecy	569
02-31-54.92	BC-0006	Loading Trucks, F.E. Loader, 3 C.Y.	185.5 cuyd	0.99	-	-	0.94	-	1.94 /cuyd	360
31-23-23.20	9498	Cycl hln(.load,trl,unld dump&rt) time per cycl,excv borw,loose cubic yards,25 min ld/w/,18 cy 8 wheel truck,cycle 20 miles,45 mph,exclld lng eqpmnt	185.5 lcy	4.19	-	-	4.45	-	8.63 /lcy	1,601
33-11-13.15	2080	Water supply distribution piping,ductile iron pipe,cement lined,mechanical joint,fittings,18'lengths,10"diameter,class 50,excludes excavation backfill	625.0 lf	30.35	62.71	-	3.25	-	96.31 /lf	60,194

Post Point Biosolids Planning - Incineration Alternate

Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
31999 10" EFF Cooling - Buried										
33-11-13.15	8410	Water supply distribution piping,fitting,45 degree bend,ductile iron,cement lined,mechanical joint,awwa c110,10"diameter,class 50 water piping	4.0 ea	329.45	782.56	-	35.22	-	1,147.23 /ea	4,589
40-05-05.00	L179048 000000	Field Testing-Hydrotest-Non-Specific 10 Inch (250mm)	625.0 lf	3.89	-	-	-	-	3.89 /lf	2,431
		10" EFF Cooling - Buried	625.0 lf	43.13	72.89		6.89		122.91 /lf	76,816
40120 10" EFF Cooling -Exposed										
40-05-19.20	A151002 200000	Pipe Plain End-Ductile Iron--C-151 6 Inch (150mm)	485.2 lf	-	20.52	-	-	-	20.52 /lf	9,956
40-05-19.20	A152411 006200	Fitting Flanged & Bolted-Ductile Iron-ElI45-CIs 150 6 Inch (150mm)	6.0 ea	-	259.44	-	-	-	259.44 /ea	1,557
40-05-19.20	A152412 006200	Fitting Flanged & Bolted-Ductile Iron-ElI90-CIs 150 6 Inch (150mm)	10.0 ea	-	415.53	-	-	-	415.53 /ea	4,155
40-05-19.20	A152414 006200	Fitting Flanged & Bolted-Ductile Iron-Tee-CIs 150 6 Inch (150mm)	2.0 ea	-	504.15	-	-	-	504.15 /ea	1,008
40-05-05.00	L153466 010000	Pipe Erection-Handle Fittings-Metal-Std 6 Inch (150mm)	18.0 ea	63.31	-	-	-	-	63.31 /ea	1,140
09-91-06.41	BC-0001	Coatings & paints, B & C coating system E-1 (Epoxy, metal pipe)	785.4 sqft	0.90	0.83	-	-	-	1.72 /sqft	1,353
40-05-19.20	L154002 0000P1	Pipe Erection-Straight Run-Ductile Iron-Non-Specific 6 Inch (150mm)	500.0 lf	30.64	-	-	-	-	30.64 /lf	15,318
40-05-07.00	A156044 000000	Pipe Support 6 Inch (150mm)	12.0 ea	97.26	15.39	-	-	-	112.65 /ea	1,352
40-05-07.00	A156045 000000	Hanger Rod 6 Inch (150mm)	12.0 ea	29.18	76.95	-	-	-	106.13 /ea	1,274
40-05-07.00	A156043 000000	Hilti-Chemical Anchor - Pipe Support Size 6 Inch (150mm)	20.0 ea	19.45	25.65	-	-	-	45.10 /ea	902
40-05-05.00	L159048 000000	Field Testing-Hydrotest-Non-Specific 6 Inch (150mm)	500.0 lf	4.86	-	-	-	-	4.86 /lf	2,431
		10" EFF Cooling -Exposed	500.0 lf	43.00	37.89				80.89 /lf	40,445
46999 Pumps and Equipment										
46-06-00.00	----	Effluent pump	2.0 ea	2,776.63	40,000.00	-	202.37	-	42,979.00 /ea	85,958
40-05-89.13	----	Strainer, basket, auto, 6"	2.0 EA	961.52	14,000.00	-	102.00	-	15,063.52 /EA	30,127
46-06-16.00	BC-0126	Hypochlorite pmp,mtr.,pd type,3/4hp,dc drive w/cont.,bpv,prv,cal. col.	2.0 ea	1,514.40	6,669.00	-	-	-	8,183.40 /ea	16,367
		Pumps and Equipment	2.0 ea	5,252.55	60,669.00		304.37		66,225.91 /ea	132,452
		05 Effluent Cooling								505,612
06 Water Treatment										
03330 Slabs										
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	361.1 sy	1.35	-	-	0.63	-	1.98 /sy	715
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	120.4 cy	-	33.62	-	-	-	33.62 /cy	4,047
03-11-13.65	3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	230.0 sfca	6.03	0.97	-	-	-	7.00 /sfca	1,610
03-11-13.65	1000	C.I.P. concrete forms, slab on grade, bulkhead with keyway, wood, 6" high, 1 use, includes erecting, bracing, stripping and cleaning	50.0 lf	5.14	1.14	-	-	-	6.28 /lf	314
03-11-13.65	2050	C.I.P. concrete forms, slab on grade, curb, wood, 6" to 12" high, 2 use, includes erecting, bracing, stripping and cleaning	56.0 sfca	10.49	1.71	-	-	-	12.20 /sfca	683

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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
03330 Slabs										
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	18.1 ton	1,488.12	1,108.00	-	-	-	2,596.12 /ton	46,876
03-21-10.60	0610	Reinforcing in place, A615 Gr 60, slab on grade, #3 to #7	237.0 lb	0.74	0.53	-	-	-	1.28 /lb	303
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	18.2 ton	57.80	-	-	6.02	-	63.82 /ton	1,160
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	18.2 ton	62.82	-	-	6.55	-	69.37 /ton	1,261
03-31-05.35	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	251.6 cy	-	135.00	-	-	-	135.00 /cy	33,966
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	251.6 cy	22.92	-	-	0.32	-	23.23 /cy	5,846
03-35-29.30	0150	Concrete finishing, floors, monolithic, screed, float and broom finish	3,250.0 sf	1.08	-	-	-	-	1.08 /sf	3,497
03-39-13.50	0300	Curing, sprayed membrane curing compound	32.5 csf	12.85	12.47	-	-	-	25.32 /csf	823
03-15-05.25	5500	Sawcut control joints, slab on grade	325.0 lf	0.80	0.52	-	0.27	-	1.58 /lf	513
		Slabs	246.7 cy	169.85	239.57		2.53		411.95 /cy	101,613
09999 Coatings										
09-00-00.01	BC-0001	Finishes allowance	1.0 ls	-	-	5,000.00	-	-	5,000.00 /ls	5,000
		Coatings	1.0 LS			5,000.00			5,000.00 /LS	5,000
40500 RO Piping										
40-05-31.13	----	Misc. process piping, RO/IE, allowance	1.0 ls	75,000.00	75,000.00	-	-	-	150,000.00 /ls	150,000
		RO Piping	1.0 LS	75,000.00	75,000.00				150,000.00 /LS	150,000
46999 Reverse Osmosis System										
22-31-16.10	----	Reverse Osmosis, Ion Exchange water treatment system, membrane skids, high press pump, instruments/controls	1.0 ls	18,655.80	1,600,000.00	-	1,700.00	-	1,620,355.80 /ls	1,620,356
46-06-18.00	BC-0066	Pumps, gen util, W/mot, mtd on base, sgl stage, 40 HP to 1500 GPM, backwash pump	2.0 ea	11,834.10	25,000.00	-	1,045.50	-	37,879.60 /ea	75,759
22-15-19.10	6080	Compressor,air,reciprocating,tank mounted,pressure lubricated,duplex, HD,2 stage,3 phase,capacity rated 175 psig,34.8 scfm,10 hp, 120 gallon tank	1.0 ea	4,736.40	25,000.00	-	442.00	-	30,178.40 /ea	30,178
46-06-00.00	BC-0106	Tanks, steel, supply, backwash	3.0 ea	3,122.42	25,000.00	-	441.87	-	28,564.29 /ea	85,693
46-06-16.00	BC-0136	Chemical metering pmp,mtr,pd type,3/4hp,dc drive w/cont.,bpv,prv,cal. col.	2.0 ea	1,399.02	7,695.00	-	-	-	9,094.02 /ea	18,188
46-06-00.00	BC-0211	Inline mixer, static	1.0 ea	243.46	1,267.62	-	-	-	1,511.08 /ea	1,511
46-06-12.00	BC-0046	XLHDPE tank, antiscalant,2500gal, insul/ht tr.24"my, 4" v, 3"n, 2 n	1.0 ea	929.59	7,182.00	-	-	-	8,111.59 /ea	8,112
		Reverse Osmosis System	1.0 LS	60,398.75	1,773,839.62		5,558.60		1,839,796.97 /LS	1,839,797
		06 Water Treatment								2,096,410
32 Process Equipment										
26131 MV Switchgear										
26-13-00.00	----	13.2kv switchgear, allowance	1.0 ls	30,000.00	600,000.00	-	-	-	630,000.00 /ls	630,000
		MV Switchgear	1.0 LS	30,000.00	600,000.00				630,000.00 /LS	630,000
40180 Condenser Piping										
40-05-24.10	----	Misc. process piping, condenser piping, allowance	1.0 ls	20,000.00	30,000.00	-	-	-	50,000.00 /ls	50,000
		Condenser Piping	1.0 LS	20,000.00	30,000.00				50,000.00 /LS	50,000



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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
46999 Steam Turbine Generator										
46-06-00.00	----	Misc. process equipment, steam turbine generator, 7,000 lb/hr, 520kw, 4.16kv	1.0 ea	52,061.82	1,085,000.00	-	3,794.40	5,000.00	1,145,856.22 /ea	1,145,856
23-65-00.00	----	Misc. process equipment, condenser and recirc pump, allowance	1.0 ea	13,473.19	175,000.00	-	530.91	-	189,004.10 /ea	189,004
23-65-00.00	----	Misc. process equipment, auxillary condenser, allowance	1.0 ea	4,230.45	50,000.00	-	316.20	-	54,546.65 /ea	54,547
		Steam Turbine Generator	1.0 LS	69,765.46	1,310,000.00		4,641.51	5,000.00	1,389,406.97 /LS	1,389,407
		32 Process Equipment								2,069,407
		16 Steam Turbine Generator								5,291,567
17 ID Fan										
32 Process Equipment										
46999 ID Fan										
46-06-00.00	----	Misc. process equipment, induced draft fan, 300hp	2.0 ea	5,311.97	104,212.00	-	210.00	-	109,733.96 /ea	219,468
		ID Fan	2.0 ea	5,311.97	104,212.00		210.00		109,733.96 /ea	219,468
		32 Process Equipment								219,468
		17 ID Fan								219,468
18 Site Remediation										
01 Sitework Improvements										
31999 Site Remediation										
31-00-00.05	BC-0001	Allowance - Site Work	1.0 ls	-	-	2,000,000.00	-	-	2,000,000.00 /ls	2,000,000
		Site Remediation	1.0 LS			2,000,000.00			2,000,000.00 /LS	2,000,000
		01 Sitework Improvements								2,000,000
		18 Site Remediation								2,000,000
19 Integrated Maintenance Building										
31 Building										
13999 Integrated Maintenance Building										
13-13-03.00	BC-0006	Administration/Laboratory/Maintenance Building, allowance	37,660.0 sqft	50.00	200.00	-	40.00	-	290.00 /sqft	10,921,400
22-05-00.00	BC-0001	Allowance - Piping, Building Service/Domestic	37,660.0 sqft	-	-	8.00	-	-	8.00 /sqft	301,280
23-05-00.00	BC-0001	Allowance - HVAC	37,660.0 sqft	-	-	12.00	-	-	12.00 /sqft	451,920
		Integrated Maintenance Building	37,660.0 sf	50.00	200.00	20.00	40.00		310.00 /sf	11,674,600
		31 Building								11,674,600
		19 Integrated Maintenance Building								11,674,600
20 Demo Admin/Shop/Storage Buildings										
34 Demolition Building										
02220 Building Gross Demolition										
02-41-16.13	0650	Building demolition, small buildings single buildings, masonry, elevated slabs, includes 20 mile haul, excludes salvage, foundation demolition dump fees	246,000.0 cf	0.27	-	-	0.16	-	0.43 /cf	106,227
02-41-16.13	0500	Building demolition, small buildings or single buildings, steel, includes 20 mile haul, excludes salvage, foundation demolition or dump fees	277,000.0 cf	0.27	-	-	0.16	-	0.43 /cf	119,613
02-41-16.13	0700	Building demolition, small buildings single buildings, wood, elevated slabs, includes 20 mile haul, excludes salvage, foundation demolition dump fees	57,000.0 cf	0.27	-	-	0.16	-	0.43 /cf	24,614
02-22-03.30	BC-0006	Dump Charge, typical urban city, fees only, bldg constr mat'ls	1,626.0 ton	-	-	-	-	33.00	33.00 /ton	53,658
02-41-13.23	----	Remove buried utilities, allowance	1.0 ls	16,770.00	-	-	15,000.00	-	31,770.00 /ls	31,770



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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
02220 Building Gross Demolition										
02-41-13.62	0400	Selective demolition, chain link fences & gates, gates, 20' width	5.0 ea	200.64	-	-	31.86	-	232.51 /ea	1,163
02-41-13.60	1700	Fencing demolition, remove chain link posts & fabric, 8' to 10' high	1,500.0 lf	4.51	-	-	0.72	-	5.23 /lf	7,837
02-41-16.17	0440	Building footings and foundations demolition, floors, concrete slab grade, concrete, rod reinforced, 6" thick, excludes disposal costs and dump fees	39,000.0 sf	0.44	-	-	0.56	-	0.99 /sf	38,715
02-41-16.17	1120	Building footings and foundations demolition, remove concrete footing, 1'-6" thick, 3' wide, excludes disposal costs and dump fees	2,700.0 lf	7.89	-	-	9.98	-	17.87 /lf	48,253
02-41-16.17	2500	Building footings and foundations demolition, remove concrete walls, plain concrete, 12" thick, excludes disposal costs and dump fees	8,100.0 sf	0.63	-	-	0.80	-	1.43 /sf	11,581
		Building Gross Demolition	580,000.0 cf	0.39			0.28	0.09	0.77 /cf	443,430
		34 Demolition Building								443,430
		20 Demo Admin/Shop/Storage Buildings								443,430
21 Odor Control										
24 Odor Control Equipment										
03330 Slabs (On Grade & Mat)										
31-22-16.10	1100	Fine grading, fine grade for slab on grade, machine	111.1 sy	1.35	-	-	0.63	-	1.98 /sy	220
03-05-13.25	1050	Aggregate, stone, 3/4" to 1-1/2", prices per C.Y., includes material only	37.0 cy	-	35.03	-	-	-	35.03 /cy	1,297
03-11-13.65	3050	C.I.P. concrete forms, slab on grade, edge, wood, 7" to 12" high, 4 use, includes erecting, bracing, stripping and cleaning	130.0 sfca	6.03	0.96	-	-	-	6.99 /sfca	909
03-21-10.60	0600	Reinforcing steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4.1 ton	1,488.12	1,108.00	-	-	-	2,596.12 /ton	10,577
03-21-10.60	2005	Reinforcing in place, unloading & sorting, add to above - slabs	4.1 ton	57.80	-	-	6.02	-	63.82 /ton	260
03-21-10.60	2215	Reinforcing in place, crane cost for handling, add to above, slabs	4.1 ton	62.82	-	-	6.55	-	69.37 /ton	283
03-31-05.35	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	75.6 cy	-	135.00	-	-	-	135.00 /cy	10,200
03-31-05.70	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes vibrating, excludes material	75.6 cy	22.92	-	-	0.32	-	23.23 /cy	1,755
03-35-29.30	0150	Concrete finishing, floors, monolithic, screed, float and broom finish	1,000.0 sf	1.08	-	-	-	-	1.08 /sf	1,076
03-39-13.50	0300	Curing, sprayed membrane curing compound	10.0 csf	12.85	12.47	-	-	-	25.32 /csf	253
		Slabs (On Grade & Mat)	222.2 cy	46.91	73.17		0.65		120.74 /cy	26,830
40555 Odor Control Ductwork										
40-05-36.00	----	Process ductwork, allowance	1.0 ls	100,000.00	100,000.00	-	-	-	200,000.00 /ls	200,000
		Odor Control Ductwork	1.0 LS	100,000.00	100,000.00				200,000.00 /LS	200,000
46999 Odor Control Equipment										
46-06-00.00	----	Odor control, chemical air scrubbers for GBT area, allowance	1.0 ls	39,030.30	800,000.00	-	5,523.32	-	844,553.62 /ls	844,554
46-06-00.00	----	Odor control, activated carbon towers for centrifuge area, allowance	1.0 ls	24,979.39	400,000.00	-	3,534.92	-	428,514.31 /ls	428,514
		Odor Control Equipment	1.0 LS	64,009.69	1,200,000.00		9,058.24		1,273,067.93 /LS	1,273,068
		24 Odor Control Equipment								1,499,898



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Phase	Item	Estimate Breakdown	Quantity	Labor Cost/Unit	Material Cost/Unit	Sub Cost/Unit	Equip Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Net Amount
		21 Odor Control								1,499,898
		22 Gut Solids Handling Building								
		33 Demolition Process								
		02228 Selective Demolition - MP&E								
	02-22-04.50	---- Gut interior process equipment, piping, electrical, misc ancillary	1.0 ls	50,200.00		-	50,000.00	-	100,200.00 /ls	100,200
	02-22-03.30	BC-0006 Dump Charge, typical urban city, fees only, bldg constr mat'ls	100.0 ton	-	-	-	-	33.00	33.00 /ton	3,300
	31-23-23.19	BC-0001 Loading Trucks, Skip Box & 25T Cherry Picker	200.0 ea	26.83	-	-	21.59	-	48.43 /ea	9,685
	31-23-23.20	3498 Cycle hlng(,load,travel,unload dump&retrn) time per cycle,excvtld borrow,loose cubic yards,25 min ld/wt/,16.5 truck,cycle 20 miles,45 mph,loadng eqpmnt	200.0 lcy	4.55	-	-	4.17	-	8.72 /lcy	1,744
		Selective Demolition - MP&E	1.0 LS	56,477.31			55,152.50	3,300.00	114,929.81 /LS	114,930
		33 Demolition Process								114,930
		22 Gut Solids Handling Building								114,930
		01 Total								71,258,082

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Estimate Totals

Description	Rate	Hours	Amount	Totals
Labor		38,241 hrs	7,075,597	
Material			41,466,549	
Subcontract			20,221,665	
Equipment		9,947 hrs	2,432,313	
Other			61,958	
			71,258,082	71,258,082
Labor Mark-up	15.000 %		1,061,340	
Material Mark-up	10.000 %		4,146,655	
Subcontractor Mark-up	5.000 %		1,011,083	
Construction Equipment Mark-up	10.000 %		243,231	
Material Shipping & Handling	2.000 %		829,331	
Net Markups			7,291,640	78,549,722
Contractor General Conditions	15.000 %		11,782,458	
			11,782,458	90,332,180
Start-Up, Training, O&M	2.000 %		1,806,644	
			1,806,644	92,138,824
Undesign/Undevelop Contingency	30.000 %		27,641,647	
			27,641,647	119,780,471
Bldg Risk, Liability Auto Ins	2.000 %		2,395,609	
			2,395,609	122,176,080
Payment and Performance Bonds	1.500 %		1,832,641	
			1,832,641	124,008,721
Escalation to Midpoint (ALL)	19.400 %		24,057,692	
			24,057,692	148,066,413
Gross Receipts Tax	8.700 %		12,881,778	
Gross Markups			12,881,778	160,948,191
Total				160,948,191