FINAL
BASIS OF DESIGN
REPORT

Lee County Utilities

THREE OAKS

WASTEWATER TREATMENT PLANT

December 2013

CDM Smith

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Section 1
Background

The Lee County Utilities (LCU) owns and operates the Three Oaks Wastewater Treatment Plant (WWTP), which has a permitted treatment capacity of 6 million gallons per day (MGD) annual average daily flow (ADF). The current process train consists of screening and grit removal, odor control, biological treatment with nitrogen removal using simultaneous nitrification/denitrification (SND) in three extended aeration oxidation ditches with brush aerators, two center feed clarifiers, four peripheral feed clarifiers, deep bed filters, and chlorine contact tanks. Biosolids are held in aerobic storage tanks and dewatered with a belt filter press for composting at the county landfill. The facility is permitted to discharge treated effluent to an unrestricted public access reuse system and the deep injection well(s).

The last major facility expansion/upgrade was constructed in 2008 to increase the wastewater treatment capacity from 3 to 6 MGD ADF by implementing the following improvements:

- A new headworks structure with automated screening, grit removal, and odor control facilities for a future capacity of 9 MGD ADF.
- A new 50 horsepower (HP) brush aerator to Oxidation Ditch 3.
- Two new 85-foot diameter center feed secondary clarifiers.
- New deep bed filters.
- New chlorine contact basins.
- New biosolids thickening and dewatering system.
- New deep injection well system.
- Additional standby electrical generator.
- New electrical building.
- Replacement of the sodium hypochlorite system.
- Conversion of two reuse storage tanks to reject storage tanks.

LCU issued a request for proposals to address concerns over oxidation ditch capacity due to the inability to maintain dissolved oxygen (DO) in the ditches. It is believed that the plant mass loadings have increased due to higher strength influent wastewater. CDM Smith was retained by LCU to evaluate the facility to determine the current facility treatment capacity and to evaluate improvements needed, if any, to maintain the 6 MGD ADF permitted capacity and determine requirements for a future expansion to 9 MGD ADF. The future requirement of 9 MGD ADF was decreased to 8 MGD ADF based on several workshops with LCU staff.

Three workshops with LCU staff have been held to date. The first workshop was held on July 8, 2013, and discussed the project scope, schedule and facility operations. The second workshop, which was held on August 30, 2013, disclosed the findings of the facility flows and load evaluation and discussed current constraints to meet a permitted design capacity of 6 MGD ADF. The major conclusions from Workshop No.2 are summarized below:

- Projected facility mass loadings at 6 MGD ADF have increased 40% for biochemical oxygen demand (BOD_5) and over 140% for total Kjeldahl nitrogen (TKN) at average conditions from what was established in the 2005 Preliminary Engineering Report.
- The current permitted capacity of the plant is 6 MGD ADF. However, CDM Smith has stated that the biological process units are limited to less than 4 MGD ADF capacity utilizing both 85-foot diameter center feed clarifiers and replacing the peripheral feed clarifiers with a third 85-foot diameter center feed clarifier. The peripheral feed clarifiers are being replaced due to the age of the units and the difficulty to operate them when they are on-line.
- A new 2 MGD ADF biological process train consisting of a 1.5 million gallon (MG) oxidation ditch and two new 85 foot diameter clarifiers are needed to maintain the current permitted treatment capacity of 6 MGD ADF.
- Preliminary evaluations performed by CDM Smith indicated that the Three Oaks WWTP can only be expanded to 8 MGD ADF, without changing treatment technology, because of existing site limitations.
- Due to site limitations, the existing site will not be able to accommodate build-out conditions or even to accommodate the 2030 population projections for the Three Oaks Service Area unless a change is made to the treatment technology used at the facility.
- Based on the Integrated Water Resource Master Plan (IWRMP), completed by others for LCU, the 2030 projections require an expansion of 8.38 MGD. Additional expansion will also be required to serve the area east of I-75 between Alico Road and the RSW International Airport, part of what is known as the Diamond District. Part of the Diamond District area currently falls within the Three Oaks Service Area, but the IWRMP excluded it from the year 2030 projections.

LCU staff met after the meeting to discuss the findings presented in Workshop No.2. The following decisions were made:

- The scope of work moving forward would be to plan on expanding the plant to 8 MGD ADF using the current extended aeration process (i.e., simultaneous nitrification and denitrification using oxidation ditches).
- LCU will internally review the sewer service areas to balance the Three Oaks Sewer Service Area built-out conditions with the future ultimate plant capacity of 8 MGD ADF. Certain areas such as the Diamond District will need to be shifted to other sewer service areas.
- CDM Smith will continue with the evaluation and recommendations to bring the plant to the current permitted capacity. The proposed recommendations must be compatible with the ultimate 8 MGD ADF expansion.

- CDM Smith will provide options using the extended aeration process with or without a new flow equalization tank.
- The master plan effort will use CDM Smith's recommended design criteria of a mixed liquor suspended solids (MLSS) concentration of 4,500 mg/L and a total system solids retention time (SRT) of 12 days at maximum month loading conditions.
- CDM Smith is to provide recommendations to reduce the wave action on the existing oxidation ditches. This entails working with the brush aerator manufacturer to identify solutions.
- CDM Smith will evaluate the current submergence, based on actual survey, and compare it to the recommended maximum submergence of 14-inch for Oxidation Ditches 1 and 2 and 12-inch for Oxidation Ditch 3.
- Based on the current flow trends, time is of the essence to bring the treatment process to 6 MGD ADF.
- The design and construction budget for addressing capacity needs for 6 MGD ADF needs to be evaluated to ensure there are adequate funds allocated for the project and to be assigned for fiscal years (FY) 2013/2014 and 2014/2015, respectively.

The third workshop, held on October 16, 2013, discussed the evaluation of the treatment alternatives to bring the plant to the current permitted capacity and recommend the proposed recommendations for the ultimate 8 MGD ADF expansion.

The major conclusions from Workshop No.3 are summarized below:

- Development of the Basis of Design Report will not include the use of flow equalization.
- Supplemental aeration in the existing ditches will be done by providing new brush aerators and upsizing some of the existing brush aerator motors. Use of this technology was LCU's preference but may be reconsidered if the wave action in the existing oxidation ditches is not remedied.

Section 2

Permit Requirements

The Three Oaks WWTP operates under Permit Number FLA145190-026. The permit was issued on June 22, 2012 and expires on June 21, 2017. **Table 2-1** summarizes the permit requirements for underground injection and for reuse and land application.

Table 2-1 Permit Requirements

Parameter	Effluent Limits			
	Underground Injection		Reuse and Land Application	
Flow	Max	6 MGD, Annual Average	Max	6 MGD, Annual Average
	Max	Report, Monthly Average	Max	Report, Monthly Average
$CBOD_5$	Max	20 mg/L, Annual Average	Max	20 mg/L, Annual Average
	Max	30 mg/L, Monthly Average	Max	30 mg/L, Monthly Average
	Max	45 mg/L, Weekly Average	Max	45 mg/L, Weekly Average
	Max	60 mg/L, Single Sample	Max	60 mg/L, Single Sample
TSS	Max	20 mg/L, Annual Average	Max	5 mg/L, Single Sample
	Max	30 mg/L, Monthly Average		
	Max	45 mg/L, Weekly Average		
	Max	60 mg/L, Single Sample		
pH	Min	6.0, Single Sample	Min	6.0, Single Sample
	Max	8.5, Single Sample	Max	8.5, Single Sample
Fecal Coliform	-	-	Max	25, #/100 mL, Single Sample
Fecal Coliform, % Less Than Detection	-	-	Min	75 percent, Monthly Total
Total Chlorine Residual	-	-	Min	1.0 mg/L, Single Sample

Section 3

Development of Flows and Loads

3.1 Methodology

LCU provided three years of operating data and discharge monitoring reports (DMRs) for the Three Oaks WWTP. Data for the period from January 1, 2010 through December 31, 2012, were evaluated to determine the updated influent flows and loads. The facility is required to report measurements taken in 24-hour influent composite samples collected during week days. Analysis of historical daily plant influent data was performed for flow, carbonaceous biochemical oxygen demand ($CBOD_5$), total suspended solids (TSS), TKN, and total phosphorus (TP).

A key step in influent data analysis is to develop mass loadings and mass loading peaking factors to account for changes in concentration during peak flow events. The mass loading peaking factors are applied along with flow peaking factors to develop design concentrations for each constituent at each flow condition. The procedure outlined below accounts for the dilution in concentration or increase in loading of some parameters during peak flow conditions that may occur during wet weather:

- Determine average day (AD) mass loads.

  The daily mass loads for the influent parameters listed were calculated using the following equation:

$$T = Q \times C \times K$$

  where:

  T = mass load (lb/day)

  Q = Flow (MGD)

  C = Concentration (mg/L)

  K = Conversion constant, 8.34

- Determine 30-day moving averages for flows and mass loadings.

  The 30-day moving averages were calculated for flow and mass loading of each parameter.

- Determine average day maximum month (ADMM) loading peaking factors.

  The 95th percentile of the 30-day moving average mass load was divided by the average of the daily mass load to determine the ADMM peaking factor.

- Determine maximum day (MD) loading peaking factors.

  The 95th percentile of daily mass load was divided by the average of the daily mass load to determine the MD peaking factor.

- Calculate design ADMM and MD concentrations.

  Using the design average daily mass loads along with the mass loading peaking factors developed previously, the ADMM and MD concentrations were developed by dividing the mass loading at each flow condition by the historical flow at that condition. This provides a concentration that may be used with projected flows at each condition to project future loadings.

- Calculate ADMM and MD flow peaking factors.

  ADMM flow peaking factors were taken from the 30-day moving average of the daily flows. The MD flow peaking factor used the maximum day flow of the data set and divided by the average daily flow of the data set.

3.2 Present Influent Flows and Loads

Table 3-1 summarizes the influent data, peaking factors, and concentrations developed according to the above procedure for the Three Oaks WWTP. The facility reports $CBOD_5$ measurements with the addition of a nitrification inhibitor. Therefore, the inhibited influent $CBOD_5$ measurements were divided by 0.84 to estimate uninhibited influent BOD_5 concentrations presented below.

Comparison of the current influent BOD_5, TSS, and TKN concentrations to what was used in the October 2005 Preliminary Engineering Report, indicates that the waste strength has increased significantly. Note that the maximum day values could not be compared as this parameter was not available in the 2005 Preliminary Engineering Report.

Table 3-1 Present Influent Peaking Factors, Flows, and Loads

Parameter		Peaking Factors		
		AD	ADMM	MD
Flow		1.00	1.20	1.50
BOD_5 mass load		1.00	1.43	1.50
TSS mass load		1.00	1.49	1.57
TKN mass load		1.00	1.40	1.50
TP mass load		1.00	1.40	1.50
Parameter	Unit	Influent Flows and Loads at Current Operating Conditions		
		AD	ADMM	MD
Flow	MGD	2.72	3.26	4.07
BOD_5	mg/L	229	274	229
	lb/day	5,198	7,441	7,788
TSS	mg/L	231	287	242
	lb/day	5,233	7,814	8,210
TKN	mg/L	49	57	49
	lb/day	1,104	1,545	1,656
TP	mg/L	5.8	6.8	5.8
	lb/day	132	185	198
Parameter	Unit	Influent Flows and Loads at 6 MGD ADF Treatment Capacity		
		AD	ADMM	MD
Flow	MGD	6.0	7.2	9.0

Parameter		Peaking Factors		
BOD_5	mg/L	229	274	229
	lb/day	11,483	16,807	18,351
TSS	mg/L	231	287	242
	lb/day	11,560	17,650	19,346
TKN	mg/L	49	57	49
	lb/day	2,438	3,414	3,658
TP	mg/L	5.8	6.8	5.8
	lb/day	292	409	438
Parameter	Unit	Influent Flows and Loads at 8 MGD ADF Treatment Capacity		
		AD	ADMM	MD
Flow	MGD	8.0	9.6	12.0
BOD_5	mg/L	229	274	229
	lb/day	15,311	21,918	22,940
TSS	mg/L	231	287	242
	lb/day	15,413	23,017	24,184
TKN	mg/L	49	57	49
	lb/day	3,251	4,552	4,877
TP	mg/L	5.8	6.8	5.8
	lb/day	390	546	585

Table 3-2 shows the relative increase in waste strength at the varying design conditions. This is likely a result of a decrease in infiltration and inflow (I/I) from an expanding collection system that is new and tight. The decreased I/I would concentrate the waste stream yielding higher concentrations.

Table 3-2 Change in Influent Concentrations from 2005 Preliminary Engineering Report

Parameter	Change		
	AD	ADMM	MD
$CBOD_5$ mass load	41% (increased)	61% (increased)	Unknown
TSS mass load	13% (increased)	35% (increased)	Unknown
TKN mass load	144% (increased)	173% (increased)	Unknown

3.3 Evaluation of Peak Hour Flows

CDM Smith evaluated the Three Oaks WWTP influent flow measurements from January 1, 2010 through December 31, 2012, and determined the days the facility received higher daily flows in an attempt to determine a PHF peaking factor. CDM Smith requested the hourly flow readings for the selected 16 days and calculated the ratios of the maximum hourly flow to ADF calculated for the same year. **Table 3-3** presents the results of the evaluation and indicates that that the highest PHF/ADF ratio occurred in the last three years was 2.60.

Table 3-3 PHF Peaking Ratio Estimates from the Three Oaks WWTP Historical Flows

Date	PHF (MGD)	ADF (MGD)	PHF/ADF
7/4/2010	6.055	2.588	2.34
7/5/2010	6.140	2.588	2.37
1/22/2011	6.483	2.832	2.29
2/19/2011	7.377	2.832	**2.60**
2/20/2011	6.486	2.832	2.29
3/20/2011	6.466	2.832	2.28
4/7/2011	6.958	2.832	2.46
10/18/2011	6.552	2.832	2.31
10/19/2011	6.457	2.832	2.28
10/23/2011	6.998	2.832	2.47
10/29/2011	7.302	2.832	**2.58**
4/7/2012	5.874	2.727	2.15
7/7/2012	5.111	2.727	1.87
7/15/2012	4.899	2.727	1.80
10/2/2012	6.042	2.727	2.22
12/9/2012	5.351	2.727	1.96

DMRs were pulled from the FDEP for August 2008 to coincide with Tropical Storm Faye. Maximum daily flows were approximately 5 MGD during the storm event, which indicates that instantaneous peak hour peaking factors might be higher than the 2.60 peaking factor generated from the 2010-2012 data set. In order to further verify the PHF peaking factor, the number of users in the collection system is considered when developing PHFs when there is not sufficient plant flow data available.

The LCU IWRMP, prepared by AECOM (dated December 2010) used 98 gallons per capita per day (gpcd) for the future wastewater flow projections. **Table 3-4** summarizes the service population estimates based on plant flows and 98 gpcd.

Table 3-4 PHF Peaking Ratio Estimates Based on Service Area Population

	ADF (MGD)	Service Population[1]	PHF/ADF Peaking Factor	Proposed PHF/ADF Peaking Factor
Current	2.72	27,755	3.0	---
Permitted Treatment Capacity	6.0	61,224	2.9	3.0
Future	9.0	91,837	2.75	2.75

[1] Service populations were estimated based on 98 (gpcd) as used in the LCU IWRMP, dated December 2010.

Peak hour to average day flow peaking factor was estimated using a PHF peaking factor curve presented in Wastewater Engineering Treatment and Reuse (Metcalf & Eddy, Fourth Edition, 2004). The PHF peaking factor shows that the PHF/ADF ratio decreases as the service population grows. A PHF peaking factor of 2.9 was determined. The 2005 PER established the PHF to ADF peaking ratio as 3.0. Therefore, CDM Smith recommends a PHF peaking factor of 3 at 6 MGD ADF treatment capacity as a more conservative approach.

A PHF peaking factor of 2.75 was estimated for the 8 MGD ADF future treatment capacity. Although this is a larger peaking ratio than 2.5 proposed by the October 2005 PER, CDM Smith believes that this is in-line with other facilities this size and should be used for evaluating the facility at a future treatment capacity of 8 MGD.

Section 4

Process/Mechanical Basis of Design

4.1 Proposed Improvements

CDM Smith conducted a treatment process evaluation to determine the capacity of the Three Oaks WWTP from a mechanical, hydraulic, and biological treatment perspective at the 6 MGD ADF and 8 MGD ADF capacities. CDM Smith identified the improvements required to bring the Three Oaks WWTP capacity to 6 MGD ADF and 8 MGD ADF in two phases. The improvements identified for 6 MGD ADF will be implemented in the current phase while the 8 MGD ADF improvements will be implemented in the future phase.

The main process modifications proposed for the current 6 MGD ADF improvements are summarized as follows:

- Modification of existing headworks to provide flow splitting for the proposed Oxidation Ditch 4 (for the current improvement) and Oxidation Ditch 5 (for the future improvements).
- Addition of a new 30 HP brush aerator for each Oxidation Ditch 1 and 2.
- Upsizing the existing 50 HP brush aerator motors to 60 HP for all four brush aerators in Oxidation Ditch 3.
- Addition of Oxidation Ditch 4 with 2 MGD ADF treatment capacity along with two new 85-foot diameter secondary clarifiers and associated RAS/WAS pumps.
- Addition of a third 85-ft diameter secondary clarifier for the existing activated sludge train consisting of Oxidation Ditches 1, 2, and 3.
- Addition of a new RAS pump station with two RAS pumps for the existing activated sludge train.
- Addition of a second belt filter press, solids feed pump, cake pumps, and polymer storage and feed system.

The main process modifications proposed for the future 8 MGD ADF improvements are summarized as follows:

- Addition of Oxidation Ditch 5 with 2 MGD ADF treatment capacity.
- Addition of an 85-foot diameter secondary clarifier with two RAS pumps.
- Addition of a deep bed filter unit.
- Addition of a chlorine contact tank.
- Addition of filter feed pump.
- Addition of a transfer pump.

Figure 4-1, **Figure 4-2**, and **Figure 4-3** present the Three Oaks WWTP process flow diagrams (PFDs) for the existing, 6 MGD ADF improvements, and 8 MGD ADF improvements with the proposed improvements, respectively.

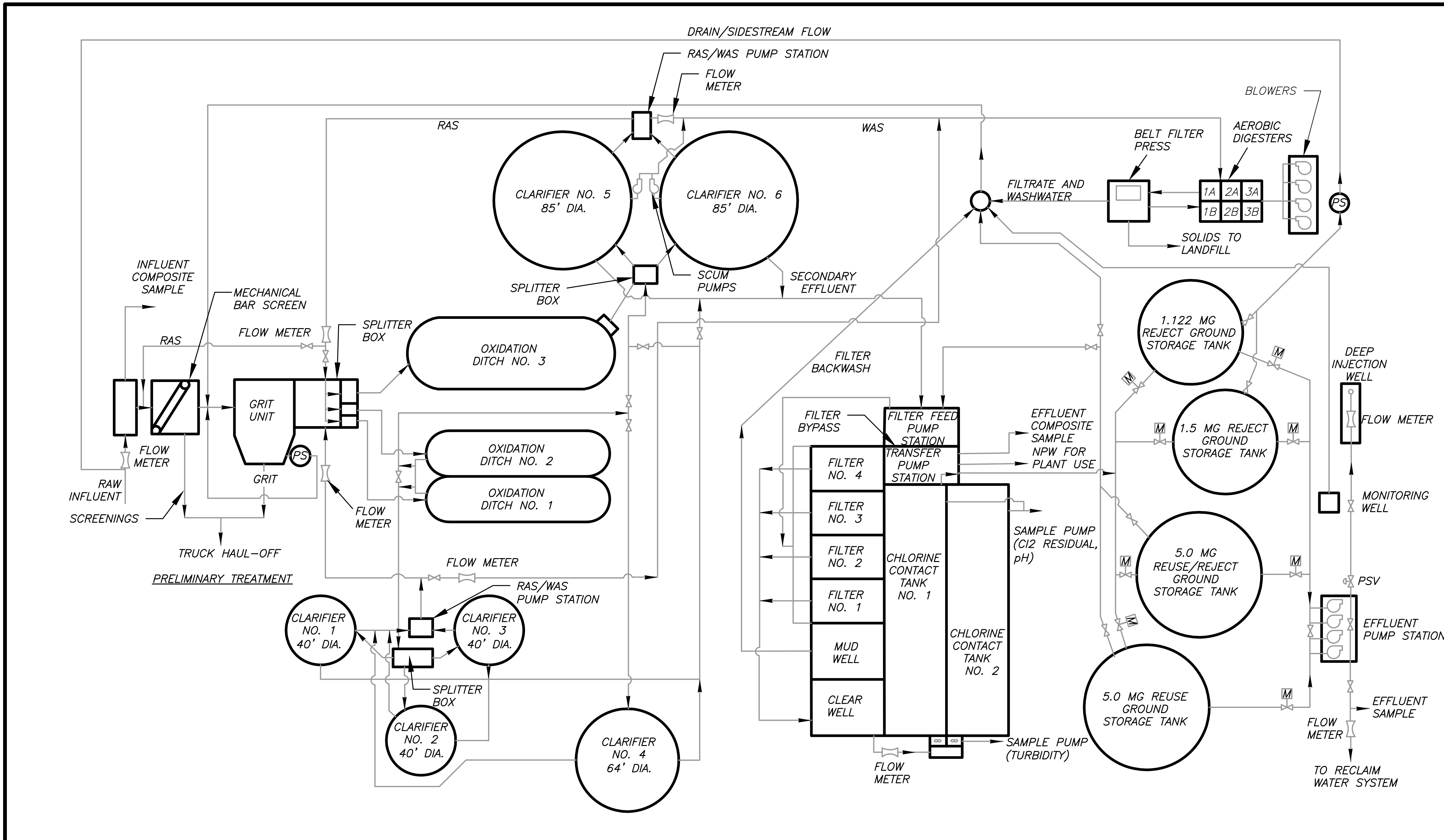

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FIGURE NO. 4-1
EXISTING PROCESS FLOW DIAGRAM
DECEMBER 2013

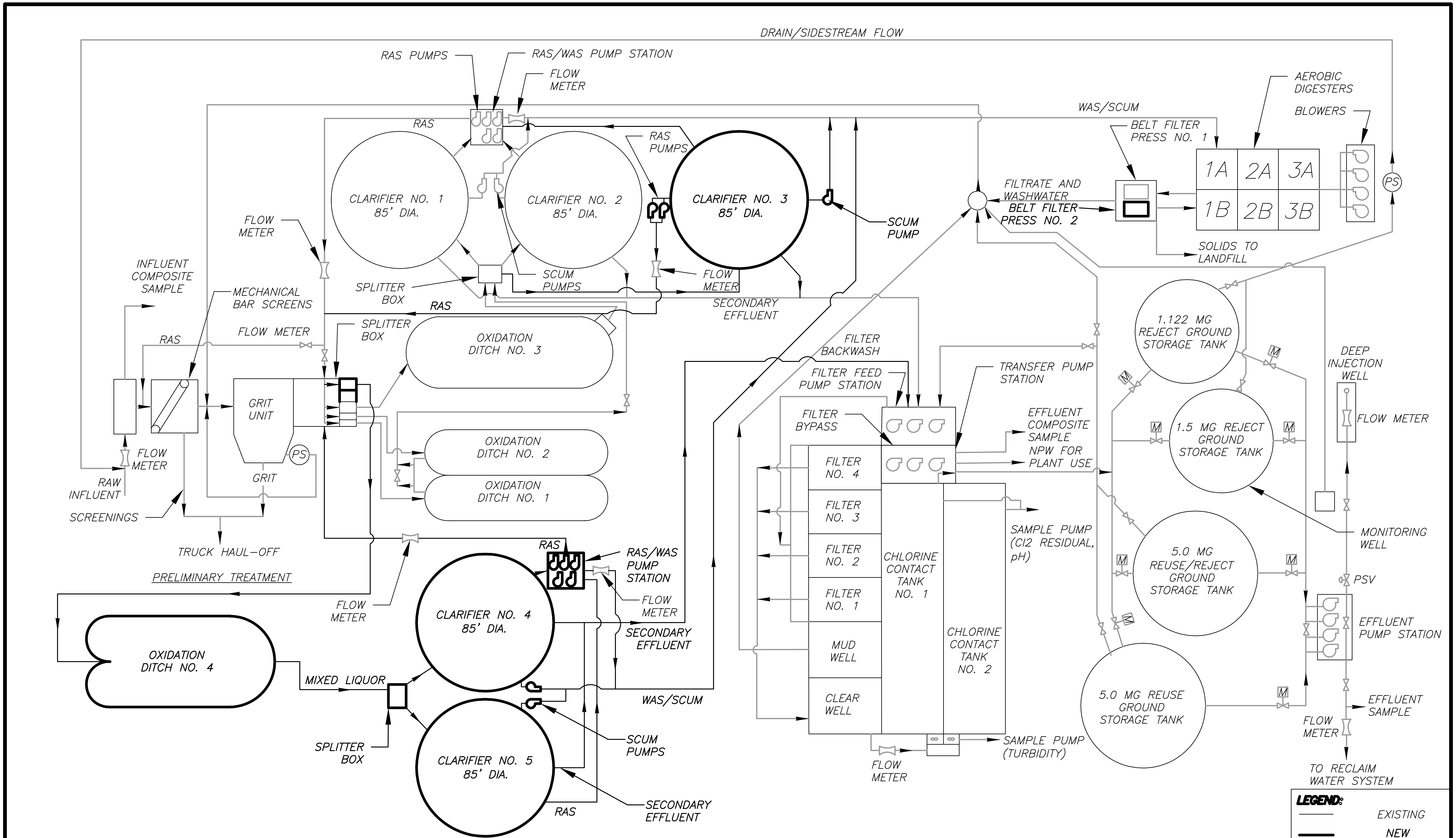

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FIGURE NO. 4-2
THE CURRENT 6 MGD ADF EXPANSION PROCESS FLOW DIAGRAM
DECEMBER 2013

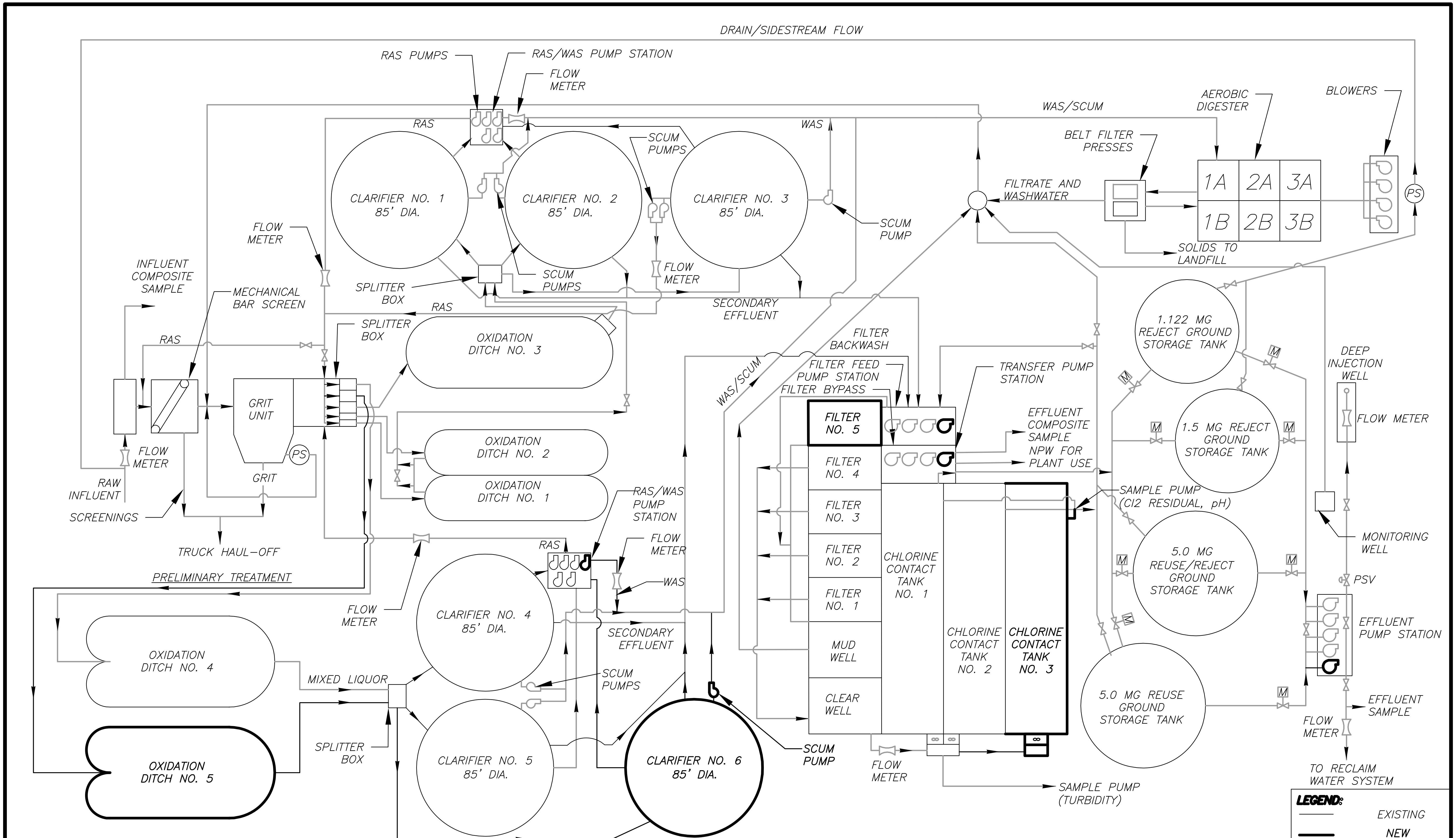

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FIGURE NO. 4-3
8 MGD ADF EXPANSION PROCESS FLOW DIAGRAM
DECEMBER 2013

Table 4-1 presents the Three Oaks WWTP equipment/structure sizing for existing, the proposed improvements for the current 6 MGD ADF, and proposed improvements for the future 8 MGD ADFAddition of an effluent pump.

4.2 Headworks

4.2.1 Existing Conditions

Influent wastewater and RAS enters the plant headworks, which consists of two mechanical screens, one manual bar screen and a stacked tray grit removal system. Each mechanical screen, manufactured by Vulcan Industries, is capable of treating a PHF of 18 MGD. The manual bar rack also provides additional standby screening capability. Screened raw wastewater enters the grit removal system. The grit removal system utilizes a 12-foot diameter Headcell unit manufactured by Eutek Hydro. The Headcell currently has five trays in place but is expandable up to 11 trays. The Headcell is capable of removing particle sizes up to 105 microns at an ADF of 6 MGD and a PHF of 18 MGD in its current configuration. Grit system effluent flows into a three-way flow splitter box which directs the flow to Oxidation Ditches 1, 2, and 3. **Table 4-2** summarizes the sizing of influent screens and the grit removal system.

Table 4-2 Summary of Influent Screens and Grit Removal System

Parameter	Unit
Influent Screens	
Number of mechanical screens, duty/standby	1/1
Number of manual bar rack	1
Type of mechanical screen	Stair Screen
Mechanical screen manufacturer	Vulcan
Mechanical screen opening size	6 mm
Mechanical screen capacity, each	18 MGD
Grit Removal System	
Number of units	1
Manufacturer	Eutek Hydro
Model	12-foot Diameter Headcell
Target grit particle size	105 microns
Number of trays installed	5
Maximum number of trays	11
Rated capacity at target particle size up to 105 microns, ADF/PHF	6/18

4.2.2 Improvements for 6 MGD ADF Capacity

Each mechanical screen has a peak flow capacity of 18 MGD. The maximum flow through the headworks could be as much as 27 MGD (18 MGD of influent PHF flow and 9 MGD of RAS) if the RAS is returned upstream of the screens. Therefore, influent screens do not require any improvements at 6 MGD ADF.

Table 4-1 Equipment and Structure Summary

PROCESS EQUIPMENT/TREATMENT STRUCTURE DESCRIPTION	EXISTING EQUIPMENT/STRUCTURE	EXISTING EQUIPMENT DESIGN CAPACITY	PROPOSED (6.0 MGD) EQUIPMENT	PROPOSED (6.0 MGD) EQUIPMENT DESIGN CAPACITY	PROPOSED (8.0 MGD) EQUIPMENT	PROPOSED (8.0 MGD) EQUIPMENT DESIGN CAPACITY
Preliminary Treatment (Headworks)						
Influent Flow Meter	One electromagnetic flow measuring system	22 MGD	None	None	None	None
Mechanical Screens	Two mechanical stair screens with 6mm openings. A wash press and a shaftless screw conveyor	18 MGD (Each), 36 MGD (total)	None	None	None	None
Manual Bar Rack	Manual bar rack with 1 inch openings	N/A	None	None	None	None
Grit Removal System	Stacked tray grit seperation system with 12' diameter maximum 11 tray capacity. Design target grit size is 105 micron.	18 MGD PHF	Add one tray	18 MGD PHF	Add two trays	22 MGD PHF
Oxidation Ditches Flow Splitter Box	Three way flow splitter box	N/A	Conversion of three way splitter box to five way splitter box to accommodate flow splitting to Oxidation Ditches 4 and 5	N/A	None	N/A
Activated Sludge Treatment System						
Oxidation Ditches 1 & 2	Oxidation ditch with 0.75 MG volume and three 30 HP brush aerators	1.0 MGD ADF, per ditch	30 HP brush aerator per ditch	1.0 MGD ADF, per ditch	None	None
Oxidation Ditch 3	Oxidation ditch with 1.5 MG volume and four 50 HP brush aerators	2.0 MGD ADF	Upgrade all four 50 HP brush aerator motors to 60 HP motors	2.0 MGD ADF	None	None
Oxidation Ditch 4	N/A	N/A	Oxidation ditch with 1.5 MG volume and three 75 HP platform mounted brush aerators on VFDs	2.0 MGD ADF	None	None
Oxidation Ditch 5	N/A	N/A	N/A	N/A	Oxidation ditch with 1.5 MG volume and three 75 HP platform mounted brush aerators on VFDs	2 MGD ADF
Splitter Box for Clarifiers 1, 2, and 3	2-way splitter	N/A	Conversion of 2-way splitter box to 3-way splitter box	None	None	None
Splitter Box for Clarifiers 4, 5, and 6	N/A	N/A	3-way splitter	N/A	None	None
Clarifiers 1 & 2	Two 85-ft Diameter center feed circular clarifiers	1.34 MGD ADF, per clarifier	None	None	None	None
Clarifiers 3, 4, and 5	N/A	N/A	Three 85-ft Diameter center feed circular clarifiers	1.34 MGD ADF, per clarifier	None	None
Clarifier 6	N/A	N/A	N/A	N/A	Three 85-ft Diameter center feed circular clarifiers	1.34 MGD ADF, per clarifier
RAS/WAS Pump Station No.1	Three dry pit RAS pumps with VFDs	1,570 gpm, each	Two dry pit RAS pumps with VFDs	1,570 gpm, each	None	None
RAS/WAS Pump Station No.2	Two dry pit WAS pumps	210 gpm, each	None	None	None	None
RAS/WAS Pump Station No.2	N/A	N/A	Three dry pit RAS pumps with VFDs	1,570 gpm, each	Four dry pit RAS pumps with VFDs	1,570 gpm, each
RAS/WAS Pump Station No.2	N/A	N/A	Two dry pit WAS pumps	210 gpm, each	None	None
Solids Holding Tanks						
Aerated Solids Holding Tanks	Six rectangular solids holding tanks with coarse bubble diffused aeration system	0.108 MG, each	None	None	None	None
Blowers	Four 40 HP Multistage Blowers	900 SCFM, each	None	None	None	None

Table 4-1	Equipment and Structure Summary					
PROCESS EQUIPMENT/TREATMENT STRUCTURE DESCRIPTION	**EXISTING EQUIPMENT/STRUCTURE**	**EXISTING EQUIPMENT DESIGN CAPACITY**	**PROPOSED (6.0 MGD) EQUIPMENT**	**PROPOSED (6.0 MGD) EQUIPMENT DESIGN CAPACITY**	**PROPOSED (8.0 MGD) EQUIPMENT**	**PROPOSED (8.0 MGD) EQUIPMENT DESIGN CAPACITY**
Filters						
Filter Feed Pumping Station	Three pumps	6,775 gpm, each	None	None	One filter feed pump	6,775 gpm
Tertiary Filters	Four deep bed filters	520 SF filter area, each	None	None	One deep bed filter	520 SF
Backwash Pumps	Two pumps	Unknown	None	Unknown	None	Unknown
Air Scour Blowers	2 positive displacement blowers	2,575 scfm, each	None	None	None	None
Disinfection						
Chlorine Contact Tanks	Two adjacent rectangular chlorine contact tanks	0.106 MG per CCT (0.212 MG total) 17 min contact time at 18.0 MGD PHF	None	None	One rectangular chlorine contact tank	0.106 MGD CCT
Sodium Hypochlorite Storage Tanks	Two polyethylene storage tanks	5,000 gallons each	Two fiberglass storage tanks	5,000 gallons each	None	None
Sodium Hypochlorite Feed Pumps	Three diaphragm pumps	85.6 gph max each	None	None	None	None
Reject Ground Storage Tank No. 1	1.12 MG (Round)	N/A	1.2 MG (Round)	None	None	None
Reject Ground Storage Tank No. 2	1.50 MG (Round)	N/A	None	None	None	None
Reuse/Reject Ground Storage Tank	5.0 MG (Round)	N/A	None	None	None	None
Reuse Ground Storage Tank	5.0 MG (Round)	N/A	None	None	None	None
Dewatering						
Polymer Feed System	Two Liquid Polymer Blend and Feed Systems	8.6 gph, each	Three Polymer Blend and Feed Systems	8.6 gph, each	Three Polymer Blend and Feed Systems	8.6 gph, each
Belt Press Feed System	Two progressive cavity pumps	100-400 gpm each	Three progressive cavity pumps	100-400 gpm each	None	None
Solids Dewatering	One 2-meter belt filter press	450 dry lb/meter.hr	One 2-meter belt filter press	450 dry lb/meter.hr	None	None
Dewatered Cake Pumps	One progressive cavity pump	5 to 15 gpm	Shaftless screw conveyor	30 gpm	None	None
In-Plant Pumping Stations						
Transfer Pump Station	Three Pumps	6,250 GPM at 48'	None	None	Four Pumps	6,250 GPM at 48'
Effluent Pump Station	Four Pumps	1,800 GPM at 139'	None	None	Five Pumps	1,800 GPM at 139'
Inplant Pump Station at Filters	Two submersible pumps	7.5 hp	None	None	None	None
Inplant Pump Station at Grit Unit	(2) Flygt Pumps Model: C-3127	Design Capacity: 450 GPM at 42.8'	None	None	None	None
Inplant Pump Station at Admin Bldg	Two submersible pumps	7.5 hp	None	None	None	None
Main InPlant Pump station	Three submersible pumps	10 hp	None	None	None	None
NPW Pump Station	Two Gould Pumps Model:3196	500 GPM at 160'	No additional units	No additional units	No additional units	No additional units
Inplant Pump Station at Oxidation Ditch 4	N/A	N/A	Duplex submersible pump station	1,100 gpm	None	None
Wells						
Monitoring Well	Dual Zone		Dual Zone		Dual Zone	

The existing Headcell grit removal system currently has five trays installed. As the plant flows increase more trays should be installed to achieve high grit removal efficiency. The grit removal system is expandable to eleven trays. The grit removal system has a maximum hydraulic capacity of 22.5 MGD which is independent of the number of trays installed. The vendor has stated that they would not recommend increasing flow beyond this to the grit removal system. Therefore, the grit removal system is limiting the hydraulic capacity of the headworks. The current scenario in which RAS is introduced upstream of the headworks can continue to be used under normal flow conditions (6 MGD of influent flow and 6 MGD of RAS). However, as flows reach peak conditions (18 MGD of PHF and 9 MGD of RAS), the RAS will need to be reintroduced downstream of the grit removal unit. This can be done automatically with a totalizer on the influent and RAS flow meters along with motorized actuators on the isolation valves for the RAS pipes at the headworks.

There are six uninstalled trays stored at the plant site. The grit removal system influent manifold is being replaced with a new one. The existing grit removal system does not require any other improvements at 6 MGD ADF.

An extension of the existing flow splitter box after grit removal will need to be provided to convey flow to the new 2 MGD ADF oxidation ditch. **Figure 4-4** illustrates the proposed modifications. Two new flow splitter boxes will be provided under current facility improvements to accommodate the future 2 MGD ADF oxidation ditch that will be constructed to increase the treatment capacity to 8 MGD ADF. This will prevent the need for a future outage when the plant needs to expand beyond 6 MGD ADF.

4.2.3 Improvements for 8 MGD ADF Capacity

The hydraulic capacity of the headworks is 22.5 MGD based on the constraints of the grit removal unit. Under most operating conditions, the facility needs only one mechanical screen. The second mechanical screen will be needed only when the flows exceed 18 MGD. The addition of a third mechanical bar screen for redundancy would require construction of an additional channel due to a smaller width in the existing bypass bar screen channel. CDM Smith does not recommend the addition of a third identical mechanical screen because the manual screen can serve as the redundant unit. The grit removal system, with all trays installed, has sufficient treatment capacity for the future 8 MGD ADF and 22 MGD PHF.

4.2.4 Control Strategy

It is recommended to add motorized actuators to the RAS return piping that can either convey RAS flow upstream of the headworks (normal operation) or downstream of the grit unit (wet weather operation). The valves would automatically open based on a totalized flow (influent flow and RAS flow combined) setpoint that exceeds 22.5 MGD.

4.3 Odor Control

4.3.1 Existing Conditions

The existing odor control system utilizes a centrifugal blower capable of providing 600 cubic feet per minute (cfm) of air to an activated carbon system, capable of 99% H_2S removal with two carbon scrubber vessels. **Table 4-3** summarizes the existing headworks odor control system.

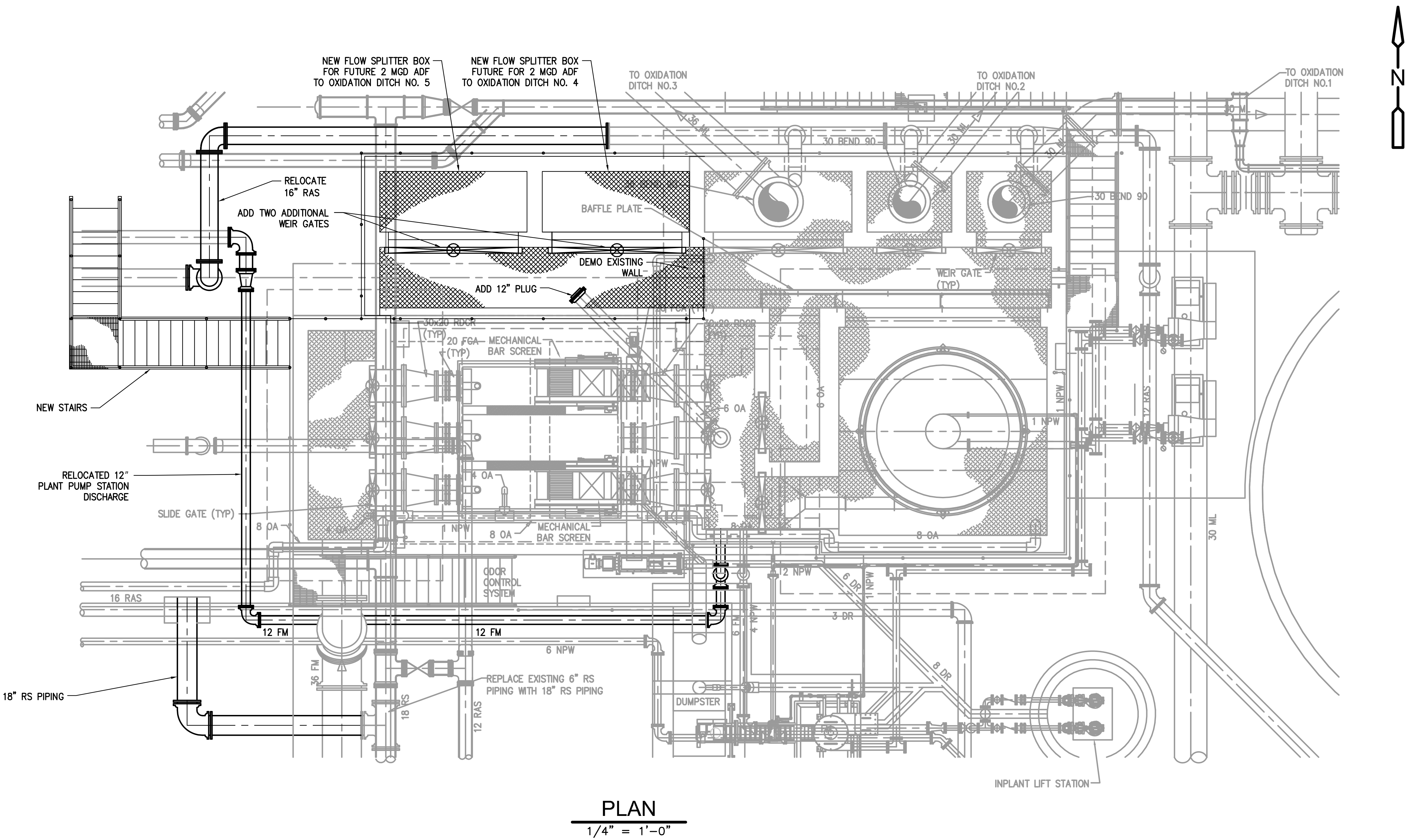

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FIGURE NO. 4-4
HEADWORKS UPGRADES
DECEMBER 2013

Table 4-3 Summary of Existing Headworks Odor Control System

Parameter	Unit
Number of units	2
Type of unit	SulfaTreat Activated Carbon
Air flow treated	600 scfm
PD Blower Motor Size	3 HP
Design H_2S removal efficiency	99%
Design average inlet H_2S concentration	100 ppm
Design peak inlet H_2S concentration	150 ppm

4.3.2 Improvements for 6 MGD ADF Capacity

The existing odor control system can provide sufficient treatment and does not require any improvements at 6 MGD ADF. This is based on the assumption that the number of air exchanges per hour and the amount of air space will remain the same although the headworks structure will be modified to provide flow splitting to the new oxidation ditches proposed for the current improvements and the future improvements.

4.3.3 Improvements for 8 MGD ADF Capacity

The odor control system will not require any additional upgrades for the increased plant capacity from 6 to 8 MGD ADF. This is based on the assumption that design average and peak inlet H_2S concentrations, the number of air exchanges per hour, and the amount of air space will remain the same as the existing.

4.3.4 Control Strategy

Major upgrades to the headworks will not be required. Control of the systems shall remain as they are presently.

4.4 Activated Sludge Treatment Capacity

4.4.1 Existing Conditions

There are three oxidation ditches that operate in parallel. Oxidation Ditches 1 and 2 are mirror images of each other. Oxidation Ditch 3 has the same volume as Oxidation Ditches 1 and 2 combined. Oxidation Ditches 1 and 2 each have three 30 HP brush aerators. Oxidation Ditch 3 has four 50 HP brush aerators.

Effluent from Oxidation Ditches 1 and 2 flows through a flow splitting structure that can convey flow to either one of the two 85-foot diameter center feed clarifiers or the four original peripheral feed clarifiers. Current operational practice is to convey the flow to the center feed clarifiers as the peripheral feed clarifiers are old and do not function well and, therefore, they are only used in emergency situations. The flow splitting structure between Oxidation Ditches 1 and 2 is arranged such that the water level in each ditch cannot be independently controlled when both ditches are flowing to the center feed clarifiers. Future removal of the peripheral feed clarifiers would allow LCU operations staff to independently control water level in Oxidation Ditches 1 and 2 and would also increase the effluent weir length which would reduce variability in the submergence of the brush aerators. Oxidation Ditch 3 has an effluent weir that can be varied in elevation. Mixed liquor from Oxidation Ditch 3 discharges to the two center feed secondary clarifiers.

Historically, target dissolved oxygen concentration levels of 1 to 2 mg/L have been difficult to maintain in all three oxidation ditches. Furthermore, there have been instances where wave action caused mixed liquor to become close to overflowing the tank, motor overloads (possibly due to the wave action and increased submergence), and spraying of mixed liquor on walkways and on staff based on the immersion of the brushes.

Concerns over these issues initiated a request to survey the installed elevation of the brush aerators and to verify that the staff gauges, presently used to measure immersion of the brushes, are reading the true immersion. Barraco and Associates conducted a survey at the facility in August and September 2013 to verify these items.

CDM Smith evaluated the survey results along with the vendor submittal drawings and determined the following:

- The installation of the brush aerators by the installing contractor was within 1 inch of the elevations shown on the vendor submittal drawings.
- The staff gauge in Oxidation Ditch 1 is reading between 1.3 and 2.0 inches higher than the actual immersion. For example, a present reading of 10 inches on the staff gauge would indicate 8.0 and 8.7 inches of immersion, depending on the aerator.
- The staff gauge in Oxidation Ditch 2 is reading between 3.0 and 3.6 inches higher than the actual immersion. For example, a present reading of 10 inches on the staff gauge would indicate 6.4 and 7.0 inches of immersion depending on the aerator. This is the likely cause of why maintaining dissolved oxygen in Oxidation Ditch 2 is more difficult.
- The staff gauge in Oxidation Ditch 3 is reading accurately.
- LCU is concerned about the wave action occurring in all three oxidation ditches. In some instances, waves were so high; the mixed liquor was close to overflowing the oxidation ditch walls. Waves can damage the brush aerators as well. Instances have occurred where motors have overloaded, presumably due to excessive submergence of the brushes when the wave occurs. CDM Smith contacted Lakeside and discussed the issue with them in detail. Lakeside indicated that the likely cause of the waves is the submergence of the deflector baffles and the current installation angles of the deflector baffles.

The mixed liquor from the three oxidation ditches flows by gravity to a splitter box that feeds the two 85-foot diameter center feed clarifiers. These secondary clarifiers have historically performed well. There are three RAS and two WAS pumps that pull from the clarifiers to return and waste biosolids. Typically, one RAS pump is dedicated to each secondary clarifier. RAS pumping is limited due to a piping hydraulic bottleneck located at the headworks. **Table 4-4** summarizes the unit processes for the existing activated sludge process.

Table 4-4 Activated Sludge Process - Existing Conditions

Parameter	Unit	Value
Oxidation Ditches 1 and 2 (Each)		
Oxidation ditch volume	MG	0.75
Sidewater depth	ft	12
Number of brush aerators	---	3
Horsepower per brush aerator	HP	30
Design average brush aerators submergence	inch	9.75

Parameter	Unit	Value
Design maximum brush aerator submergence	inch	14.25
Break horsepower draw at 14.25 inch submergence	HP	25.1
Field aeration efficiency at design maximum submergence at 66 rpm	lb/HP-hr	2.05
Oxygen transfer, field conditions at design maximum submergence	lb/d/aerator	1,234
Total oxygen transfer capability, field at design maximum submergence	lb/d	3,702
Oxidation Ditch 3		
Oxidation ditch volume	MG	1.5
Sidewater depth	ft	12
Number of brush aerators	---	4
Horsepower per brush aerator	HP	50
Design average brush aerators submergence	inch	9.0
Design maximum brush aerator submergence	inch	12.0
Break horsepower draw at 12-inch submergence	HP	45.8
Field aeration efficiency at design maximum submergence at 66 rpm	lb/HP-hr	2.1
Oxygen transfer, field conditions at design maximum submergence	lb/d/aerator	2,308
Total oxygen transfer capability, field at design maximum submergence	lb/d	9,232
Secondary Clarifiers		
Number of center feed units	---	2
Diameter of center feed units	ft	85
Number of peripheral feed units	---	4
Diameter of peripheral feed units	ft	40/40/40/64
RAS/WAS Pumping		
Number of RAS pumps, center feed units	---	3
Number of WAS pumps, center feed units	---	2
Firm capacity RAS pumps, center feed units	gpm	3,140
Firm capacity WAS pumps, center feed units	gpm	260
Number of RAS pumps, peripheral feed units	---	2
Number of WAS pumps, peripheral feed units	---	none
Firm capacity RAS pumps, peripheral feed units	gpm	2,420

4.4.2 Improvements for 4 MGD ADF Capacity

The existing activated sludge train treatment capacity was evaluated at an MLSS of 4,500 mg/L and a system SRT of 12 days at the ADMM influent loading conditions. The design SRT of 12 days has been proposed to achieve simultaneous nitrification and denitrification, while maintaining approximately 8-day aerobic and 4-day anoxic SRTs by means of dissolved oxygen control. The evaluation results indicated that the existing three oxidation ditches have an approximate treatment capacity of 4 MGD ADF. However, the existing brush aerators in Oxidation Ditches 1 and 2 cannot provide sufficient air for the maximum day loading conditions at 4 MGD ADF. In addition, the two-center feed secondary clarifiers would fail during peak flow conditions assuming that the four peripheral feed clarifiers are not in service. **Table 4-5** summarizes the BioWin model and desktop process calculation results.

Table 4-5 Activated Sludge Process – Design Criteria for 4 MGD Condition

Parameter	Unit	Value
Design MLSS	mg/L	4,500
Design system SRT, ADMM	days	12
Design system SRT, AD	days	19

Parameter	Unit	Value
Net yield	lb WAS/lb BOD_5	0.84
Biosolids production, ADMM	lb/d	9,200
Dewatered cake, ADMM	lb/d	8,250
Effluent NO_3-N, ADMM	mg/L	12
Design DO in aerated fraction of ditch, MD [1]	mg/L	2
Total actual oxygen requirement, AD	lb O_2/d	11,500
Total actual oxygen requirement, MD	lb O_2/d	17,400
Total oxygen required, field conditions, Oxidation Ditch 1, MD	lb O_2/d	4,350
Total oxygen required, field conditions, Oxidation Ditch 2, MD	lb O_2/d	4,350
Total oxygen required, field conditions, Oxidation Ditch 3, MD	lb O_2/d	8,700
MLSS SVI	mL/g	150
Clarifier hydraulic overflow rate, at ADF/PHF[2]	gpd/sf	235/705
Clarifier solids loading rate, AD/MD[2]	lb/d/sf	22/26.5
RAS pumping required, max	gpm	4,200
WAS pumping required[3]	gpm	420

[1] Minimum of 2.0 mg/L DO provided at the brush aerator locations of the oxidation ditches.
[2] Assumes three 85-foot center feed clarifiers.
[3] Assumes wasting is done 6 hours per day at ADMM loads.

The existing facility was benchmarked with a biological treatment system capacity of 4 MGD ADF during Workshop No. 2 with the following modifications:

- Addition of a third 85-foot diameter center feed clarifier or use of all of the peripheral feed units.
- Addition of supplemental air in Oxidation Ditches 1 and 2. Aeration system improvements should be implemented in Oxidation Ditch 3 to provide more flexibility with aeration, even though existing aeration capacity of Oxidation Ditch 3 is higher than the estimated actual oxygen demand at maximum day loading.
- Two new RAS pumps for the secondary clarifiers. Only one duty pump is required for the third 85-foot diameter clarifier. However, this pump station will be dedicated only to this clarifier, and therefore, a redundant pump is needed.

4.4.2.1 Supplemental Aeration

There are several means to provide supplemental aeration to Oxidation Ditches 1, 2, and 3. These include increasing the aerator speed, additional brush aerators, jet aeration, fine bubble diffused air, and self-aspirating floating aerators. CDM Smith evaluated supplemental aeration system alternatives. LCU selected to implement improvements to the existing brush aerators and add a new brush aerator as needed. CDM Smith identified the following improvements for the existing brush aerators:

- Add one 30 HP new brush aerator in each Oxidation Ditch 1 and 2. **Figure 4-5** shows the proposed locations for the new brush aerators.
- Replace 50 HP brush aerator motors with 60 HP motors in Oxidation Ditch 3. Brush aerators will draw approximately 46 HP at the maximum design submergence of 12 inches and 66 rpm speed. This upgrade is necessary to prevent the motors from being overloaded.

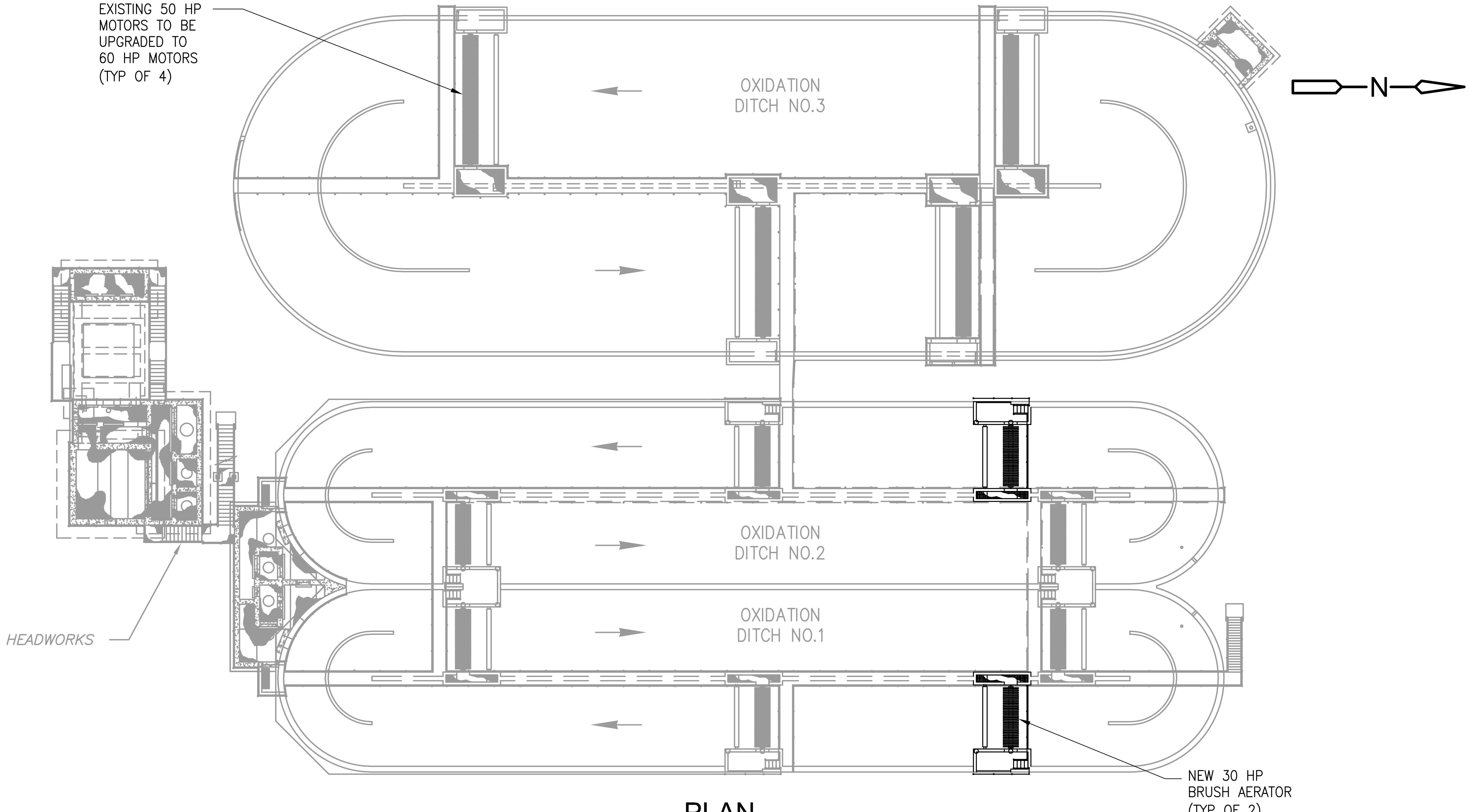

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FIGURE NO. 4-5

OXIDATION DITCH AERATION SYSTEM IMPROVEMENTS

NOVEMBER 2013

LCU selected not to increase the speed of the brush aerators from 66 to 72 rpm due to the concerns regarding mixed liquor splash. Although this improvement would provide additional aeration capability and operational flexibility in terms of required brush aerator submergence, it is not necessary to meet the maximum day actual oxygen requirement.

Table 4-6 summarizes how the brush aerator improvements would affect the aeration system capability of Oxidation Ditches 1, 2, and 3.

Table 4-6 Brush Aeration System Sizing Summary for Supplemental Air

Parameter	Unit	Value
Oxidation Ditch 1		
Number of brush aerators (existing/new)	---	3/1
Horsepower per brush aerator	HP	30
Brush aerator speed	rpm	66
Design average brush aerators submergence	inch	9.75
Design maximum brush aerator submergence	inch	14.25
Break horsepower draw at 14.25-inch submergence	HP	25.1
Field aeration efficiency at design maximum submergence	lb O_2/HP-hr	2.05
Oxygen transfer rate, field conditions at design maximum submergence	lb O_2/d/aerator	1,235
Total oxygen transfer rate, field conditions at design maximum submergence	lb O_2/d	4,940
Design actual oxygen requirement, MD	lb O_2/d	4,350
Oxidation Ditch 2		
Number of brush aerators (existing /new)	---	3/1
Horsepower per brush aerator	HP	30
Brush aerator speed	rpm	66
Design average brush aerators submergence	inch	9.75
Design maximum brush aerator submergence	inch	14.25
Break horsepower draw at 14.25-inch submergence	HP	25.1
Field aeration efficiency at design maximum submergence	lb O_2/HP-hr	2.05
Oxygen transfer rate, field conditions at design maximum submergence	lb O_2/d/aerator	1,235
Total oxygen transfer rate, field conditions at design maximum submergence	lb O_2/d	4,940
Design actual oxygen requirement, MD	lb O_2/d	4,350
Oxidation Ditch 3		
Number of brush aerators (existing/new)	---	4/0
Horsepower per brush aerator	HP	60 [1]
Brush aerator speed	rpm	66
Design average brush aerators submergence	inch	9
Design maximum brush aerator submergence	inch	12
Break horsepower draw at 12-inch submergence	HP	45.8
Field aeration efficiency at design maximum submergence	lb O_2/HP-hr	2.1
Oxygen transfer rate, field conditions at design maximum submergence	lb O_2/d/aerator	2,308
Total oxygen transfer rate, field conditions at design maximum submergence	lb O_2/d	9,232
Design actual oxygen requirement, MD	lb O_2/d	8,700

[1] Existing four 50-HP brush aerators will be upsized the 60 HP.

4.4.2.2 Mitigation of Wave Action in Ditches 1 and 3

Lakeside sent a service technician to the site to identify the cause(s) of wave actions on November 5th and 6th, 2013. A CDM Smith process engineer was also on the site during these two days. Lakeside will provide a report summarizing their observations and firm recommendations to CDM Smith for consideration to mitigate the wave action in the oxidation ditches. The following was recommended based on initial discussions on the site visit along with additional hydraulic evaluation by CDM Smith:

- Oxidation Ditch 1 and 2
  - Water surface elevation difference between Oxidation Ditches 1 and 2 may cause deflector baffles to submerge more in Oxidation Ditch 1. This may be the primary reason for the wave action. Providing the means to control water levels in Oxidation Ditches 1 and 2 may help mitigating the waves in Oxidation Ditch 1.
  - The flow entrance to oxidation ditches will be modified in Oxidation Ditches 1 and 2 by installing 45-degree elbows. This modification may improve the hydraulic conditions in the oxidation ditches.
- Oxidation Ditch 3:
  - Deflector baffles for Brush Aerators 8 and 10 are currently installed by 60 degree angles. These should be adjusted to 45 degrees. This may be a primary reason for the waves occurring in Oxidation Ditch 3. [Note – this was done by LCU staff after the site visit and it appears it did not mitigate the wave action].
  - Adding additional effluent weir length. Immersion range of the brush aerators will be exceeded at peak flows if additional weir length is not provided. This will be done by tieing into the existing discharge structure on the north side of Oxidation Ditch No. 3.

4.4.3 Improvements for 6 MGD ADF Capacity

The existing activated sludge train with Oxidation Ditches 1, 2, and 3 with dedicated secondary clarifiers will continue to operate as a 4 MGD ADF facility. A new 2 MGD ADF activated sludge train with two dedicated secondary clarifiers is proposed to increase the facility capacity to 6 MGD ADF.

All these improvements also include increasing the size of the existing RAS piping at the existing headworks. It is estimated that only 1,000 gpm RAS flow can be returned due to this hydraulic restriction.

The existing 4 MGD ADF train requires a third 85-foot diameter clarifier. **Figure 4-6** presents the layout of the proposed third secondary clarifier, proposed modification to the flow splitter box, and the two new RAS pumps. Addition of this new clarifier will require modification of the existing flow splitter box to provide a three way flow split. The existing flow splitter box is configured to provide a two way flow split. A new 2 MGD ADF train will consist of a new oxidation ditch with 1.5 MG volume, three 75 HP surface aerators, and two new 85-foot diameter secondary clarifiers yielding a total of five clarifiers on site. **Table 4-7** summarizes the design criteria for the new 2 MGD ADF train. **Figure 4-7** presents the proposed layout for the new 2 MGD ADF activated sludge train with secondary clarifier, flow splitter box, and RAS/WAS pump station.

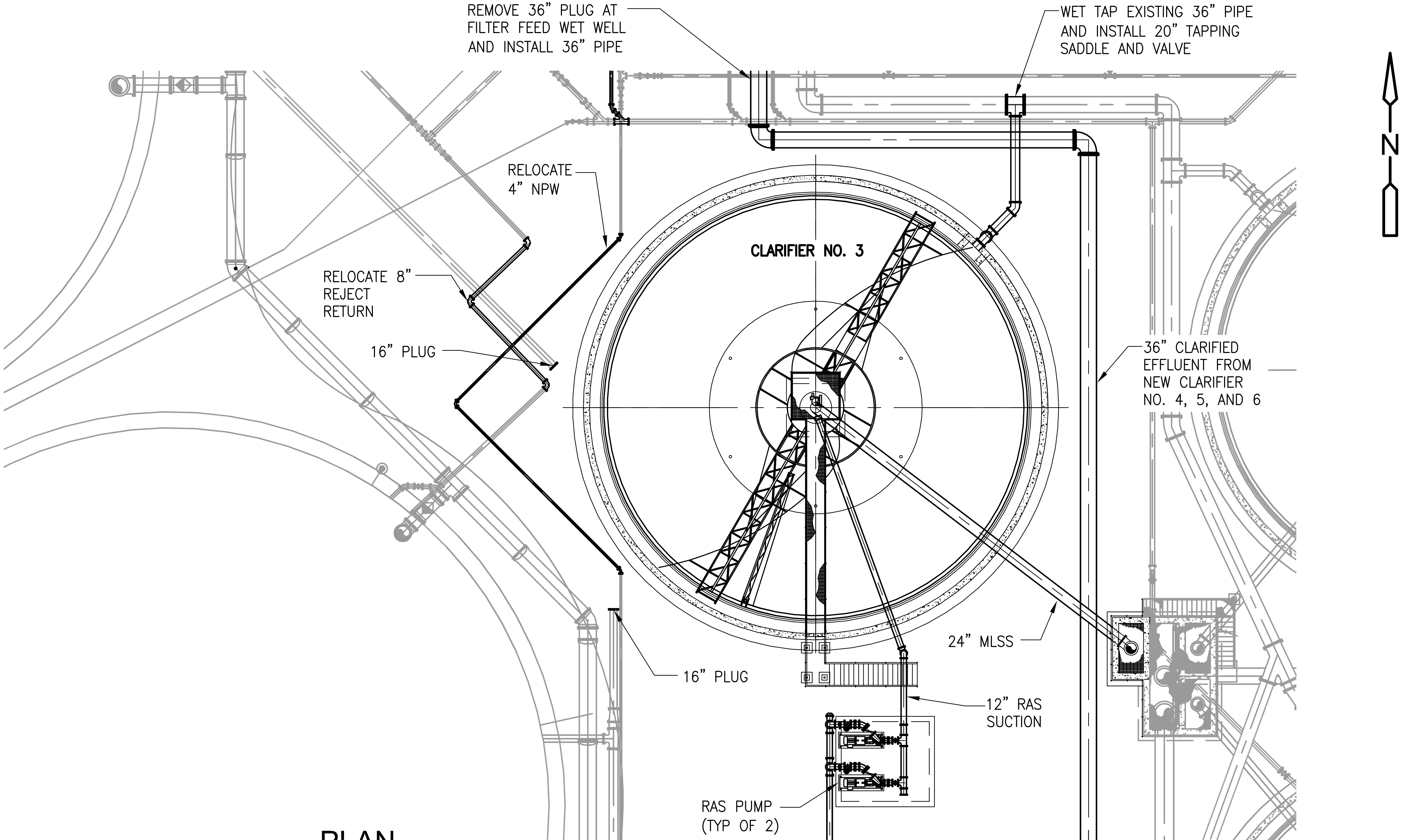

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FIGURE NO. 4-6
CLARIFIER NO. 3 ADDITION
DECEMBER 2013

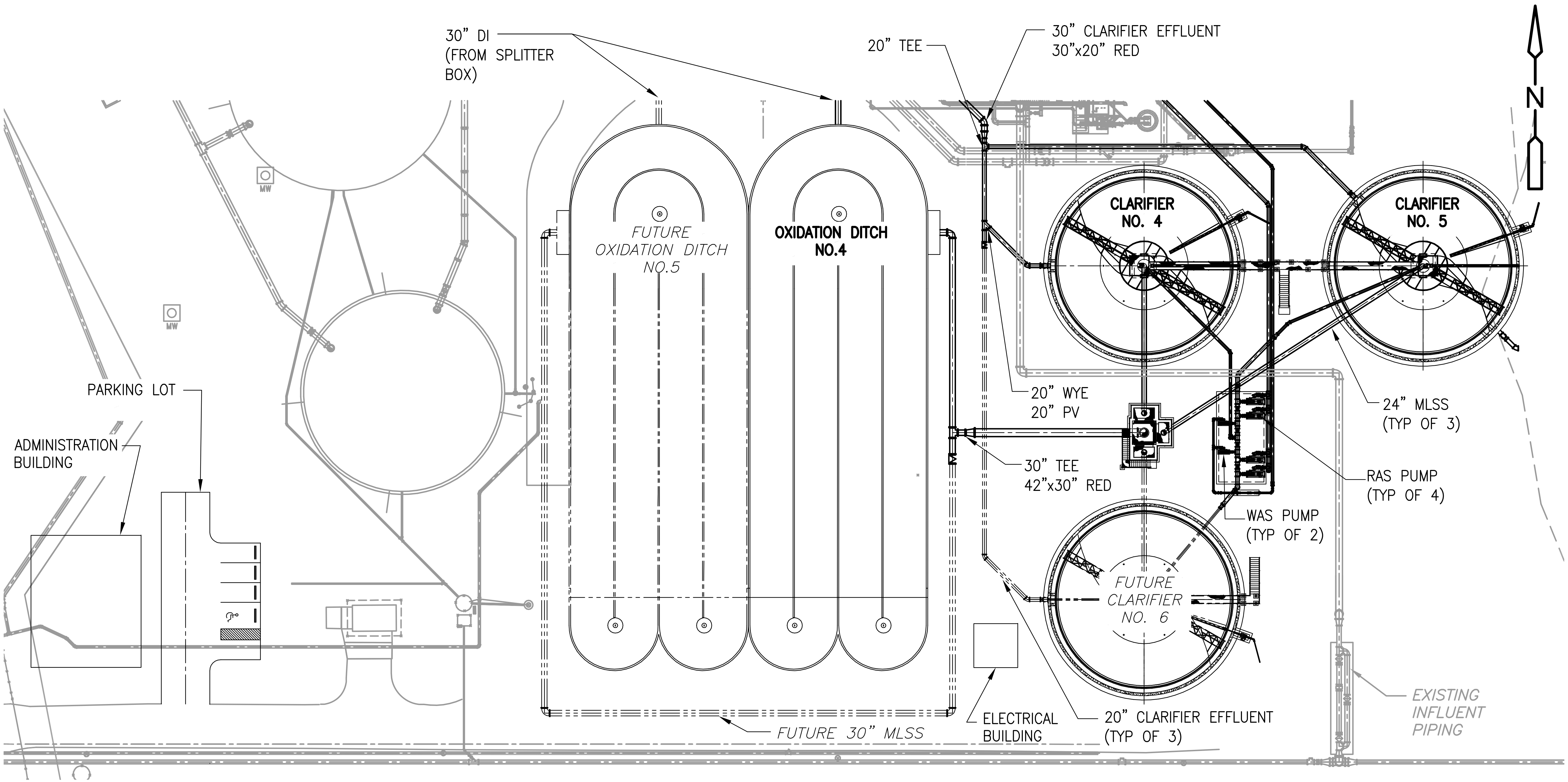

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FIGURE NO. 4-7
2 MGD ACTIVATED SLUDGE TRAIN EXPANSION
DECEMBER 2013

Table 4-7 Design Criteria for New 2 MGD ADF Process Train

Parameter	Unit	Value
Process Design Parameters		
Design capacity	MGD ADF	2
Number of oxidation ditches	---	1
Oxidation ditch volume	MG	1.50
Design MLSS	mg/L	4,500
Design system SRT, ADMM	days	12.0
Design system SRT, AD	days	19.0
Net yield	lb WAS/lb BOD_5	0.84
Effluent NO_3-N from ditch	mg/L	12
Number of clarifiers	---	2
Diameter of clarifier	feet	85
MLSS SVI	mL/g	150
Clarifier hydraulic overflow rate, at ADF/PHF	gpd/sf	176/529
Clarifier solids loading rate, AD/MD	lb/d/sf	16.5/20
RAS pumping required, max	gpm	2,100
Number of RAS Pumps, duty/standby	---	2/1
WAS pumping required [1]	gpm	210
Number of WAS Pumps, duty/standby	---	1/1
Design DO in aerated fraction of ditch, MD	mg/L	2.0
Design actual oxygen requirement, AD	lb O_2/d	5,800
Design actual oxygen requirement, MD	lb O_2/d	8,700

[1] Assumes wasting is done 6 hours per day at ADMM loads.

Table 4-8 summarizes the aeration system requirements for the new oxidation ditch. **Figure 4-8** shows a conceptual site plan for the current 6 MGD ADF plant expansion.

Table 4-8 Oxidation Ditch Summary for New 2 MGD ADF Process Train

Parameter	Unit	Value
Number of aerators	---	3
Horsepower per aerator	HP	75
Total installed aerator horsepower	HP	225 [1]
Break horsepower draw for aeration at design maximum impeller submergence	HP	60
Total oxygen transfer rate, field conditions at design maximum submergence	lb O_2/d/aerator	2.3
Total oxygen transfer rate, field conditions at design maximum submergence	lb O_2/HP-hr	9,936

[1] Up to 10% of installed HP may be dedicated to lower impeller for mixing

Biosolids projections for the entire facility were estimated at the 6 MGD ADF design condition. **Table 4-9** summarizes the conclusions.

Table 4-9 Biosolids Production for Facility at 6 MGD ADF

Parameter	Unit	Value
Process Design Parameters		
Waste activated sludge, ADMM	lb/d	13,800
Solids feed to the belt filter press, ADMM	lb/d	12,900
Dewatered cake, ADMM	lb/d	12,400 [1]

[1] Assumes 96% solids capture by belt filter press.

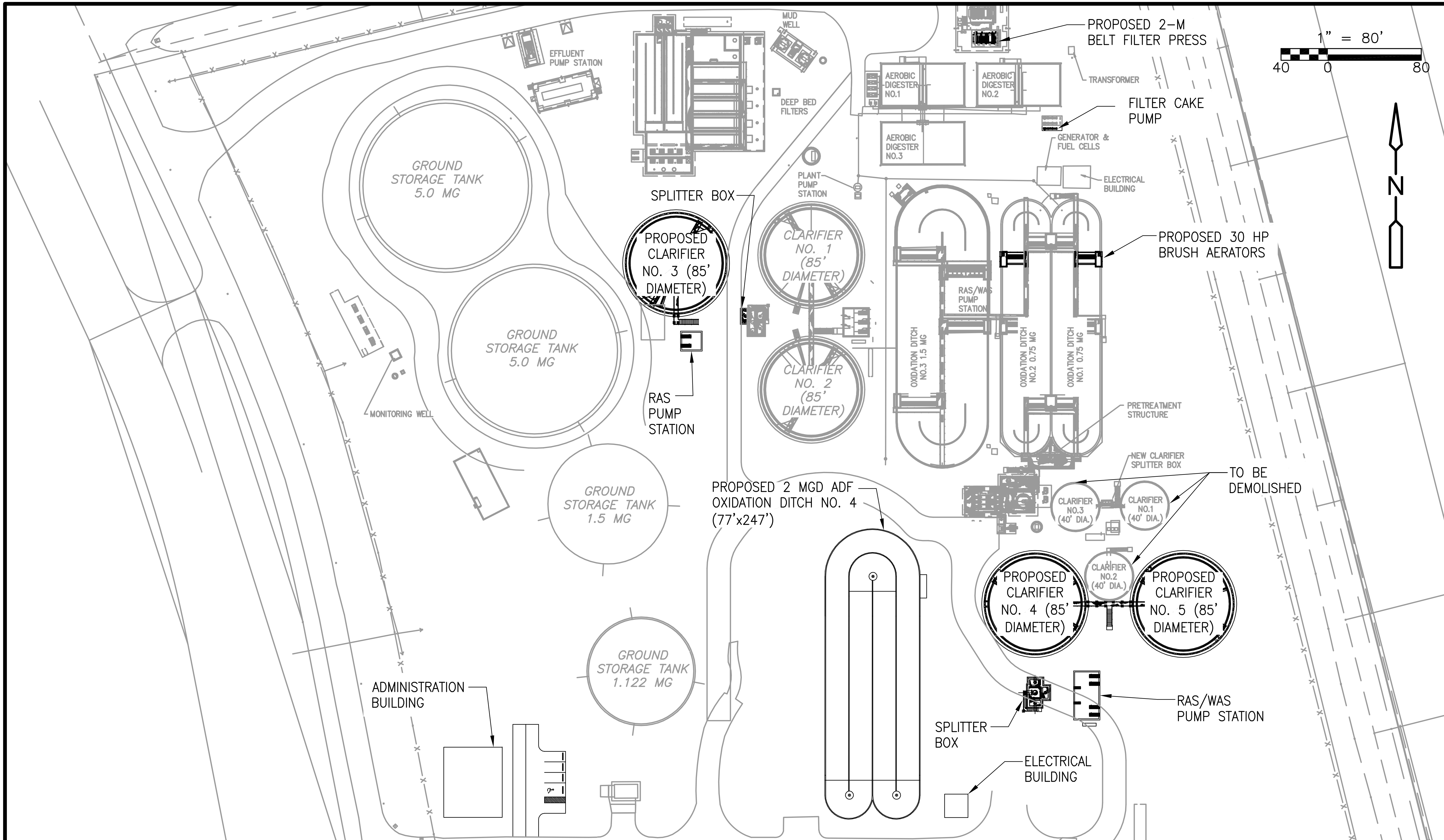

FIGURE NO. 4-8
SITE PLAN FOR 6 MGD ADF PLANT EXPANSION
DECEMBER 2013

Table 4-10 summarizes the clarifier and RAS pumping design criteria proposed for the current 6 MGD ADF plant expansion.

Table 4-10 Activated Sludge Process – Clarifier and RAS Pumping Design Criteria for 6 MGD ADF Plant Expansion

Parameter	Unit	Value
Existing 4 MGD ADF Activated Sludge Train		
Number of secondary clarifiers	---	3
Secondary clarifier diameter	feet	85
Clarifier hydraulic overflow rate, at ADF/PHF	gpd/sf	235/705
Clarifier solids loading rate, AD/MD	lb/d/sf	22/26.5
RAS pumping required, max	gpm	4,200
Existing firm RAS pumping capacity	gpm	3,140
Number of new RAS pumps required	---	2 [1]
New 2 MGD ADF Activated Sludge Train		
Number of secondary clarifiers	---	2
Secondary clarifier diameter	feet	85
Clarifier hydraulic overflow rate, at ADF/PHF	gpd/sf	176/529
Clarifier solids loading rate, AD/MD	lb/d/sf	16.5/20
RAS pumping required, max	gpm	2,100

[1] Two new RAS pumps (one duty/one standby) will be dedicated to the new third 85-ft diameter clarifier for the existing 4 MGD ADF activated sludge train.

4.4.4 Improvements of 8 MGD ADF Capacity

The improvements proposed for the 8 MGD ADF plant expansion will be implemented in the future phase. A second new oxidation ditch, rated at 2 MGD ADF, will be constructed to expand to the total facility treatment capacity to 8 MGD ADF. Oxidation Ditch 5 will be identical to Oxidation Ditch 4 proposed for the 6 MGD ADF plant expansion. Therefore, the information presented in Tables 4-7 and 4-8 is applicable for Oxidation Ditch 5 as well.

A third 85-foot diameter secondary clarifier will be constructed for the new activated sludge train which will yield a total of six secondary clarifiers for the facility. The facility will have two 4 MGD ADF activated sludge trains that have oxidation ditches followed by three 85-foot diameter secondary clarifiers at build-out. **Table 4-11** summarizes the design condition for the activated sludge train consisting of Oxidation Ditches 4 and 5 and with three 85-foot diameter secondary clarifiers. **Figure 4-9** shows a conceptual site plan for the future 8 MGD ADF plant expansion.

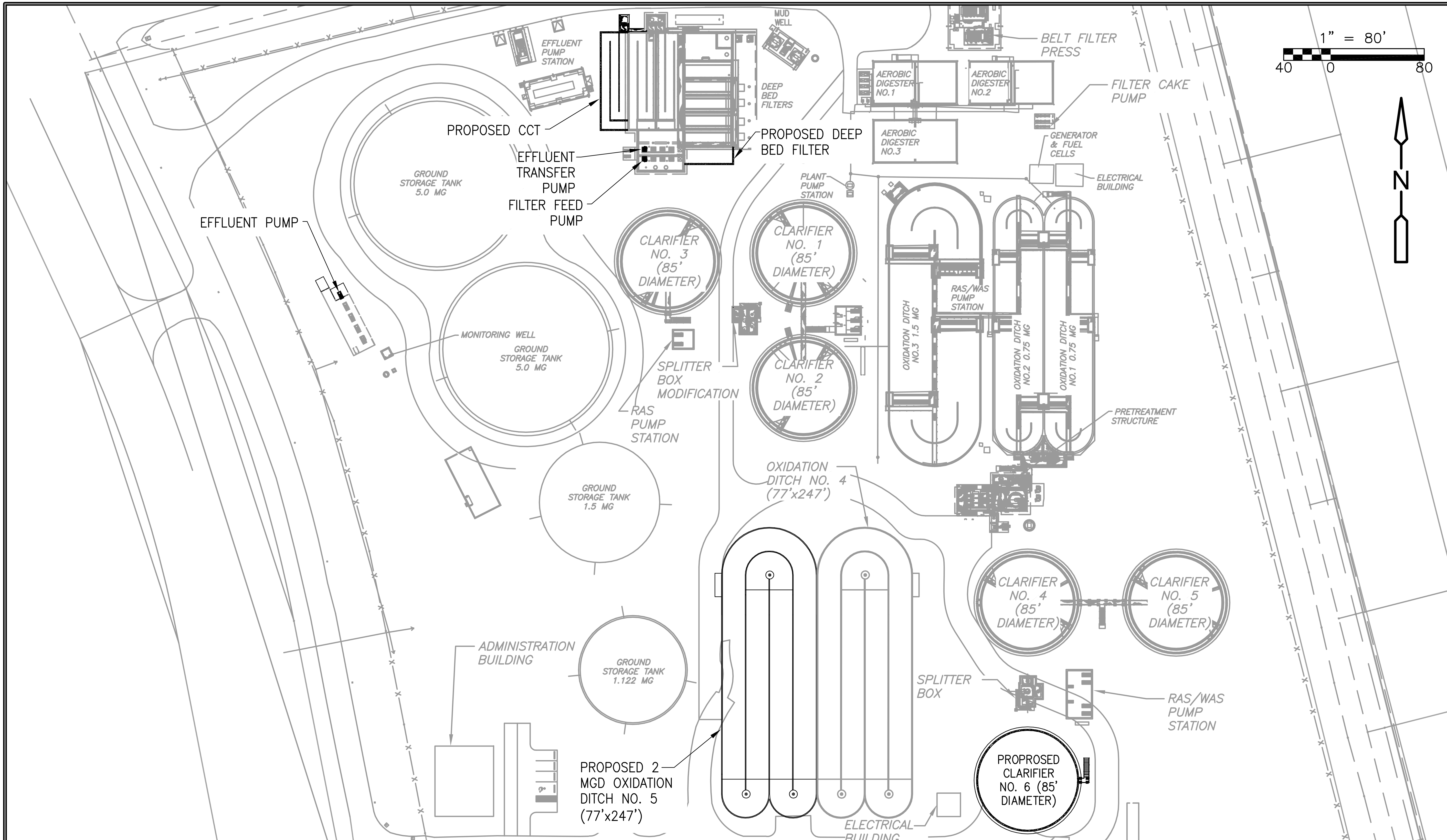

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FIGURE NO. 4-9
SITE PLAN FOR 8 MGD ADF PLANT EXPANSION
DECEMBER 2013

Table 4-11 Design Criteria for New Activated Sludge Train with Oxidation Ditches 4 and 5

Parameter	Unit	2 MGD ADF	4 MGD ADF
Design capacity	MGD ADF	2.0	2.0
Number of ditches	---	1	2
Ditch volume, each	MG	1.50	1.50
Design MLSS	mg/L	4,500	4,500
Design system SRT, ADMM	days	12.0	12.0
Design system SRT, AD	days	19.0	19.0
Net yield	lb WAS/lb BOD_5	0.84	0.84
Effluent NO_3-N from ditch	mg/L	12	12
Number of clarifiers	---	2	3
Diameter of clarifier	feet	85	85
MLSS SVI	mL/g	150	150
Clarifier hydraulic overflow rate, at ADF/PHF	gpd/sf	176/529	235/705
Clarifier solids loading rate, AD/MD	lb/d/sf	16.5/20	22/26.5
RAS pumping required, max	gpm	2,100	4,200
Number of RAS Pumps, duty/standby	---	2/1	3/1
WAS pumping required[1]	gpm	210	420
Number of WAS Pumps, duty/standby	---	2/0	2/0
Design DO in aerated fraction of ditch, MD	mg/L	2	2
Design actual oxygen requirement, AD	lb O_2/d	5,800	11,600
Design actual oxygen requirement, MD	lb O_2/d	8,700	17,400 [1]

[1] Identical aeration system of Oxidation Ditch 4 shall be provided for Oxidation Ditch 5 to double the aeration system capacity at during total facility treatment capacity expansion to 8 MGD ADF.

Table 4-12 summarizes biosolids projections at 8 MGD ADF build-out treatment capacity at the ADMM loading conditions.

Table 4-12 Biosolids at 8 MGD ADF Treatment Capacity

Parameter	Unit	Value
Process Design Parameters		
Design capacity	MGD ADF	8.0
Waste Activated Sludge, ADMM	lb/d	18,400
Solids Feed to the Belt Filter Press, ADMM	lb/d	17,200
Dewatered Cake, ADMM	lb/d	16,500 [1]

[1] Assumes 96% solids capture by belt filter press.

4.4.5 Control Strategy

4.4.5.1 Existing 4.0 MGD ADF Process Train

Presently, the brush aerators are controlled on timers and are not controlled through a dissolved oxygen control loop to turn aerators on or off. The aerators also do not have variable frequency drives which would allow turndown. Operations staff appears to have a very robust system in place in order to provide a high quality effluent, and therefore, CDM Smith recommends that LCU continue to operate the aeration system as they do presently.

The RAS pumps can be controlled automatically. RAS flow is an operator-entered fraction of the raw influent wastewater flow. RAS pump speeds are ramped up and down slowly over the course of several minutes in case of sudden flow changes.

Sludge blanket detectors are installed at the secondary clarifiers for monitoring purposes only. These units are not working well and should be replaced. The sludge blanket detectors do not provide a control output for the RAS pumps presently and it is not recommended to do this in the future either.

WAS pumping is presently done by selecting a start and stop time within a 24 hour period and total flow per day in gallons. The WAS pump shall start and stop according to the timer. Pumps also receive feedback to slow when the sludge blanket is low and pump is in auto.

4.4.5.2 New 2.0 MGD ADF Process Train (Expansion to 6 MGD ADF)

The proposed Oxidation Ditch 4 will be provided with three 75 HP platform mounted surface aerators which will be equipped with VFDs. The VFDs will provide turn down capability and more flexibility with maintaining target residual dissolved oxygen profile in the oxidation ditch. The surface aerators will be designated as primary, secondary and tertiary aerator for the automated control loop. The operation of the surface aerators will be controlled automatically based on either dissolved oxygen or oxidation reduction potential (ORP) measurements taken in the oxidation ditch. One dissolved oxygen and one ORP probe will be installed downstream of the primary and secondary surface aerators. The tertiary aerator will be controlled per secondary aerator operation. Depending on the dissolved oxygen and ORP high and low set points, primary and secondary aerators will be ramped up, slowed down, turned off, or turned on. The set point may be adjusted by the operations staff to optimize the surface aerator automated operation. The proposed automated aeration system control will maximize the SND achieved in the oxidation ditch while providing power cost savings.

The new RAS pumps will be controlled in a similar manner as the existing units which are currently an input as a percent of the plant influent flow rate. WAS pumping will also be controlled similarly with using a start and stop time within a 24 hour period and total flow per day in gallons. There is also a way to control WAS pumps via a total suspended solids analyzer in the RAS line and a user entered WAS mass rate if LCU operations staff wish to pursue this as part of the control algorithm.

4.4.5.3 New 2.0 MGD ADF Process Train (Expansion to 8 MGD ADF)

The controls for the future Oxidation Ditch 5 and RAS/WAS pumps will be similar to Oxidation Ditch 4 and RAS/WAS pump station proposed for the current 6.0 MGD ADF plant expansion.

4.5 Deep Bed Filters

4.5.1 Existing Conditions

Secondary clarifier effluent is pumped to the deep bed filters. There are currently three vertical turbine pumps (with room for a fourth) that pump water out of a wetwell next to the filters and into the filter feed manifold. There are four Leopold deep bed tertiary filters that were installed in the last plant expansion. Typically, only three are used at current flows. The deep bed filters with Leopold undrain systems remove suspended solids from the secondary effluent before chlorine disinfection. In order to send the treated effluent to the reclaimed water system, TSS must be below 5 mg/L. These deep bed filters are highly efficient for TSS removal that the plant effluent TSS averaged less than 1.0 mg/L for the last three years. **Table 4-13** summarizes the existing facilities.

Table 4-13 Deep Bed Filters – Existing Conditions

Parameter	Unit	6 MGD ADF
Number of filters	---	4
Filter dimensions, unit	feet	13x40
Surface area, each	sf	520
Surface area, total	sf	2,080
Filtration rate at ADF of 6 MGD	gpm/sf	2.0
Filtration rate at PHF of 18 MGD	gpm/sf	6.0 [1]
Number of filter feed pumps, duty/standby	---	2/1
Filter feed pump capacity, each	gpm	6,775
Filter feed pump capacity, firm	gpm	13,550
Filter feed pump total dynamic head	feet	23

[1] Leopold confirmed using 6.0 gpm/sf as the maximum filtration rate at the design PHF for the deep bed filters.

4.5.2 Improvements for 6 MGD ADF Capacity

Plant operations and maintenance manuals suggest that two duty filter feed pumps have adequate capacity to pump over the design PHF of 18 MGD and, therefore, are adequate at the 6 MGD ADF design condition. A detailed system curve was not developed in this task and it is recommended that this be done to verify nameplate data prior to construction of the next phase of upgrades.

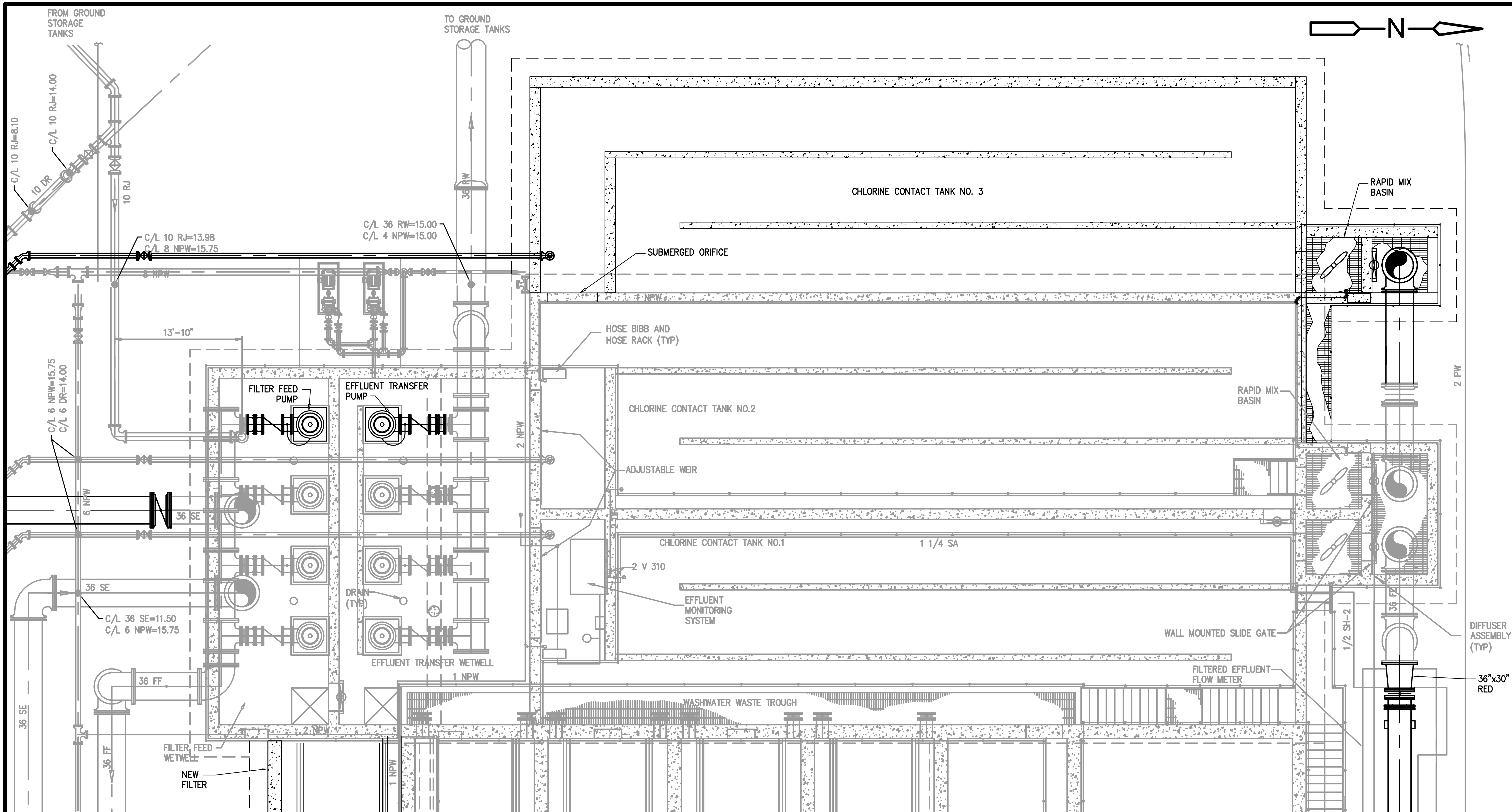
These types of deep bed filters are typically designed for filtration rates of 2 gpm/sf and 5 gpm/sf at the average and peak flow, respectively. While the filtration rate at average flows is within the acceptable range, the filtration rate may go up to 6 gpm/sf at the design PHF of 18 MGD. CDM Smith confirmed with Leopold that the filtration rate of 6 gpm/sf at the design PHF is an acceptable filtration rate. Therefore, the existing four deep bed filters and filter feed pumps are sufficient at the design flow of 6 MGD ADF and there is no need to add new filters.

4.5.3 Improvements for 8 MGD ADF Capacity

CDM Smith recommends the following deep bed filter improvements for the future plant treatment capacity expansion to 8 MGD ADF:

- A new identical filter feed pump.
- A new identical deep bed filter.

Figure 4-10 presents the proposed new filter layout and filter feed pump addition. With a total of five filters in service at 8 MGD ADF treatment capacity, the filtration rate would be 5.9 gpm/sf at the future PHF of 22 MGD. This recommendation is different than what was planned during the last expansion, which proposed the addition of two more filters when the plant capacity was increased to 9 MGD ADF. **Table 4-14** summarizes the filter sizing basis at 6 and 8 MGD ADF.



PLAN

3/32" = 1'-0"

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FIGURE NO. 4-10

FILTER AND CHLORINE CONTACT TANK EXPANSION FOR 8 MGD ADF

DECEMBER 2013

Table 4-14 Deep Bed Filters Sizing Summary

Parameter	Unit	6 MGD ADF	8 MGD ADF
Number of filters	---	4	5
Filter dimensions, unit	feet	13x40	13x40
Surface area, each	sf	520	520
Surface area, total	sf	2,080	2,600
Filtration rate at ADF of 6 and 8 MGD	gpm/sf	2.0	2.1
Filtration rate at PHF of 18 and 22 MGD	gpm/sf	6.0 [1, 2]	5.9 [1, 2]
Number of filter feed pumps, duty/standby	---	2/1	3/1
Filter feed pump capacity, each	gpm	6,775	6,775
Filter feed pump capacity, firm	gpm	13,550	20,325
Filter feed pump total dynamic head	feet	23	23

[1] With largest unit out of service remaining units have capacity for at least 75% design flow per EPA Class I reliability requirements.

[2] Filtration rates up to 6.0 gpm/sf at the design PHF is acceptable per deep bed filter manufacturer Leopold.

4.5.4 Control Strategy

It is recommended that the control strategy for the filters and the filter feed pumps remain the same as they are currently. The filter feed pumps would continue to operate off of level control in the wet well and the filters would be controlled by the PLC that currently controls the units.

4.6 Chlorine Contact Tanks

4.6.1 Existing Conditions

The facility has two chlorine contact tanks and uses sodium hypochlorite for effluent disinfection to achieve high-level disinfection. Each tank has three passes. The Florida Administrative Codes (FAC) specify the required minimum chlorine residual and contact time (CT) value at peak flow according to effluent coliform counts before disinfection. Based on FAC Section 62-600.440, the CT value should be at least 40 mg-min/L for effluent containing more than 1,000 and less than 10,000 fecal coliforms per 100 mL. The CT value should be at least 120 mg-min/L for effluent containing more than 10,000 fecal coliforms per 100 mL. The existing deep bed filters are expected to have effluent fecal coliform counts ranging from 1,000 to 10,000 per 100 mL, based on our experience at other facilities. Therefore, the plant should have at least a (CT) value of 40 mg-min/L. In addition, total residual chlorine (TRC) concentration must be higher than 1.0 mg/L and the minimum contact time must be at least 15 min at 18 MGD. The existing two CCTs with a total volume of 213,200 gal provide contact times of 50 and 17 minutes at the design flows of 6 MGD ADF and 18 MGD PHF, respectively.

Industry standards recommend designing the chlorine contact tanks to have a length-to-width ratio (L:W) of at least 20:1 and, preferably, 40:1. The Three Oaks WWTP chlorine contact tanks have an L:W ratio of 35:1. The geometry of the existing units should maintain plug flow conditions, which would minimize short-circuiting and dead spots providing efficient disinfection. In addition, there is one flash mixer installed at the chlorine feed point before the flow enters each tank.

4.6.2 Improvements for 6 MGD ADF Capacity

The contact time provided by the two existing CCTs will be 17 minutes at 18 MGD PHF, which is longer than the required minimum contact time of 15 minutes. It is concluded that the existing two CCTs are sufficient at the 6 MGD ADF treatment capacity and meet the EPA Class I reliability requirements of 50% of the peak flow with one unit out of service. Therefore, improvements are not needed at this condition. **Table 4-15** summarizes the existing chlorine contact tank sizing at 6 MGD ADF.

Table 4-15 Chlorine Contact Tanks – Design Criteria at 6 MGD ADF

Parameter	Unit	Value
Number of chlorine contact tanks	---	2
Volume, each	gal	106,600
Volume, total	gal	213,200
Length to width ratio	---	35:1
Required minimum contact time at PHF of 18 MGD	min	15
Contact time at average day flow	min	50
Contact time at peak hour flow	min	17
Minimum (chlorine residual x contact time) C x T	mg-min/L	40

4.6.3 Improvements for 8 MGD ADF Capacity

The contact time of chlorine contact tanks is 14 minutes at 22 MGD PHF, which is shorter than the required minimum contact time of 15 minutes. The plant will need a third identical chlorine contact tank. **Table 4-16** presents that three identical chlorine contact tanks will provide 21 minute contact time at the design PHF of 22 MGD. Figure 4-10 presented the proposed third chlorine contact tanks layout with a new rapid mix basin and flow splitting structure modifications.

Table 4-16 Chlorine Contact Tanks – Design Criteria at 8 MGD ADF

Parameter	Unit	Value
Number of chlorine contact tanks, existing/new	---	2/1
Volume, each	gal	106,600
Volume, total	gal	319,800
Length to width ratio	---	35:1
Contact time at average day flow	min	38
Contact time at peak hour flow	min	21
Minimum (chlorine residual x contact time) C x T	mg-min/L	40

4.6.4 Control Strategy

Sodium hypochlorite dosing is presently done using a chlorine residual feedback loop. It is recommended that the control strategy for the sodium hypochlorite and the disinfection process remain the same as they are currently.

4.7 Solids Holding Tanks

4.7.1 Existing Conditions

There are six aerated solids holding tanks that store WAS prior to dewatering. Evaluation of the facility data indicates that less than 10% volatile solids reduction is occurring and the tanks truly are serving as storage and are not stabilizing the biosolids. The facility is not required to generate Class B solids as the dewatered cake is disposed at the County's landfill. The units are aerated using a course bubble diffused aeration system with four multistage centrifugal blowers. The units once had the ability to decant, but the current piping arrangement precludes that. Several slide gates are frozen and need to be replaced. Tanks 2A, 2B, 3A, 3B are presently used to store biosolids. Tanks 1A and 1B are not used because the course bubble diffusers are mounted higher in the tank and LCU operations staff cannot mix the tank at depths of 3 feet or less. **Table 4-17** summarizes the existing facilities.

Table 4-17 Solids Holding Tanks – Existing Facilities

Parameter	Unit	Value
Number of tanks	---	6
Volume, each tank	gal	108,000
Volume, total	gal	648,000
Number of multistage centrifugal blowers, duty/standby	---	3/1
Multistage centrifugal blower motor size	HP	40
Nameplate capacity of blowers	scfm	900
Firm blower capacity, total	scfm	2700

4.7.2 Improvements for 6 MGD ADF Capacity

Table 4-18 summarizes solids holding tanks operating conditions at the project maximum month biosolids projections at 6 MGD ADF. The existing six solids holding tanks are estimated to provide approximately a 6.3-day holding time. This holding time is sufficient and additional solids holding tank volume is not required.

Table 4-18 Solids Holding Tanks –Design Criteria at 6 MGD ADF

Parameter	Unit	Value
Total sludge holding tank volume	gal	648,000
ADMM WAS	lb/day	13,800
Solids in holding tanks	lb/day	12,900
Solids concentration in holding tanks	mg/L	15,000
ADMM WAS	gal/day	103,000
Estimated sludge holding time	day	6.3

Table 4-19 summarizes existing multistage centrifugal blower sizing evaluation for providing mixing air to the aerobic solids holding tanks. The existing three duty and one standby 40-HP centrifugal blowers provide a firm aeration capacity of 2,700 scfm. A mixing air requirement of 30 scfm per 1,000 cubic feet should be provided for the solids holding tanks. The estimated total air flow requirement of 2,600 scfm for mixing is less than the firm blower capacity of 2,700 scfm, and therefore, the existing blower capacity is sufficient.

Table 4-19 Solids Holding Tanks –Mixing/Aeration Requirements at 6 MGD

Parameter	Unit	Value
Firm blower capacity, total	scfm	2,700
Total solids holding tank volume	ft^3	86,625
Basis for mixing air requirement	scfm/1000 ft^3	30
Total air flow requirement for mixing	scfm	2,600

The frozen slide gates will need to be replaced. In addition, it is recommended that the course bubble diffusers in Tanks 1A and 1B be modified to match the height of the remaining tanks to allow for adequate mixing and constant backpressure for the blowers.

4.7.3 Improvements for 8 MGD ADF Capacity

Table 4-20 summarizes solids holding tanks operating conditions at the maximum month biosolids loads and 8 MGD ADF. The existing three solids holding tanks are estimated to provide approximately a 4.7-day holding time. This holding time is sufficient and additional solids holding tank volume is not required. However, this holding time may be increased by thickening the solids in the holding tanks from 15,000 to 20,000 mg/L. The existing belt filter press is configured to thicken the solids and return the thickened solids to the solids holding tanks.

Table 4-20 Solids Holding Tanks –Design Criteria at 8 MGD ADF

Parameter	Unit	Value
Total Sludge Holding Tank Volume	gal	648,000
ADMM WAS	lb/day	18,400
Solids in holding tanks	lb/day	17,200
Solids Concentration in holding tanks	mg/L	15,000
ADMM WAS	gal/day	137,000
Estimated sludge holding time	day	4.7

The mixing air requirement for the solids holding tanks will be similar at 6 and 8 MGD ADF treatment capacity as the air requirement is dependent on the solids holding tank volume. Table 4-18 can be used as a basis for the expansion to 8 MGD ADF.

4.7.4 Control Strategy

It is recommended that the control strategy for the blowers remain the same as they are currently.

4.8 Dewatering

4.8.1 Existing Conditions

There is currently one 2-meter belt filter press on-site. Redundancy is provided through the use of a mobile centrifuge, owned by LCU. Current practice is to operate the press 4 to 5 days per week at 8 to 10 hours per day. Four-day operation results in 10-hour dewatering shifts. Therefore, the units operate approximately 40 hours per week. Dewatering frequency is limited by the landfill and the ability to move trailers at the plant site. Future dewatering conditions will require a 40-hour per week schedule, as well. **Table 4-21** summarizes the existing facilities. CDM Smith evaluated existing belt filter press operation data from January to May 2013 assuming 9 hour/day operation, as indicated by the operations staff. The data showed solids throughput rate of 451 dry lb/hr/meter. The solids throughput from the current operation is in agreement with the 350-450 dry lb/hr/meter range recommended by the belt filter press manufacturer Ashbrook for raw WAS. The existing 2-meter belt filter press is capable of dewatering 36,000 dry lb/week at the current operating schedule of 40 hr/week.

Table 4-21 Dewatering - Existing Facilities

Parameter	Unit	Value
Number of belt presses	---	1
Belt size	meter	2
Existing belt filter press solids throughput	dry lb/hr/meter	450
Belt filter press operation	hr/week	40
Existing press capacity at 40 hr/week	dry lb/week	36,000
Solids feed to the belt filter press at 6 MGD ADMM loads	dry lb/week	90,300

4.8.2 Improvements for 6 MGD ADF Capacity

CDM Smith process calculations and BioWin model simulations projected 90,000 dry lb/week of solids to be dewatered at the maximum month biosolids projection at 6 MGD ADF. One existing 2-meter belt filter press capacity will not be sufficient at 6 MGD treatment capacity. CDM Smith recommends installation of a new belt filter press. Two 2-meter belt filter presses can dewater 90,000 dry lb/day, when operated 50 hr/week at a solids throughput of 450 dry lb/hr/m. **Table 4-22** summarizes the belt filter press capacity evaluation and sizing basis. The proposed improvements include:

- A 2-meter belt filter press.
- A belt filter press feed pump.
- Belt filter press cake pump/screw conveyor.
- Polymer feed system improvements consisting of a polymer feed pump and a polymer storage tote.

Figure 4-11 and **Figure 4-12** present the proposed solids dewatering system improvements.

Dewatering system redundancy can still be provided through the use of the mobile centrifuge owned by LCU. In addition, the ability to move trailers that haul dewatered biosolids should be provided to operate two belt filter presses 10 hr/day and 5 days a week.

Table 4-22 Dewatering Requirements at 6 MGD ADF Capacity

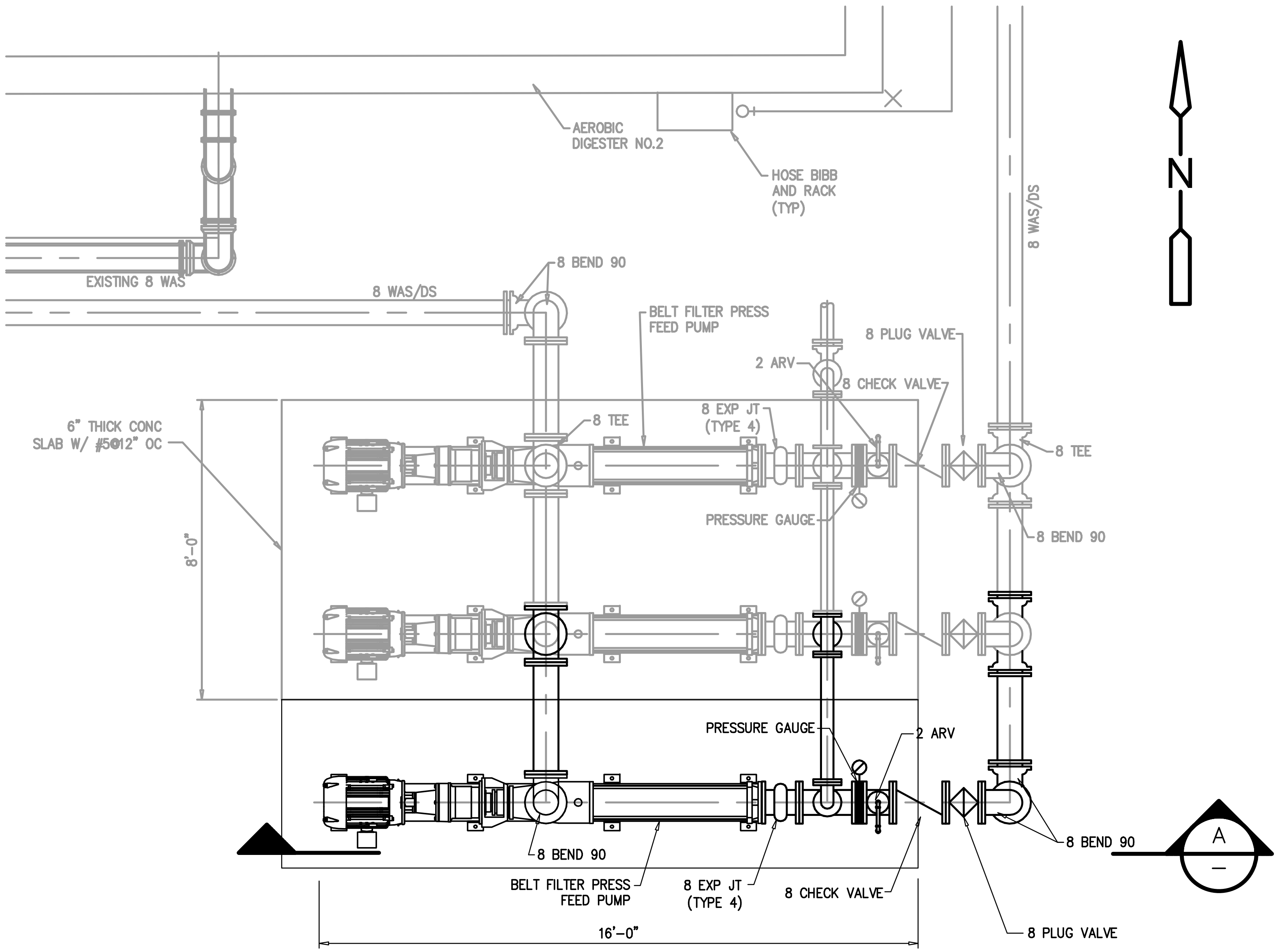
Parameter	Unit	Value
Number of belt filter presses, existing/new	---	1/1
Dewatering schedule	hr/week	50
Belt filter press solids throughput	dry lb/hr/meter	450
Total belt filter press capacity when operated 50 hr/week	dry lb/week	90,000
Solids feed to the belt filter press at 6 MGD ADMM loads	dry lb/day	12,900
Solids feed to the belt filter press at 6 MGD ADMM loads	dry lb/week	90,300

4.8.3 Improvements for 8 MGD ADF Capacity

CDM Smith estimated that a two 2-meter belt filter presses will be required to dewater 17,200 dry lb/day and 120,400 dry lb/day of solids at 8 MGD ADF and ADMM loading conditions. Two belt filter presses will have to run approximately 67 hr/week. This operation time seems to be high, but there is not sufficient room at the site for a third belt filter press without expanding the existing building. LCU may consider 14 hr/day operation for 5 days/week if the ability to move trailers that haul biosolids is provided. **Table 4-23** summarizes the belt filter sizing evaluation at 8 MGD ADF.

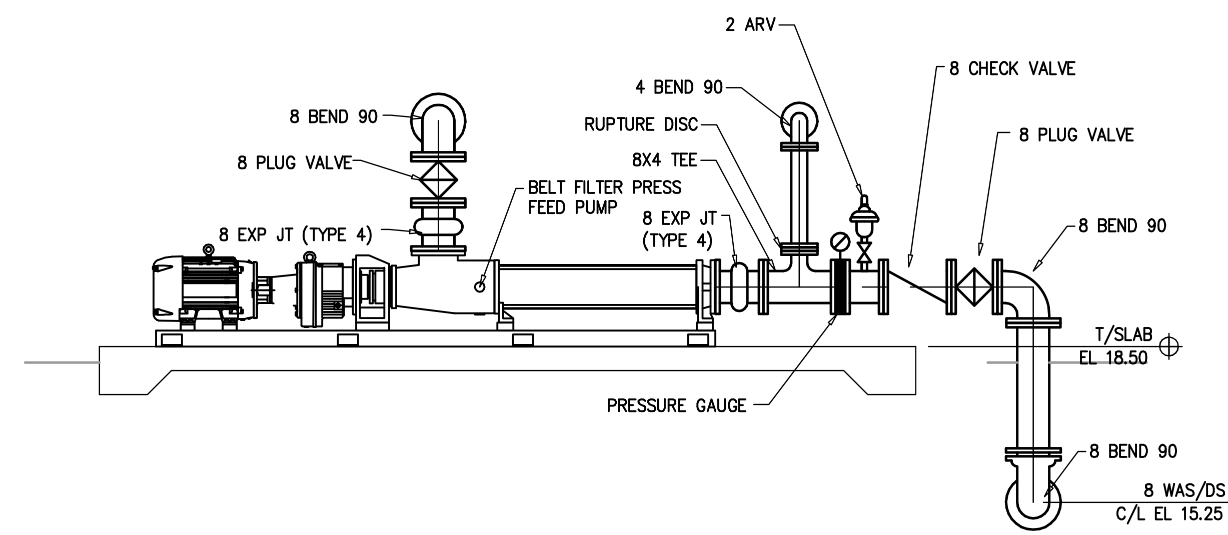
Table 4-23 Dewatering Requirements at 8 MGD ADF Capacity

Parameter	Unit	Value
Number of belt filter presses, existing/new		1/1
Dewatering schedule	hr/week	67
Belt filter press solids throughput	dry lb/hr/meter	450
Total belt filter press capacity when operated 67 hr/week	dry lb/week	120,400
Solids feed to the belt filter press at 6 MGD ADMM loads	dry lb/day	17,200
Solids feed to the belt filter press at 6 MGD ADMM loads	dry lb/week	120,400



PLAN

1/4" = 1'-0"



SECTION A

1/4" = 1'-0"

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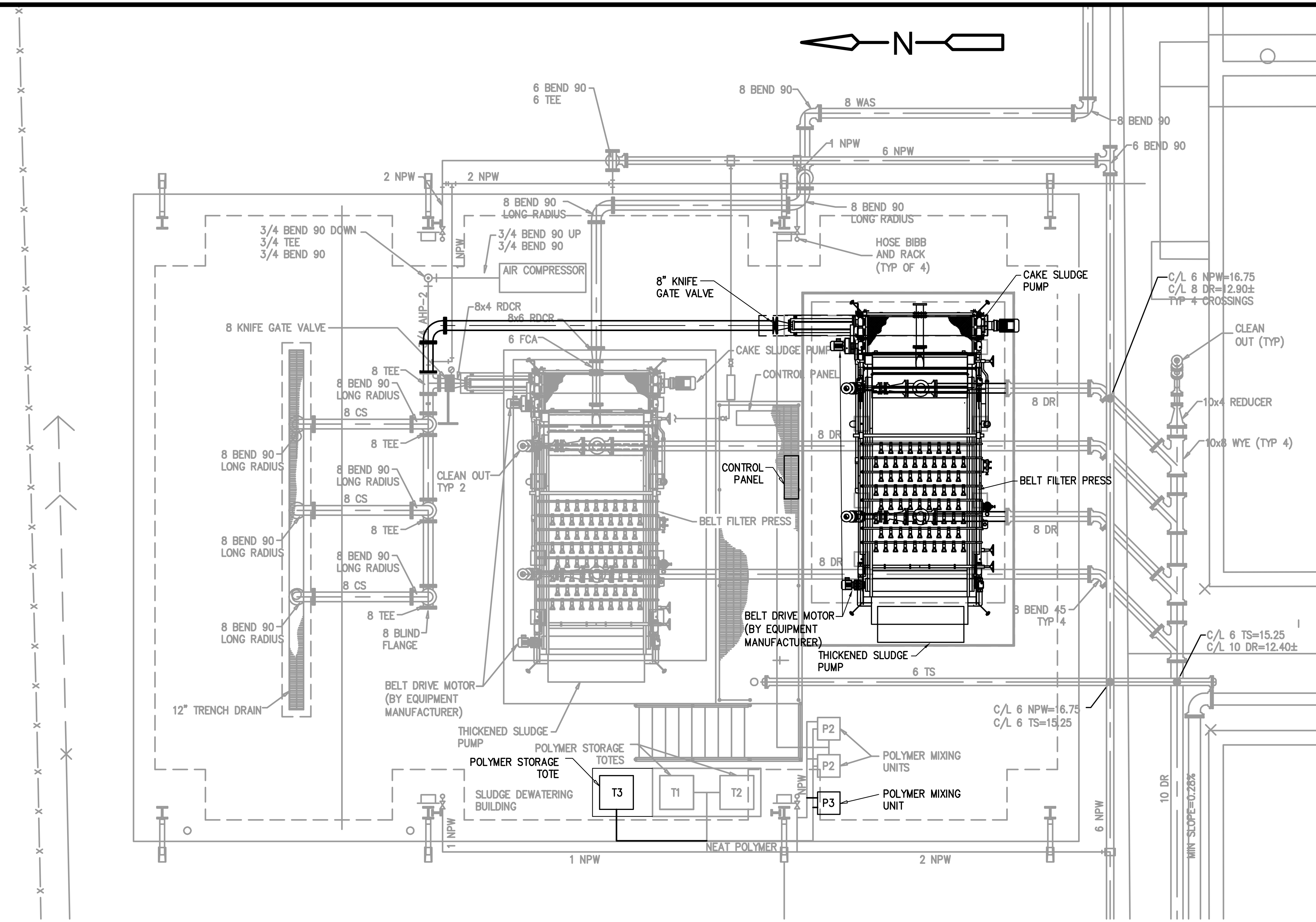
FIGURE NO. 4-11

BELT FILTER PRESS FEED PUMP IMPROVEMENTS FOR 6 MGD ADF

DECEMBER 2013



PLAN
1/8" = 1'-0"

CDM Smith

FIGURE NO. 4-12
SOLIDS DEWATERING SYSTEM EXPANSION FOR 6 MGD ADF
DECEMBER 2013

CDM Smith recommends the following to reduce the operating time of the belt filter presses:

- Utilizing solids thickening capability of the existing belt filter press. Solids concentration in the holding tanks may be raised from the current 1.5% solids to 2.0 to 2.5% solids. This would increase solids holding time and therefore additional solids stabilization. This may allow increasing solids throughput over 450 dry lb/hr/m.
- Maintaining higher percent solids in the holding tanks will also provide additional volatile solids reduction thereby decreasing the amount of solids to be dewatered.
- Consideration of operating mobile centrifuge owned by LCU when needed.

CDM Smith does not recommend installation of a third belt filter press. The above recommendations may provide acceptable operating schedules for the operations staff. Shorter weekly belt filter press operating hours will be required for the average day loading conditions.

4.8.4 Control Strategy

It is recommended that the control strategy for the existing belt filter press and polymer feed system remain the same. Also the same control strategy is implemented for the new belt filter press and polymer feed system.

4.9 Transfer Pumping

4.9.1 Existing Conditions

There are three transfer pumps (with room for a fourth) that withdraw water from the chlorine contact tanks and pump chlorinated effluent to either the reuse or reject storage tanks. **Table 4-24** summarizes the existing conditions.

Table 4-24 Transfer Pumps – Existing Conditions

Parameter	Unit	Value
Number of transfer pumps	---	3
Transfer pump capacity, each	gpm	6,250
Transfer pump capacity, firm	gpm	12,500
Transfer pump total dynamic head	ft	48

4.9.2 Improvements for 6 MGD ADF Capacity

Based on the manufacturer's operations and maintenance manuals, the transfer pumps have adequate capacity to pump 18 MGD, and therefore, are adequate at the 6 MGD ADF design condition. A detailed system curve was not developed in this task and it is recommended that this be done to verify nameplate data prior to construction of the next phase of upgrades.

4.9.3 Improvements for 8 MGD ADF Capacity

A fourth effluent transfer pump will be installed when the facility expands to 8 MGD ADF. Figure 4-10 presented the proposed location of a fourth effluent transfer pump.

4.9.4 Control Strategy

A change in the transfer pump protocol is not recommended in the future. The existing pumps turn on and off based on level set point in wet well. Effluent that is not compliant for reuse (due to high turbidity or low chlorine residual) is automatically diverted to reject storage using motor operated valves.

4.10 Effluent Pumping

4.10.1 Existing Conditions

There are four horizontal split case pumps that withdraw water from the reuse and reject storage tanks and pump to either the reclaimed water system or the deep injection well. An isolation valve is located on the discharge manifold that allows two pumps to be dedicated to reclaimed water and two pumps to the deep injection well. **Table 4-25** summarizes the existing conditions.

Table 4-25 Effluent Pumps – Existing Conditions

Data	Unit	Value
Number of effluent pumps	---	4
Effluent pump capacity, each	gpm	1,800
Effluent pump capacity, firm	gpm	12,500
Effluent pump total dynamic head	feet	139

4.10.2 Improvements for 6 MGD ADF Capacity

The effluent pumps will not have to pump the peak plant flows because of the 10 MG of reuse and reject storage tanks that serve as effluent flow equalization for the facility. At a maximum day flow of 9 MGD and a firm pumping capacity of 7.75 MGD, the tanks can store eight consecutive days of maximum day flows before the tank would fill while the effluent pumps were turned on. This is a conservative approach to evaluating the capacity requirements of the pump station as the data from 2010 through 2012 indicated that the highest weekly flow peaking factor was 1.25.

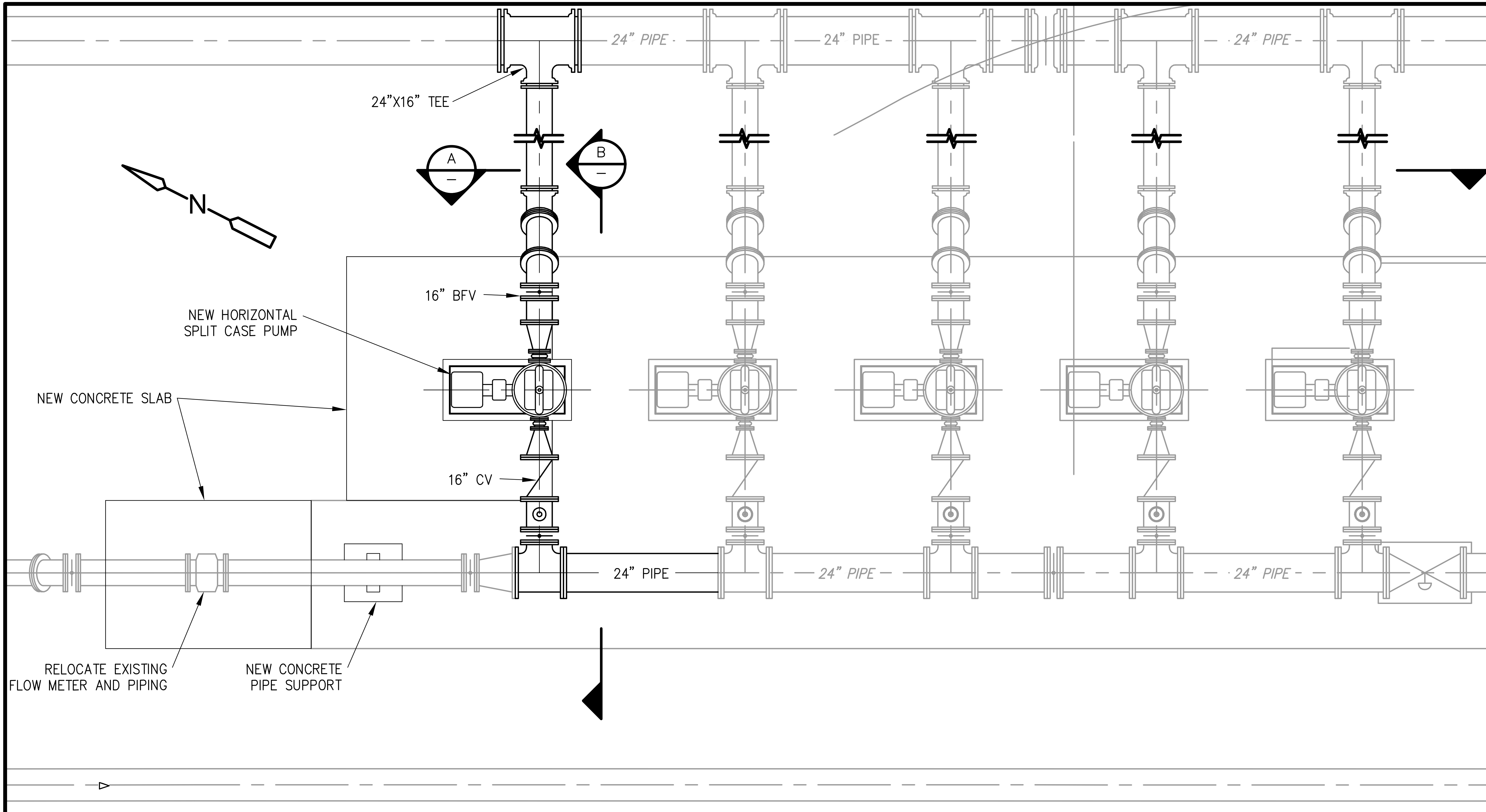
Based on the manufacturer's operations and maintenance manuals along with storage calculations utilizing 10 MG of reuse and reject storage, the effluent pumps have adequate capability at the 6 MGD condition, assuming that maximum day flows do not occur over nine consecutive days. A detailed system curve was not developed in this task and it is recommended that this be done in conjunction with a more thorough evaluation of the deep wells using mechanical integrity tests to verify that the pumps will still operate at their design condition.

4.10.3 Improvements for 8 MGD ADF Capacity

At a maximum day flow of 12 MGD and a firm pumping capacity of 8.75 MGD (assumes a new effluent pump will be installed so deep well capacity can be maximized), the tanks can store three consecutive days of maximum day flows before the pump station would be compromised. It is recommended to increase the pump station capacity during the expansion to 8 MGD ADF. **Figures 4-13 and 4-14** present the effluent pump station improvements.

4.10.4 Control Strategy

A change in the transfer pump protocol is not recommended in the future. Each offsite reuse disposal facility has an individual controller to control reuse flow to their site. Each of the off-site disposal facilities are also equipped with level control valves which automatically close as reuse disposal storage capacity diminishes. As each site nears capacity and reaches the prescribed maximum reuse water storage level, its level control valve will automatically close. To maintain a constant pressure in the reuse distribution system when offsite disposal facility valves automatically close, the reuse



PLAN

1" = 60'-0"

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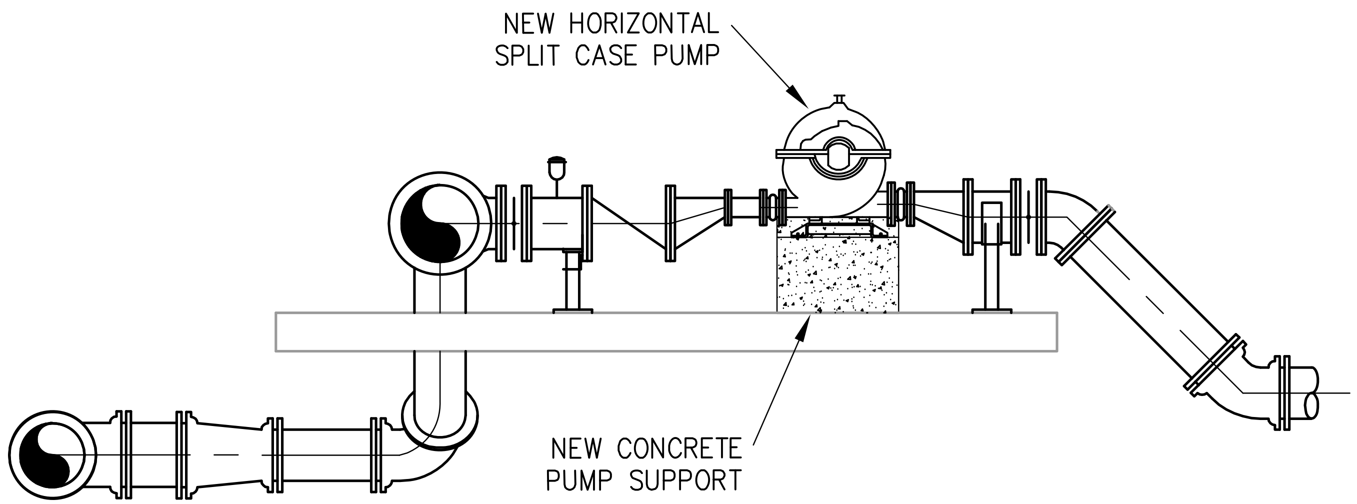
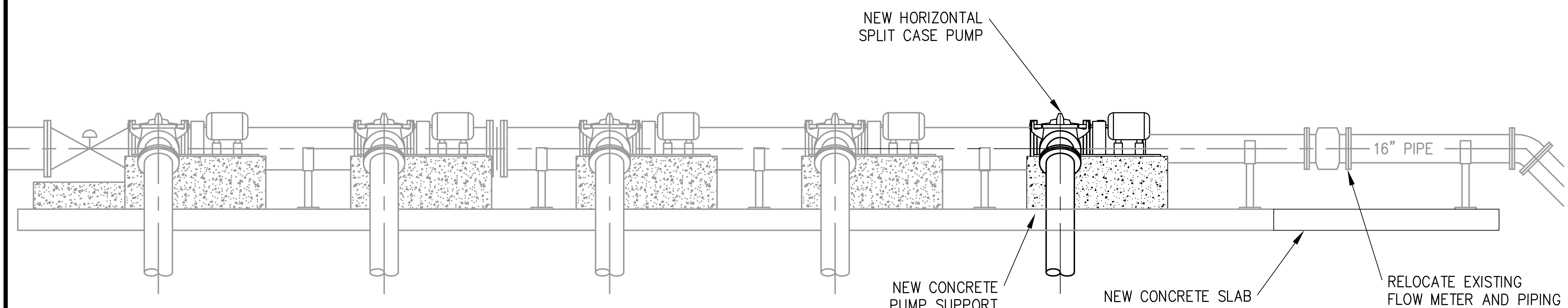
FIGURE NO. 4-13

EFFLUENT PUMP STATION EXPANSION FOR 8 MGD ADF

DECEMBER 2013



SECTION A
1" = 60'-0"



SECTION B
1" = 60'-0"

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FIGURE NO. 4-14
EFFLUENT PUMP STATION EXPANSION FOR 8 MGD ADF
DECEMBER 2013

distribution pressure controller will automatically slow down the speed of the effluent transfer pump variable frequency drives to meet the diminished reuse disposal. As the pumps slow down, reuse flow offsite will decrease and the level in reuse storage tank 80-T-4 will increase.

During a wet weather event, the reuse distribution pressure controller is automatically disabled and the effluent pumps are controlled from level sensors in the storage tanks. The pumps speed up to drain the tanks, causing an increase in pressure, until the maximum allowable pressure in the reuse system is achieved which leads to the pressure sustaining valve opening and diverting flow to the deep wells.

4.11 Reuse and Reject Storage

4.11.1 Existing Conditions

The transfer pumps discharge water to either the reuse or reject storage tanks on-site. Existing motor operated valves allow flow diversion to the reject storage tanks. There are four open-top storage tanks presently on site that serve as either reuse or reject storage. **Table 4-26** provides a summary of the volume and function of the storage tanks on-site.

Table 4-26 Storage Tanks – Existing Conditions

Tank	Unit	Value
Reuse	MG	5.00
Reuse/reject	MG	5.00
Reject	MG	1.50
Reject	MG	1.12

4.11.2 Improvements for 6 MGD ADF Capacity

FAC Section 62-610.464 governs the requirements for reuse and rejects storage. For restricted access slow-rate land application systems, system storage capacity shall be the volume equal to three times that portion of the average daily flow of the total reuse capacity for which no alternative reuse or disposal system is permitted. The effluent pump station capacity is less than the deep well permitted capacity (to be discussed later), and thus, is used as the maximum flow to the effluent disposal system.

The storage requirement for reuse would be determined by the difference between the maximum three-day flow to the facility and the deep well capacity. The maximum three-day flow peaking factor from historical data is 1.34, yielding an average influent flow of 8.04 MGD each day for a three-day period. The current firm capacity of the effluent pump station is 7.75 MGD. Three days of storage would yield a requirement of 0.87 MG, which can be stored in the dedicated 5 MG reuse storage tank. Reuse storage is adequate for the 6 MGD condition.

FAC Section 62.610.464(3) also mandates the requirement for a separate, off-line system for storage of reject water, unless another permitted reuse system or effluent disposal system is capable of discharging the reject. At a minimum, this capacity shall be the volume equal to one day flow at the average daily design flow of the treatment plant or the average daily permitted flow of the reuse system, whichever is less.

The storage requirement for reject storage would be determined by the difference between the maximum day flow to the facility and the treated effluent send to reuse and disposal. In this case, the resulting differential flow is 1.25 MG. One day of storage would yield a requirement of 1.25 MG, which can be stored in the 5 MG reuse/reject storage tank or in the 1.5 MG reject storage tank. Reject storage is adequate for the 6 MGD ADF condition.

4.11.3 Improvements for 8 MGD ADF Capacity

A similar approach for storage can be used at the 8 MGD ADF condition. The storage requirement for reuse would be determined by the difference between the maximum day flow to the facility and the flow out of the plant. It is presumed that in this case, the effluent pump station would be expanded at a minimum to match the Three Oaks WWTP allocation of deep well disposal capacity. This capacity assumes that 0.5 MG of deep well capacity is used by the concentrate generated at the Pinewoods Water Treatment Plant. The allocated deep well capacity for the Three Oaks facility is estimated at 8.75 MGD.

Maximum three-day flows for the 8 MGD ADF design condition at a 1.34 peaking factor is 10.72 MGD. The differential flow between the influent flow and the deep well capacity is 1.97 MGD. Three days of storage would yield a requirement of 5.91 MG, which can be stored in the dedicated 5 MG reuse storage tank and a portion of the 5 MG reuse/reject storage tank. Reuse storage is adequate for the 8 MGD ADF condition.

Likewise, 3.25 MG of reject storage would be required at the 8 MGD ADF design condition. Reject water can be stored in the 5 MG reuse/reject storage tank and both dedicated reject storage tanks. Reject storage is adequate for the 8 MGD ADF condition.

4.11.4 Control Strategy

Not applicable.

4.12 Deep Injection Wells

4.12.1 Existing Conditions

There are two deep injection wells that the facility can use to dispose of effluent that is not sent for reuse. **Table 4-27** provides a summary of the deep injection wells.

Table 4-27 Deep Injection Wells – Existing Conditions

Parameter	Unit	Value
Well No.1 (at the Pinewoods Water Treatment Plant site)		
Maximum flow	MGD	1.87
Casing diameter	inches	14
Annular space material	---	Fluid
Permitted maximum pressure	psi	101
Well No.2 (at the Three Oaks WWTP site)		
Maximum flow	MGD	7.4
Casing diameter	inches	14.5
Annular space material	---	Packer
Permitted maximum pressure	psi	117

4.12.2 Improvements for 6 MGD ADF Capacity

Additional deep well capacity is not anticipated to be needed at 6 MGD ADF.

4.12.3 Improvements for 8 MGD ADF Capacity

Additional deep well capacity is not anticipated to be needed at 8 MGD ADF.

4.13 Design Conditions

4.13.1 BioWin Model Calibration

CDM Smith used steady-state process model simulations to evaluate the existing biological treatment capacity at the Three Oaks WWTP. "Methods for Wastewater Characterization in Activated Sludge Modeling," published by Water Environment Research Foundation (2003), describes the following four levels of model calibration in detail:

1. Level 1: Defaults and assumptions only
2. Level 2: Historical data only
3. On-site, full-scale testing
4. Direct parameter measurements

A Level 2 calibration of the BioWin model was performed using the historical Three Oaks WWTP data. Level 2 BioWin model calibration indicates that influent chemical oxygen demand (COD) characterization was not performed. CDM Smith adjusted the COD fractions in the model in an attempt to calibrate to the field conditions.

The calibration information provided by LCU for influent flows, concentrations, effluent concentrations, and other process parameter including WAS quantities, MLSS concentrations in the oxidation ditches, ant RAS flows etc. The plant data used for the model calibration was from March through May 2013, which was the most recent available data. **Table 4-28** summarizes the results of the operational parameters and effluent concentrations from the facility during that time period and compares it to the model prediction. The results indicate a very strong correlation and, therefore, it is presumed that the model is calibrated for use to evaluate the biological treatment capacity of the facility under current and future conditions. The calibrated model was used for the following:

- Treatment capacity evaluation of the existing Oxidation Ditches 1, 2, and 3.
- Aeration system capacity evaluation of the existing Oxidation Ditches 1, 2, and 3.
- Sizing the proposed Oxidation Ditch 4 volume for the current phase and Oxidation Ditch 5 volume for the future phase.
- Sizing the aeration system for the proposed Oxidation Ditch 4 for the current phase and Oxidation Ditch 5 for the future phase.
- Estimating the mass balances for the current and future phase AD and ADMM conditions.
- Estimating solids loading to the solids holding tanks and solids dewatering systems.

Table 4-28 Steady-State Calibration of Model Process Parameters

Parameter	Unit	Facility Average (Mar-May 2013)	Model Prediction
Process Parameters			
MLSS	mg/L	5,503	5,519
MLVSS	mg/L	4,604	4,443
WAS	lb/d	4,192	4,263
Dewatered Cake	lb/d	4,018	3,900
SRT	days	32.8	32.4
Net yield	lb WAS/lb BOD_5 removed	0.72	0.74
Effluent Concentrations			
BOD_5	mg/L	1.1	0.9
TSS[1]	mg/L	0.2	1.4
TN	mg/L	7.4	7.9
TKN	mg/L	1.7	2.1
NH_4-N	mg/L	0.22	0.22
NO_3-N	mg/L	5.5	5.7

[1] Facility average includes use of filters while the model prediction did not include filters. This discrepancy is a non-issue in terms of predicting biological treatment performance.

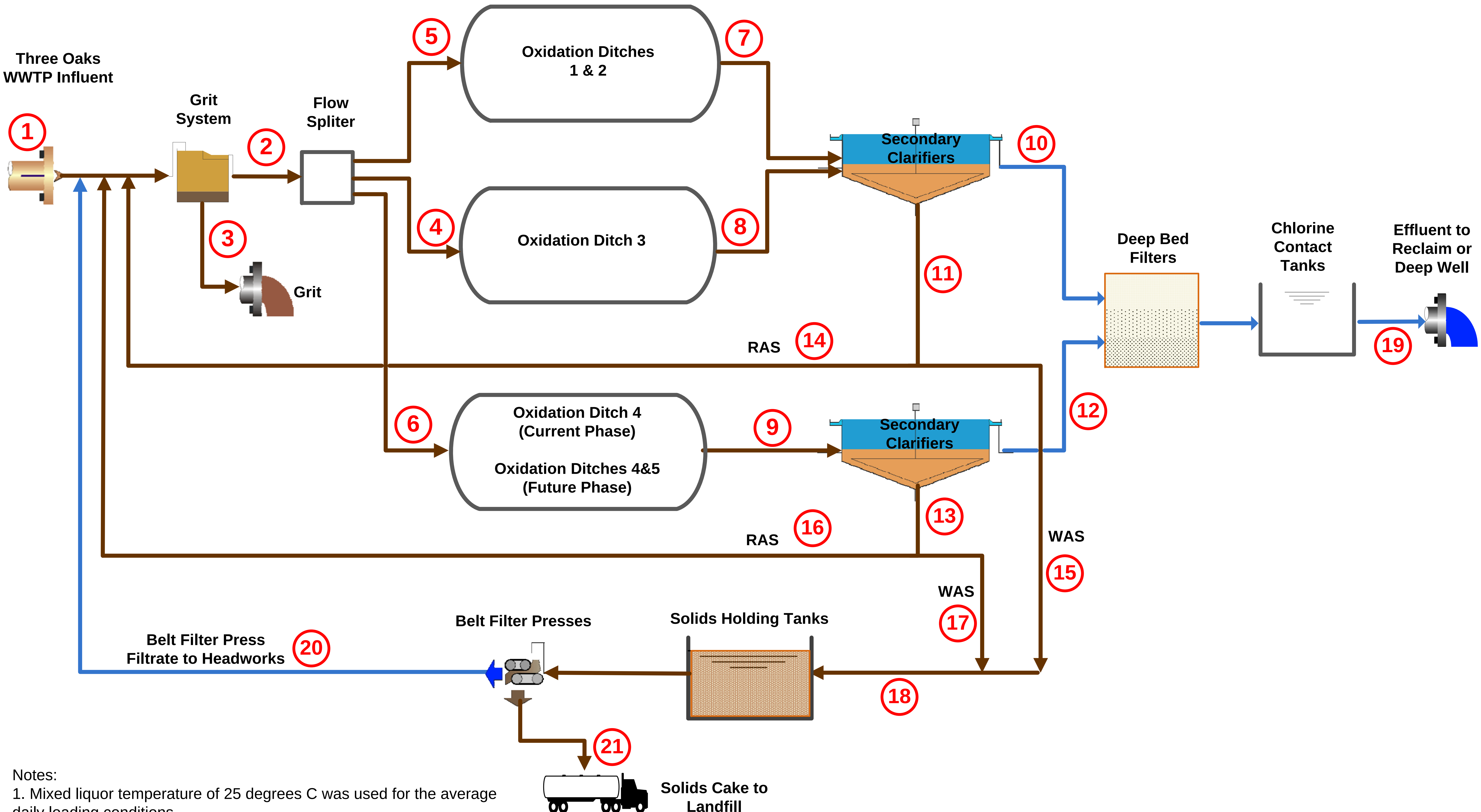
4.13.2 Mass Balance

Figure 4-15 presents the flowstreams used for the Three Oaks WWTP mass balance. **Table 4-29** and **Table 4-30** present the mass balance at 6 and 8 MGD average day and average day max month loads, respectively. Calibrated BioWin model was used for the mass balance calculations.

4.13.3 Hydraulic Profile

The gravity hydraulics for the facility were run at the respective peak hour flows at the 6 MGD ADF and 8 MGD ADF design capacities. The hydraulic modeling program Visual Hydraulics® was used to estimate the water surface elevations throughout the facility at peak flow conditions. Friction losses in piping, conduits, and open channels were obtained using the Manning's equation using a roughness coefficient of 0.012. The hydraulic profile was generated based on the facility arrangements shown on the existing record drawings as well as proposed layouts for each expansion as detailed in this report. The following assumptions were made for this analysis:

- A maximum flow of 22.5 mgd is conveyed through the headworks. RAS flow during wet weather events is diverted downstream of the grit removal units.
- Proportional flow splitting to all four oxidation ditches at 6 MGD ADF treatment capacity and to all five oxidation ditches at 8 MGD ADF treatment capacity utilizing the flow splitting structure at the headworks structure.
- Mixed liquor flows from the Oxidation Ditches 1, 2, and 3 are equally split to Secondary Clarifiers 1, 2, and 3 (per new clarifier numbering).
- Mixed liquor flows from the Oxidation Ditches 4 and 5 will be equally split to Secondary Clarifiers 4, 5, and 6 (per new clarifier numbering).
- Peripheral Secondary Clarifiers 1 through 4 (per current clarifier numbering) are demolished.



Notes:
1. Mixed liquor temperature of 25 degrees C was used for the average daily loading conditions.
2. Mixed liquor temperature of 20 degrees C was used for the average day maximum month loading conditions.

CDM Smith

Figure 4-15
THREE OAKS WWTP MASS BALANCES AT 6 AND 8 MGD ADF

Table 4-29: Three Oaks WWTP Mass Balance at 6 MGD Average Day and Average Day Max Month

6 MGD Average Day Flows and Loads

Flowstream ID	Elements	Flow	COD		BOD5		TSS		VSS		Total N		TKN		Ammonia-N		Nitrate-N		Nitrite-N		Alkalinity	
		mgd	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mmol/L	lb mol/day
1	Influent	6.00	528	26,435	229	11,468	231	11,569	205	10,265	49	2,454	49	2,454	33.3	1,668	0	0	0.0	0.0	6.0	136,275
2	Grit System Effluent	10.50	5,848	512,193	767	67,150	4,509	394,912	3,742	327,795	267	23,426	263	23,060	19.2	1,680	4.1	363	0.0	3.6	4.7	186,562
3	Grit Removed		528	1	229	0	78,205	131	205	0	49	0	49	0	33.3	0	0	0	0.0	0.0	6.0	5
4	Oxidation Ditch 3 Influent	3.50	5,848	170,731	767	22,383	4,509	131,637	3,742	109,265	267	7,809	263	7,687	19.2	560	4.1	121	0.0	1.2	4.7	62,187
5	Oxidation Ditches 1 & 2 Combined Influent	3.50	5,848	170,731	767	22,383	4,509	131,637	3,742	109,265	267	7,809	263	7,687	19.2	560	4.1	121	0.0	1.2	4.7	62,187
6	Oxidation Ditch 4 Influent	3.50	5,848	170,731	767	22,383	4,509	131,637	3,742	109,265	267	7,809	263	7,687	19.2	560	4.1	121	0.0	1.2	4.7	62,187
7	Oxidation Ditches 1&2 Combined Effluent	3.50	5,681	165,868	651	18,993	4,472	130,564	3,703	108,113	249	7,273	242	7,057	0.4	12	7.3	214	0.1	2.7	3.2	41,898
8	Oxidation Ditch 3 Effluent	3.50	5,684	165,940	652	19,046	4,474	130,625	3,705	108,174	246	7,175	242	7,056	0.3	10	3.9	114	0.1	3.8	3.4	45,022
9	Oxidation Ditch 4 Effluent	3.50	5,679	165,799	648	18,933	4,471	130,549	3,702	108,093	253	7,401	241	7,051	0.2	5	11.9	348	0.1	2.0	2.8	37,338
10	Existing Train Clarifiers Effluent	4.00	31	1,037	2	52	2	78	2	65	8	272	2	81	0.4	13	5.6	187	0.1	3.8	3.3	49,652
11	Existing Train (RAS+WAS)	3.00	13,212	330,771	1,517	37,987	10,429	261,111	8,636	216,221	566	14,175	560	14,032	0.4	10	5.6	141	0.1	2.8	3.3	37,268
12	New Train Clarifiers Effluent	2.00	31	509	1	19	2	39	2	32	14	238	2	38	0.2	3	11.9	199	0.1	1.1	2.8	21,329
13	New Train (RAS+WAS)	1.50	13,204	165,290	1,511	18,914	10,426	130,509	8,632	108,060	572	7,163	560	7,012	0.2	2	11.9	149	0.1	0.8	2.8	16,009
14	Existing Train RAS	2.936	13,212	323,715	1,517	37,177	10,429	255,541	8,636	211,608	566	13,873	560	13,732	0.4	9	5.6	138	0.1	2.8	3.3	36,473
15	Existing Train WAS	0.064	13,212	7,056	1,517	810	10,429	5,570	8,636	4,613	566	302	560	299	0.4	0	5.6	3	0.1	0.1	3.3	795
16	New Train RAS	2.903	13,204	161,654	1,511	18,498	10,426	127,638	8,632	105,683	572	7,005	560	6,858	0.2	2	11.9	146	0.1	0.8	2.8	15,657
17	New Train WAS	0.033	13,204	3,636	1,511	416	10,426	2,871	8,632	2,377	572	158	560	154	0.2	0	11.9	3	0.1	0.0	2.8	352
18	Combined WAS	0.097	13,209	10,693	1,515	1227	10,428	8,442	8,635	6,990	568	460	560	454	0.3	0	7.8	6	0.1	0.1	3.1	1,147
19	Final Effluent	6.00	31	1,546	1	71	2	118	2	97	10	511	2	120	0.3	16	7.7	386	0.1	4.9	3.1	70,981
20	Belt Filter Press Filtrate	0.044	1,031	379	21	8	799	294	650	239	246	91	40	15	0.0	0	206.0	76	0.0	0.0		
21	Solids Cake	0.005	240,814	8,861	4,909	181	191,808	7,058	156,090	5,743	9,415	346	9,209	339	0.0	0	206.0	8	0.0	0.0		

6 MGD Average Day Max Month Flows and Loads

Flowstream ID	Elements	Flow	COD		BOD5		TSS		VSS		Total N		TKN		Ammonia-N		Nitrate-N		Nitrite-N		Alkalinity	
		mgd	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mmol/L	lb mol/day
1	Influent	7.20	637	38,292	274	16,466	287	17,248	256	15,382	57	3,425	57	3,425	38.8	2,329	0	0	0.0	0.0	6.0	163,530
2	Grit System Effluent	11.69	5,913	576,987	1,079	105,271	4,508	439,911	3,786	369,456	287	27,973	282	27,475	24.1	2,348	5.0	492	0.1	6.7	4.6	203,087
3	Grit Removed		637	1	274	0	111,856	187	256	0	57	0	57	0	38.8	0	0	0	0.0	0.0	6.0	5
4	Oxidation Ditch 3 Influent	3.90	5,913	192,329	1,079	35,090	4,508	146,637	3,786	123,152	287	9,324	282	9,158	24.1	783	5.0	164	0.1	2.2	4.6	67,696
5	Oxidation Ditches 1 & 2 Combined Influent	3.90	5,913	192,329	1,079	35,090	4,508	146,637	3,786	123,152	287	9,324	282	9,158	24.1	783	5.0	164	0.1	2.2	4.6	67,696
6	Oxidation Ditch 4 Influent	3.90	5,913	192,329	1,079	35,090	4,508	146,637	3,786	123,152	287	9,324	282	9,158	24.1	783	5.0	164	0.1	2.2	4.6	67,696
7	Oxidation Ditches 1&2 Combined Effluent	3.90	5,709	185,710	938	30,525	4,465	145,242	3,739	121,613	266	8,665	256	8,318	0.6	21	10.5	342	0.2	5.4	2.6	38,045
8	Oxidation Ditch 3 Effluent	3.90	5,714	185,858	941	30,619	4,469	145,364	3,742	121,733	265	8,616	256	8,319	0.5	16	9.0	292	0.2	5.7	2.7	39,542
9	Oxidation Ditch 4 Effluent	3.90	5,710	185,733	939	30,540	4,466	145,290	3,740	121,660	265	8,610	256	8,313	0.4	14	8.9	290	0.2	6.6	2.7	39,494
10	Existing Train Clarifiers Effluent	4.80	37	1,467	2	75	2	87	2	73	13	509	3	112	0.6	22	9.7	390	0.2	6.8	2.6	47,730
11	Existing Train (RAS+WAS)	3.00	14,783	370,101	2,439	61,068	11,604	290,519	9,717	243,274	670	16,773	660	16,525	0.6	14	9.7	244	0.2	4.2	2.6	29,858
12	New Train Clarifiers Effluent	2.40	36	717	1	26	2	44	2	37	12	236	3	53	0.4	9	8.9	179	0.2	4.1	2.7	24,296
13	New Train (RAS+WAS)	2.40	14,780	185,017	2,438	30,514	11,603	145,246	9,716	121,623	669	8,375	660	8,260	0.4	5	8.9	112	0.2	2.6	2.7	15,198
14	Existing Train RAS	2.908	14,783	358,752	2,439	59,196	11,604	281,609	9,717	235,813	670	16,258	660	16,018	0.6	14	9.7	236	0.2	4.1	2.6	28,942
15	Existing Train WAS	0.092	14,783	11,350	2,439	1,873	11,604	8,909	9,717	7,460	670	514	660	507	0.6	0	9.7	7	0.2	0.1	2.6	916
16	New Train RAS	2.862	14,780	179,343	2,438	29,579	11,603	140,792	9,716	117,893	669	8,118	660	8,007	0.4	5	8.9	108	0.2	2.5	2.7	14,732
17	New Train WAS	0.046	14,780	5,674	2,438	936	11,603	4,454	9,716	3,730	669	257	660	253	0.4	0	8.9	3	0.2	0.1	2.7	466
18	Combined WAS	0.138	14,782	17,024	2,439	2809	11,604	13,363	9,717	11,190	670	771	660	760	0.5	1	9.5	11	0.2	0.2	2.7	1,382
19	Final Effluent	7.19	36	2,183	2	101	2	131	2	110	12	745	3	165	0.5	31	9.5	568	0.2	10.9	2.7	72,025
20	Belt Filter Press Filtrate	0.063	1,111	582	58	31	856	448	702	367	315	165	45	23	0.0	0	270.0	141	0.0	0.0		
21	Solids Cake	0.006	258,882	13,552	13,920	729	205,366	10,751	168,481	8,820	10,571	553	10,301	539	0.0	0	270.0	14	0.0	0.0		

Table 4-30: Three Oaks WWTP Mass Balance at 8 MGD Average Day and Average Day Max Month

8 MGD Average Day Flows and Loads

Flowstream ID	Elements	Flow	COD		BOD5		TSS		VSS		Total N		TKN		Ammonia-N		Nitrate-N		Nitrite-N		Alkalinity	
		mgd	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mmol/L	lb mol/day
1	Influent	8.00	528	35,247	229	15,291	231	15,425	205	13,686	49	3,271	49	3,271	33.3	2,225	0.0	0.0	0.0	0.0	6.0	181,700
2	Grit System Effluent	13.99	5,824	680,131	763	89,160	4,490	524,341	3,727	435,267	267	31,172	262	30,644	19.2	2,239	4.5	523	0.0	4.6	4.7	247,500
3	Grit Removed		528	1	229	0	104,205	174	205	0	49	0	49	0	33.3	0	0.0	0.0	0.0	0.0	6.0	5
4	Oxidation Ditch 3 Influent	3.50	5,824	170,033	763	22,290	4,490	131,085	3,727	108,817	267	7,793	262	7,661	19.2	560	4.5	131	0.0	1.1	4.7	61,875
5	Oxidation Ditches 1 & 2 Combined Influent	3.50	5,824	170,033	763	22,290	4,490	131,085	3,727	108,817	267	7,793	262	7,661	19.2	560	4.5	131	0.0	1.1	4.7	61,875
6	Oxidation Ditch 4&5 Influent	3.50	5,824	340,065	763	44,580	4,490	262,170	3,727	217,633	267	15,586	262	15,322	19.2	1,119	4.5	262	0.0	2.3	4.7	123,750
7	Oxidation Ditches 1&2 Combined Effluent	3.50	5,658	165,187	648	18,913	4,453	130,022	3,688	107,674	248	7,229	241	7,032	0.4	13	6.6	194	0.1	3.1	3.2	42,564
8	Oxidation Ditch 3 Effluent	3.50	5,660	165,260	649	18,961	4,456	130,086	3,690	107,737	247	7,201	241	7,032	0.3	9	5.7	166	0.1	3.3	3.3	43,354
9	Oxidation Ditch 4&5 Effluent	7.00	5,655	330,233	646	37,705	4,453	260,007	3,687	215,305	252	14,710	241	14,052	0.2	12	11.2	653	0.1	4.4	2.9	76,134
10	Existing Train Clarifiers Effluent	4.00	31	1,036	2	51	2	78	2	65	9	290	2	81	0.4	13	6.2	206	0.1	3.7	3.2	49,080
11	Existing Train (RAS+WAS)	3.00	13,157	329,412	1,511	37,823	10,386	260,029	8,601	215,346	565	14,140	558	13,983	0.4	9	6.2	154	0.1	2.8	3.2	36,838
12	New Train Clarifiers Effluent	4.00	31	1,017	1	38	2	78	2	65	14	453	2	77	0.2	7	11.2	373	0.1	2.5	2.9	43,491
13	New Train (RAS+WAS)	3.00	13,150	329,216	1,505	37,667	10,382	259,929	8,597	215,240	569	14,257	558	13,975	0.2	5	11.2	280	0.1	1.9	2.9	32,643
14	Existing Train RAS	2.935	13,157	322,275	1,511	37,003	10,386	254,395	8,601	210,680	565	13,833	558	13,680	0.4	9	6.2	151	0.1	2.7	3.2	36,040
15	Existing Train WAS	0.065	13,157	7,137	1,511	819	10,386	5,634	8,601	4,666	565	306	558	303	0.4	0	6.2	3	0.1	0.1	3.2	798
16	New Train RAS	2.935	13,150	322,083	1,505	36,851	10,382	254,297	8,597	210,576	569	13,948	558	13,672	0.2	5	11.2	274	0.1	1.8	2.9	31,936
17	New Train WAS	0.065	13,150	7,133	1,505	816	10,382	5,632	8,597	4,664	569	309	558	303	0.2	0	11.2	6	0.1	0.0	2.9	707
18	Combined WAS	0.130	13,154	14,270	1,508	1636	10,384	11,266	8,599	9,329	567	615	558	606	0.3	0	8.7	9	0.1	0.1	3.1	1,505
19	Final Effluent	7.99	31	2,053	1	89	2	156	2	129	11	743	2	158	0.3	19	8.7	579	0.1	6.2	3.1	92,571
20	Belt Filter Press Filtrate	0.059	1,038	512	30	15	805	397	656	324	230	114	41	20	0.0	0	189.6	93	0.0	0.0		
21	Solids Cake	0.006	242,718	11,969	7,017	346	193,217	9,528	157,493	7,767	9,570	472	9,381	463	0.0	0	189.6	9	0.0	0.0		

8 MGD Average Day Max Month Flows and Loads

Flowstream ID	Elements	Flow	COD		BOD5		TSS		VSS		Total N		TKN		Ammonia-N		Nitrate-N		Nitrite-N		Alkalinity	
		mgd	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mg/L	lb/d	mmol/L	lb mol/day
1	Influent	9.60	637	51,057	274	21,955	287	22,998	256	20,510	57	4,567	57	4,567	38.8	3,105	0.0	0.0	0.0	0.0	6.0	218,040
2	Grit System Effluent	15.59	5,921	770,477	1,080	140,556	4,515	587,449	3,792	493,434	288	37,429	282	36,715	24.1	3,130	5.4	705	0.1	9.2	4.6	269,351
3	Grit Removed		637	1	274	0	149,056	249	256	0	57	0	57	0	38.8	0	0.0	0.0	0.0	0.0	6.0	5
4	Oxidation Ditch 3 Influent	3.90	5,921	192,619	1,080	35,139	4,515	146,862	3,792	123,358	288	9,357	282	9,179	24.1	782	5.4	176	0.1	2.3	4.6	67,338
5	Oxidation Ditches 1 & 2 Combined Influent	3.90	5,921	192,619	1,080	35,139	4,515	146,862	3,792	123,358	288	9,357	282	9,179	24.1	782	5.4	176	0.1	2.3	4.6	67,338
6	Oxidation Ditches 4&5 Influent	7.80	5,921	385,238	1,080	70,278	4,515	293,725	3,792	246,717	288	18,714	282	18,358	24.1	1,565	5.4	352	0.1	4.6	4.6	134,675
7	Oxidation Ditches 1&2 Combined Effluent	3.90	5,719	186,020	940	30,590	4,472	145,474	3,745	121,829	265	8,636	256	8,339	0.7	22	8.9	290	0.2	6.9	2.7	39,782
8	Oxidation Ditch 3 Effluent	3.90	5,727	186,282	946	30,763	4,478	145,657	3,751	122,014	261	8,476	257	8,346	0.7	22	3.7	120	0.3	9.4	3.1	45,231
9	Oxidation Ditch 4&5 Effluent	7.80	5,717	371,934	939	61,071	4,473	290,979	3,745	243,671	272	17,680	256	16,664	0.3	21	15.5	1,008	0.1	7.9	2.2	65,165
10	Existing Train Clarifiers Effluent	4.80	37	1,466	2	74	2	87	2	73	9	378	3	115	0.7	27	6.3	252	0.3	10.0	2.9	52,298
11	Existing Train (RAS+WAS)	3.00	14,812	370,836	2,448	61,279	11,625	291,043	9,737	243,770	668	16,734	662	16,570	0.7	17	6.3	158	0.3	6.3	2.9	32,715
12	New Train Clarifiers Effluent	4.80	36	1,435	1	52	2	87	2	73	18	729	3	103	0.3	13	15.5	620	0.1	4.9	2.2	40,088
13	New Train (RAS+WAS)	3.00	14,799	370,500	2,437	61,019	11,619	290,892	9,730	243,598	677	16,951	661	16,560	0.3	8	15.5	388	0.1	3.0	2.2	25,077
14	Existing Train RAS	2.908	14,812	359,464	2,448	59,400	11,625	282,118	9,737	236,294	668	16,221	662	16,062	0.7	16	6.3	153	0.3	6.1	2.9	31,712
15	Existing Train WAS	0.092	14,812	11,372	2,448	1,879	11,625	8,925	9,737	7,476	668	513	662	508	0.7	1	6.3	5	0.3	0.2	2.9	1,003
16	New Train RAS	2.908	14,799	359,138	2,437	59,147	11,619	281,971	9,730	236,128	677	16,432	661	16,053	0.3	8	15.5	376	0.1	3.0	2.2	24,308
17	New Train WAS	0.092	14,799	11,362	2,437	1,871	11,619	8,921	9,730	7,470	677	520	661	508	0.3	0	15.5	12	0.1	0.1	2.2	769
18	Combined WAS	0.184	14,805	22,734	2,442	3750	11,622	17,846	9,733	14,946	673	1,033	662	1,016	0.5	1	10.9	17	0.2	0.3	2.5	1,772
19	Final Effluent	9.59	36	2,900	2	126	2	175	2	146	14	1,106	3	219	0.5	40	10.9	873	0.2	14.9	2.5	92,385
20	Belt Filter Press Filtrate	0.084	1,138	794	76	53	876	611	720	503	286	200	47	33	0.0	0	239.3	167	0.0	0.0		
21	Solids Cake	0.009	265,177	18,509	18,222	1,272	210,163	14,669	172,901	12,068	10,981	766	10,742	750	0.0	0	239.3	17	0.0	0.0		

- All deep bed filters are in operation and even flow split to each is achieved.
- All chlorine contact basins are in operation and even flow split to each is achieved.

4.13.3.1 Results for 6 MGD Design Capacity

The design peak flow is 18.0 MGD. When the combined raw influent flow and RAS flow exceed 22.5 MGD peak hydraulic capacity of the grit system, 9 MGD of RAS flow (150 percent of 6 MGD ADF) will be diverted to downstream of the grit unit using two motorized valves. The oxidation ditches and clarifiers will be required to handle a total peak flow of 27 MGD. **Figure 4-16** presents the anticipated revised hydraulic profile accounting for all process modifications required through the liquids treatment trains at 18 MGD. The addition of the oxidation ditch splitter box at the headworks will be done during this phase. This will include a drop box and adjustable weir gate to send flow to future Oxidation Ditch 5 which is a part of the 8 MGD ADF expansion.

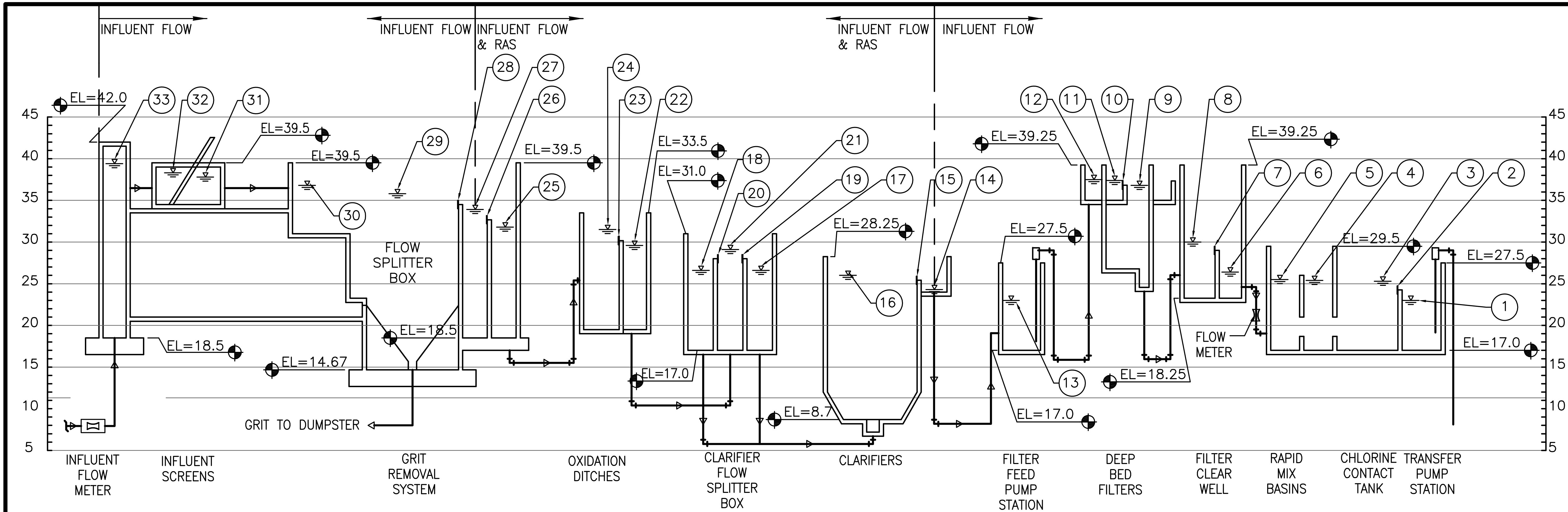
Proposed yard piping for the 6 MGD ADF expansion is summarized below:

- A new 30-inch mixed liquor (ML) pipe from the new oxidation ditch flow splitter box at the headworks to Oxidation Ditch 4.
- A new 30-inch ML pipe from Oxidation Ditch 4 transitioning to a 42-inch ML pipe to the proposed clarifier splitter box. The transition will be accomplished by a 42-inch by 30-inch tee located east of Oxidation Ditch 4. This tee will have a valve to connect to future Oxidation Ditch 5 without taking Oxidation Ditch 4 out of service.
- A new 24-inch ML pipe from the clarifier splitter box to Clarifiers 4 and 5.
- A new 20-inch secondary clarifier effluent (SCE) pipe from Clarifiers 4 and 5. The 20-inch SCE pipes from Clarifiers 4 and 5 and will manifold and transition to a 30-inch SE pipe. The transition will be accomplished using a 30-inch by 20-inch wye. The 30-inch SE pipe will run north and transition to a 36-inch SCE pipe via 30-inch by 36-inch tee. This tee will also serve to connect to future Clarifier 6 which is a part of the 8 MGD ADF expansion. A valve will be provided to make the future connection so that the treatment train will not require an outage for connection in the future.
- A new 36-inch SCE pipe from Clarifiers 4 and 5 running to the Filter Feed Pump Station wet well. The connection will be made using the existing 36-inch stub out located at the Filter Feed Pump Station.

The hydraulic modeling results indicated minor changes to the hydraulic grade line at the 6.0 MGD ADF with the proposed improvements. The results also showed that sufficient freeboard (at least 1 foot) was maintained in all process basins. The associated oxidation ditch effluent weir gates need to be adjusted to maintain target brush aerator immersions in Oxidation Ditches 1, 2, and 3.

4.13.3.2 Results for 8 MGD Design Capacity

The design peak flow is 22 MGD. An additional 12 MGD of RAS flow (150% of 8.0 MGD ADF) will be diverted downstream of the grit unit during peak flow events. The oxidation ditches and clarifiers will be required to handle a total peak flow of 34.0 MGD**.** Figure 4-16 presents the anticipated revised hydraulic profile accounting for all process modifications required through the process liquid train at 22 MGD PHF.



18 MGD PHF (CURRENT PHASE)	Point	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	Flow (MGD)	22	22	22	22	22	22	27	9	9	9	9	9	9	4.5	4.5	4.5	4.5	4.5	3	3	18	18	2.25	2.25	18	18	18	18	18	9	9	9	18
	Elevation	39.07	38.38	37.88	36.78	35.78	35.00 (Weir)	33.75	33.17 (Weir)	31.84	31.59 (See Note 1)	31.02 (Weir)	29.58	28.92	28.50 (Weir)	28.50 (Weir)	26.23	26.23	26.00	25.9 (Weir)	24.82	23.00	38.15	37.41	37.32 (Weir)	36.80	30.02	29.50 (Weir)	28.04	25.45	25.36	25.26	24.75 (Weir)	23.00
22 MGD PHF (FUTURE PHASE)	Point	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	Flow (MGD)	22	22	22	22	22	22	34	8.5	8.5	8.5	8.5	8.5	8.5	5.7	5.7	5.7	5.7	5.7	3.7	3.7	22	22	2.20	2.20	22	22	22	22	22	7.3	7.3	14.7	22
	Elevation	39.07	38.38	37.88	36.78	35.78	35.00 (Weir)	34.04	33.17 (Weir)	31.87	31.73 (See Note 2)	30.67 (Weir)	31.70	28.74	28.50 (Weir)	28.50 (Weir)	26.38	26.38	26.01	25.9 (Weir)	24.15	23.00	38.15	37.41	37.32 (Weir)	36.80	30.09	29.50 (Weir)	28.02	25.83	25.73	25.66	24.75 (Weir)	23.00

NOTES:

1. OXIDATION DITCH NO. 1 WATER SURFACE ELEVATION = 31.59
   CONTROL WEIR ELEVATION = 31.05
   OXIDATION DITCH NO. 2 WATER SURFACE ELEVATION = 31.59
   CONTROL WEIR ELEVATION = 31.05
   OXIDATION DITCH NO. 3 WATER SURFACE ELEVATION = 31.72
   CONTROL WEIR ELEVATION = 31.15
   OXIDATION DITCH NO. 4 WATER SURFACE ELEVATION = 31.57
   CONTROL WEIR ELEVATION = 31.00

2. OXIDATION DITCH NO. 1 WATER SURFACE ELEVATION = 31.56
   CONTROL WEIR ELEVATION = 31.05
   OXIDATION DITCH NO. 2 WATER SURFACE ELEVATION = 31.56
   CONTROL WEIR ELEVATION = 31.05
   OXIDATION DITCH NO. 3 WATER SURFACE ELEVATION = 31.73
   CONTROL WEIR ELEVATION = 31.15
   OXIDATION DITCH NO. 4 WATER SURFACE ELEVATION = 31.44
   CONTROL WEIR ELEVATION = 30.67
   OXIDATION DITCH NO. 5 WATER SURFACE ELEVATION = 31.44
   CONTROL WEIR ELEVATION = 30.67

CDM Smith

FIGURE NO. 4-16
HYDRAULIC PROFILE
DECEMBER 2013

Proposed yard piping for the 8.0 MGD ADF expansion is summarized below:

- A new 30-inch ML pipe from the new oxidation ditch flow splitter box at the headworks to Oxidation Ditch 5.
- A new 30-inch ML pipe from Oxidation Ditch 5 to the 42-inch x 30-inch tee mentioned in the previous section.
- A new 20-inch SCE pipe from Clarifier 6 to the 36-inch x 30-inch tee mentioned in the previous section.

The hydraulic modeling results indicated minor changes to the hydraulic grade line at the 8 MGD ADF with the proposed improvements. The results also showed that sufficient freeboard (at least 1 foot) was maintained in all process basins. However, modifications will be required at the 24-inch pipe located between the filter clearwell and rapid mix basins prior to the Chlorine Contact Tanks. Flow velocities in this line may reach approximately 11 feet per second (fps) which increases the headloss in the system and subsequently submerges the upstream filter clearwell overflow weir. CDM Smith recommends replacement of the 24-inch pipe and magnetic flow meter with 30-inch pipe and flow meter.

References

Melcer, H., Dold, P.L., Jones, R.M., Bye, C.M., Takacs, I., Stensel, H.D., Wilson, A.W., Sun, P., Bury, S. (2003). Methods for Wastewater Characterization in Activated Sludge Modeling. *Water Environment Research Foundation,* Alexandria, VA.

Section 5

Structural Basis of Design

5.1 Improvements for 6 MGD ADF Capacity

The following demolition, modifications to existing structures, and new structures will be required to expand the plant to 6 MGD.

5.1.1 Demolition

All demolition shall be coordinated for plant operations in accordance with the approved process design to comply with the local and state codes.

5.1.2 Headworks

The existing cast in place concrete facility shall be structurally modified as described as stated in this section to accommodate the revised process design. The access platforms shall be structurally designed and coordinated with the new process and the operations staff.

5.1.3 Oxidation Ditch

The existing facilities shall be investigated for required structural repairs and coordinated with operations staff. Modifications will be structurally designed in accordance with the following criteria in this section. All new brush aerator bearing access areas shall be designed with drainage sumps. New aeration basins shall be designed as cast in place concrete structures, unless LCU directs otherwise, and will comply with the codes and standards listed. Buoyancy will be addressed as coordinated with the geotechnical report and LCU.

5.1.4 Secondary Clarifiers

The new clarifiers will be designed to comply with the following codes and standards in this section. Buoyancy will be addressed as coordinated with the geotechnical report and LCU. The existing secondary clarifiers that were installed in the last facility expansion were prestressed concrete. New secondary clarifiers shall be designed as prestressed structures and will comply with the codes and standards listed.

5.1.5 Sodium Hypochloride Canopy

The existing canopy shall be evaluated and alternative weather screens investigated for addition to the canopy to provide better weather and sun protection of the tanks and equipment.

5.1.6 Dewatering

Structural supports and platforms shall be designed in accordance with the criteria in this section to conform to the proposed process modifications.

5.1.7 New Buildings

All new structures shall be designed to comply with the following codes and standards.

5.2 Improvements for 8 MGD ADF Capacity

In addition to items in Section 5.1, the following additional structures will be required to expand the plant to 8 MGD.

5.2.1 Oxidation Ditch and Clarifier

The second new oxidation ditch and the fourth new clarifier required for the 8 MGD ADF expansion will be evaluated in a similar manner as what is presented in Section 5.1. Buoyancy will be addressed as coordinated with the geotechnical report and LCU.

5.2.2 Deep Bed Filter

The new cast in place deep bed filters will be designed to comply with the following codes and standards in this section. Buoyancy will be addressed as coordinated with the geotechnical report and LCU.

5.2.3 Chlorine Contact Tank

The new cast in place Chlorine Contact Tank will be designed to comply with the following codes and standards in this section. Buoyancy will be addressed as coordinated with the geotechnical report and LCU.

5.3 Codes, Standards, and References

5.3.1 Codes

The governing code for the project will be the Florida Building Code, 2010 Edition which will be monitored for the latest revision. In no case will the strength, serviceability, or quality standards for materials and procedures be less than that required by the governing code. Where the provisions contained or referenced herein differ from those in the governing code, design will be performed in accordance with the most stringent.

5.3.2 Standards

Design of specific systems and materials will be performed in accordance with the codes, specifications, and other standards adopted by the governing code. In the absence of direction from the governing code, the most recent edition of the documents referenced herein for each system and material will be used.

5.3.3 References

Engineering software, manuals, handbooks, articles, and technical publications that is generally acceptable for use in design shall be used. Other publications may be used if acceptable to the supervising structural personnel. In the use of all technical publications and software, whether included herein or not, it is recognized that there is no guarantee they are free from errors or omissions. The results obtained will be evaluated for correctness by use of separate calculations, engineering experience and/or judgment.

5.4 Design Loads and Serviceability

5.4.1 Scope

All applicable loads and load combinations will be determined as required by the governing code, occupancy, site and environmental effects, equipment and processes. Appropriate load combinations will be established as well as appropriate allowable stresses, load factors and safety factors (as applicable). These criteria will be established at the beginning of preliminary design and confirmed at the beginning of final design.

5.4.2 Dead Loads

Dead loads are those resulting from the weight of all fixed construction such as walls, partitions, floors, roofs, cladding, equipment bases and all permanent, nonremovable, stationary furnishings.

Numerical values for the dead load of well-defined components of a structure will be used as documented in the following publications:

- ASCE 7
- AISC Manual
- CRSI Handbook
- Manufacturer's catalogs for fabricated components

5.4.3 Live Loads

Live loads will consist of all loads due to occupancy, furnishings and equipment. Live load reduction will not be employed for members of large influence area in the design of environmental and industrial facilities, due to the relatively high probability of simultaneous loads on all areas. Live load reduction may be employed in general buildings that are not part of environmental or industrial facilities, with approval.

5.4.3.1 Uniform Live Loads

Uniform live loads will be established in accordance with the governing code. Values are listed below for purposes of preliminary design. Actual usage and equipment will be considered during final design and higher loadings used when appropriate.

<u>General Administrative Buildings</u>

▪ Office areas	50 psf
▪ Office file, record and mainframe computer areas	125 psf
▪ Personnel assembly areas	100 psf
▪ Stairways, corridors, lobbies	100 psf
▪ Partitions (present or future)	30 psf
▪ Roofs	20 psf

▪ Storage areas	250 psf
▪ Garages, other vehicles	AASHTO load or design vehicle

Process Buildings and Structures

▪ Office areas	150 psf
▪ Office file, record and mainframe computer areas	150 psf
▪ Personnel assembly areas	150 psf
▪ Stairways, corridors, lobbies, catwalks	150 psf
▪ Storage areas	300 psf
▪ Process areas (including hatches and gratings)	200 psf
▪ Electrical rooms	300 psf
▪ Control rooms	150 psf
▪ Maintenance garages	AASHTO loading or 300 psf
▪ Unrestricted vehicular areas	AASHTO loading

5.4.3.2 Equipment Loads

Loads from equipment will be considered live loads. The maximum loads and support details for each major piece of equipment will be provided by the discipline designing or specifying it. Final weights of process-mechanical equipment will be established during preliminary design. Preliminary weights of building service equipment (HVAC, plumbing, and electrical) will be established during preliminary design, and confirmed during final design.

In addition to the mechanism's static dead load, design will be performed for other effects, such as those due to operation, maintenance and malfunction. Examples include, but are not limited to, the following:

- Rotating agitator equipment (mixers, flocculators, and mechanical aerators): Design will be performed for moment, torque, and lateral/vertical thrust.
- Rotating clarifier mechanisms: Design will be performed for stalling torque.
- Vertical turbine pumps: Design will be performed for suction load plus the weight of the suspended water column in the riser.
- Sluice gates, non-self-contained: Design will be performed for a load equal to the breaking strength of the operating stem, or the stalling torque of the motorized operator, in the event the gate is frozen.
- All equipment: Design will be performed for required maintenance procedures, such as the removal of a large component and the placing of it temporarily on the adjacent structure.

5.4.3.3 Impact Loads

Static loads will be increased for the effects of impact by the following percentages:

- Vehicular loads: In accordance with the AASHTO Specification.
- Light machinery supports, shaft or motor driven: 20 percent of the operating weight (minimum) or manufacturer's recommendation.
- Reciprocating machinery or power-driven unit supports: 50 percent of the operating weight (minimum) or manufacturer's recommendation.
- Hangers supporting floors or balconies: 33 percent of live load reaction

5.4.3.4 Construction Live Loads

The contractor is normally responsible for maintaining loads on partially or fully complete structures at or below the design live loads noted on the contract documents or for providing supplemental support. However, in certain cases, if the service load on a structural element is negligible, a design load will be used which would accommodate reasonable construction activities.

When it is necessary to provide particular restrictions on construction sequencing, special loads conditions may result. This is particularly applicable to work involving the modification of existing structures. These cases will be evaluated and appropriate criteria established during final design. Such restrictions will be indicated in the drawings or specifications.

5.4.4 Environmental Loads

5.4.4.1 Rainwater Loads

Roofs will be designed for retained water to its maximum depth (accounting for deflection) assuming that the primary drainage system is blocked. Overflow scuppers or other secondary drainage systems may be used to minimize this load. This criterion will be coordinated with architectural and plumbing disciplines.

5.4.4.2 Wind Loads

Wind loads will be developed from the following criteria in accordance with the governing code. Appropriate shape modification factors, uneven distributions, and orthogonal effects will be considered for each structure. Main windforce resisting systems, as well as appropriate components and cladding, will be designed for internal and external effects. Increased allowable stresses or reduced load factors will be used, as appropriate.

- Wind Risk Category: III
- Ultimate Wind Velocity V_{ult}: 169 mph (per Florida Building Code ASCE 7-10)
- Allowable Wind Velocity V_{asd}: 126 mph (per Florida Building Code)

Internal loads due to positive or negative air pressure caused by mechanical or process systems will not be considered wind loads. These loads will be considered in the manner of a process liquid load.

5.4.5 Process Liquid Loads

Design will be performed for liquid loads assuming liquid surface at the maximum working level using normal allowable stresses, or the load factor for a live load, as appropriate. In addition, design will be performed assuming the liquid surface at the maximum possible level under surcharge conditions using an increase in allowable stresses, or the load factor for a dead load, as appropriate.

The separating walls will not be designed for liquid on one side only where cells of a tank communicate so that one cannot be isolated from an adjacent cell (by valves, gates, stoplogs, or other normal operational means). Design will be performed for a 12-inch minimum water level differential on either side of the wall to account for flow lag and minor dynamic effects unless hydraulic indicate different level.

Elements acting as or affected by screens (which remove trash or other solids from flow) will be designed for liquid to its maximum level, assuming the screen is completely blocked. Elements acting as flow baffles (at which blockage is unlikely) will be designed for a 12 inch minimum water level differential, unless hydraulic analyses indicate a different level.

Closed liquid containing structures will, whenever possible, be vented to preclude pressurization or depressurization. However, certain structures may experience pressure or vacuum effects due to particular mechanical or process systems, or the malfunction of systems or components. In such cases, design will be performed for the maximum water, air or gas pressure as provided by in preliminary design.

5.4.6 External Earth and Groundwater Loads

Earth and groundwater loads will be developed from the following criteria in accordance with the project geotechnical report and the governing code.

5.4.6.1 Design Grade Elevation

Design will be performed for ground surface at finish grade. Substructures will be designed to permit the external excavation to be backfilled after the construction of the ground level slab. If substantial economic advantages could be realized by altering this criterion, then limits of backfill requirements will be indicated in the Contract Documents.

5.4.6.2 Design Groundwater Elevation

Design will be performed for groundwater at the following elevations:

- Normal elevation: At grade.
- Flood elevation: At grade and as determined by survey.

When the project design groundwater level is below finish grade, design groundwater elevation will be established at finish grade for relatively small below-grade structures, such a manholes and vaults, to account for localized rises in groundwater due to pipe breaks, leaking structures, etc.

5.4.6.3 Groundwater Pressures

Design will be performed for pressures generated by groundwater acting laterally, downward and upward, as appropriate. Load factors appropriate for live loads will be used. Design will be performed for groundwater at the normal elevation for normal allowable stresses or load factors, as appropriate. Design will be performed for groundwater at the following flood elevation for increased allowable stresses or reduced load factors, as appropriate.

5.4.6.4 Lateral Soil and Groundwater Pressures

For hydrostatic loads the following equivalent fluid pressures will be used in preliminary design for well-graded, granular, mineral soils with a moist unit weight of 120 pcf. Soil pressures for final design will be developed in accordance with the geotechnical report. Design for cantilevered walls of environmental engineering structures will be performed for at-rest soil pressures. **Table 5-1** summarizes the estimated design criteria. Final values will be provided in the Geotechnical Report.

Table 5-1 Hydrostatic Load Design Criteria

Pressure Condition	Pressure Coefficient	Equivalent Lateral Fluid Pressure	
		Above Groundwater	Below Groundwater
At rest	0.50	60 pcf	90 pcf
Active[1]	0.33	40 pcf	80 pcf
Passive[2]	3.00	360 pcf	170 pcf

[1] Minimum

[2] Maximum

For surcharge, walls to which vehicles can reasonably be expected to approach within a distance equal to half the wall height will be designed for a uniform surcharge equal to 2 feet of soil.

5.4.7 Miscellaneous Loads

Design will be performed for other applicable loads as required by the project circumstances. Appropriate acceptable allowable stresses and load factors will be established.

5.4.8 Combination of Loads

5.4.8.1 General

Design will be performed for combinations of loads along with appropriate load factors or allowable stresses in accordance with the governing code. In the absence of specific direction by the code, the most severe distribution, concentration and combination of design loads and forces will be used. These combinations may be limited by practical considerations, such as the following:

- Combination of certain loads will not be considered when the probability of their simultaneous occurrence is negligible. Such loads include wind on superstructures; and live load surcharge, and flood on substructures.
- An increase in allowable stress of 33 percent, or a reduced load factor of 0.75, will be applied to the entire load combination where such is permitted for any of the loads considered in the combination.
- The effects of any load type (other than dead load) will not be used to reduce the effects of another load type. A maximum percentage of the dead load will be used in any combination where it reduces the effects of another load type per ASCE 7.

5.4.8.2 Liquid Containing or Below-grade Structures

Design will be performed for structures that contain liquids, extend below grade, or both, for the following load combinations:

- Liquid-containing compartments full, no backfill for liquid containing compartments. No reduction will be made for any counteracting soil pressure on the face remote from a contained liquid unless approved.
- Backfill and groundwater with liquid-containing compartments empty and full.
- Liquid containing compartments empty or full in any combination.

5.4.9 Serviceability

Additional requirements for serviceability will be considered as provided in subsequent sections and referenced standards for specific materials.

5.4.9.1 Deflection

Design will be performed to limit deflections to the following. Deflection limit will apply to live load effects only in cases indicated with an asterisk (*). For monorails and cranes, impact need not be included. **Table 5-2** summarizes the deflection design criteria.

Table 5-2 Deflection Design Criteria

Item	Criteria
Floor plates and gratings*	L/360
Beams, lintels or slabs supporting masonry	L/720, 3/8" max at windows
Roofs without plastered ceilings*	L/240
Floors, steel framed*	L/360
Floors, concrete	In accordance with ACI 318

5.4.9.2 Ponding

Ponding refers to water retention due to the effects of deflection on a flat roof. Sufficient stiffness will be provided to prevent successive water retention and deflection leading to failure for flexible roof systems.

5.4.9.3 Mechanical Vibration

Design will be performed for the effects of vibration to provide appropriate protection against structural deterioration, mechanical deterioration, and significant occupant discomfort. The guidelines below will generally be followed under normal circumstances. A dynamic analysis of the system will be performed if deemed necessary by the supervising structural personnel.

Concern for mechanical vibration is greatest for equipment such as induced-draft fans, generators, steady bearings at pump shafts and brush aerators. Operating frequencies, unbalanced loads, and specific design recommendations will be obtained from the manufacturer by the discipline specifying the equipment.

To avoid resonant vibration, the ratio of the structure's natural frequency to the operating frequency of the equipment will be restricted to less than 0.50 or greater than 1.50. Where practical, the latter will be used to avoid resonance during equipment startup and shutdown. Consideration will be given to applicable modes of vibration, including vertical, lateral, and rotational.

Design will be performed in accordance with the following guidelines for equipment which produce significant vibrational effects, where possible and appropriate:

- Equipment will be mounted on concrete foundations or supporting systems rather than metal supporting systems.
- A foundation pad or mat will be provided with a mass equal to ten times the rotating mass of the equipment or three times the gross mass of the equipment (minimum), whichever is greater.
- Major equipment foundations and supporting systems will be isolated by expansion joints or independent supports from the remaining structure to minimize vibrational transmission.
- Vibration isolators, dampeners, and/or inertia blocks will be provided where appropriate.
- Anchorage to foundations will be provided by embedded anchor bolts. Drilled anchors will not be used.

5.4.9.4 Transient Vibration

Design will be performed for the effects of vibration to provide appropriate protection against structural deterioration, mechanical deterioration, and significant occupant discomfort. The guidelines below will generally be followed under normal circumstances. A dynamic analysis of the system will be performed if deemed necessary by the supervising structural personnel. Beams will be provided with a depth greater than or equal to 1/20 of the span for elevated steel walkways or platforms.

5.5 Foundation Design

5.5.1 Scope

Criteria will be established for the design of structure foundations in coordination with the geotechnical recommendations. Permanent structure foundation elements will be designed to distribute loads to the supporting soil, rock, or piling in accordance with their allowable loads, and to accommodate predicted deformations of the structure caused by settlement or movement of the supporting elements. Piling elements (piles and caissons) will be designed as structural elements to the accommodate stresses generated by the design loads. The design of the transmission of loads from the pilings to the supporting soil or rock will be performed by the geotechnical discipline. Structure foundation elements will be designed to resist effects of groundwater, including buoyancy.

5.5.2 Geotechnical Report

A geotechnical analysis and report will be required. The geotechnical report will provide a description of the subsurface conditions as well as recommendations for design and construction. The draft report will be reviewed for applicability and feasibility of the recommendations to the preliminary structural design. Comments will be provided to the geotechnical engineer for incorporation in the final report.

5.5.3 Shallow Foundation Support

Design of shallow foundation elements (footings and mats), including excavation and backfill limits and details, will be performed in accordance with the recommendations of the geotechnical report.

Buried piping and ductbanks will be maintained outside the influence zone of the foundation elements to the extent possible. Limits of this zone will be established based on bearing materials' characteristics as documented in the geotechnical report. At a minimum, this zone will be defined by a line extended outward and downward from the bottom corners of a foundation element at a 1 vertical to 1 horizontal slope. A reinforced concrete encasement or other appropriate protection will be provided for any utilities extending into this zone.

5.5.4 Deep Foundation Support

Piling will be designed in accordance with the recommendations of the final geotechnical report. Where a transition is required from pile supported to soil supported elements of a structure, design will be performed to accommodate the predicted deformation from such a transition.

Lateral loads to the structures will be resisted by the piling elements, the surrounding elements, or both. The strain compatibility of the elements will be considered to determine the distribution of the lateral reactions where appropriate.

5.5.5 Retaining Walls

The stability of retaining walls will be confirmed for appropriate lateral soil and groundwater pressures, surcharges and other applicable loads. Passive pressures from the soil in front of the wall or footing keys will not be used to reduce loads, stresses, or overturning and sliding effects, unless measures are taken to ensure against erosion or removal of the soil and approved. Design will be performed for the following factors of safety using ASD loading combinations.

- Overturning: 2.0
- Sliding: 1.5

The effects of uplift pressures will be considered in stability analyses for design of retaining walls with portions below the design groundwater level.

5.5.6 Buoyancy

Buoyancy is defined as the condition of instability resulting when uplift forces due to groundwater exceed resisting forces due to dead load and anchorage systems. Design will be performed in accordance with the following.

5.5.6.1 Dewatering Wellpoint System

The construction cost estimate generated in this report utilizes a dewatering wellpoint system similar to what is installed presently. CDM Smith will consult with LCU staff prior to finalizing the scope for the design phase of this project. Other systems may have a higher construction cost but provide significant benefits.

Dewatering wellpoints will be designed for pressure relief on an intermittent basis. Such systems will not be used for permanent or continuous relief unless approved. They usually consist of an underdrain system beneath and around the structure. Pumps are permanently or temporarily installed to lower the groundwater for limited periods to allow dewatering and maintenance of the tank.

5.5.6.2 Ballasted System

For completed structures, structures will be designed to resist buoyancy considering only the structure dead load, soil directly above the structure and footing extensions for groundwater at the design level. The effects of live loads, liquid contents (unless relief valves are used), vertical soil friction and soil cohesion will be neglected unless significant cost savings can be utilized.

For partially complete structures, it will be assumed that groundwater will be maintained, at any given time, at or below the surface of the backfill currently in place since the contractor will normally be required to maintain a dewatered excavation. The groundwater elevations at which the structure is stable will be provided in the contract documents if the completed portion of the structure has insufficient resistance against pressures generated in this condition.

5.5.6.3 Anchorage Systems

Anchorage systems will be designed to resist the net uplift force transmitted to the components of the anchorage if used.

Rock anchors or tension piles may be used to resist buoyancy where appropriate geotechnical conditions exist. Design these elements will be performed considering recommendations from the geotechnical engineer.

5.6 Concrete Design

5.6.1 Scope

Design of all cast-in-place, site-cast, and precast concrete structures will be performed, except as indicated below. Member sizes, reinforcement, and details will be determined in accordance with the governing code(s).

Design of site concrete work, such as paving, curbing, and sidewalks will be performed by the civil discipline. Design of the following structures and elements will be performed by the fabricator or erector, in accordance with criteria provided in the contract documents.

- Precast site structures, including manholes, vaults, pipe, culverts, and headwalls.
- Precast, prestressed roof planks and tees.
- Precast architectural elements, including wall panels, copings, and sills.
- Prestressed circular concrete tanks.

5.6.2 General Criteria

5.6.2.1 Codes and Standards

Concrete structures will be designed in accordance with the following, as appropriate:

General structures:	ACI 318
Environmental engineering structures:	ACI 318, with ACI 350R recommendations
Bridge structures:	AASHTO Bridge Specification
Reinforcing steel, welding:	AWS D1.4

- Wire-wrapped prestressed tanks AWWA D110
- Post-tensioned prestressed tanks AWWA D115

Structures that convey, store or treat liquid, are subjected to severe exposures, or have restrictive leakage requirements will be designed as environmental engineering structures.

Design of miscellaneous roadway structures, such as culverts and headwalls, which are located on public road right-of-ways, will be performed in accordance with the state highway standards and the AASHTO Specification. Miscellaneous roadway structures that are part of facilities or located on private property may be designed by either the AASHTO Specification or ACI 318.

5.6.2.2 Materials and Design Strengths

Design will be performed for concrete with the following minimum 28-day compressive strengths (f'c):

- Structural concrete for environmental structures: 4,500 psi
- Structural concrete: 4000 psi
- Concrete topping: 3,000 psi
- Precast concrete: 5,000 psi
- Prestressed concrete: 5,000 psi

Design will be performed for the strengths and properties of the following materials:

- Deformed reinforcing bars: ASTM A615, Grade 60
- Deformed reinforcing bars, welded or field bent: ASTM A706
- Welded wire fabric, plain: ASTM A185
- Welded wire fabric, deformed: ASTM A497

5.6.2.3 Design Methods

Environmental engineering structures will be designed by the Strength Design Method (Ultimate Strength) with the modified allowable stresses, durability coefficients and serviceability requirements recommended in ACI 350R for the appropriate sanitary exposure. Structures other than environmental engineering structures will be designed by the Strength Design Method. The Alternate Design Method (Working Stress) may be used where significant cost savings will not be realized by the use of the Strength Design Method.

5.6.3 General Design and Detailing Concepts

5.6.3.1 Joints - General

Design will be performed using the following joint types:

- Isolation joints are formed discontinuities in or between structures which allow movement in any direction. They are not considered to be load-transferring joints. The movement may be due to anticipated settlements, differential deflections, or temperature and shrinkage.

- Expansion joints are formed discontinuities in or between structures that allow movement perpendicular to the plane of the joint only. They are not considered to be load-transferring joints. Most often, this movement is due to both expansive and contractive forces generated by temperature and shrinkage. This movement is accommodated by providing smooth dowels across the joint, debonded on one side. Expansion joints are normally constructed using a joint filler that has sufficient stiffness to maintain its shape during concrete placement, but compresses under the subsequent movement. Keys will not be used in expansion joints. The end surfaces of the elements forming the joint will have face reinforcing to prevent spalling.

- Contraction joints function as a plane of weakness for crack formation to dissipate shrinkage stresses, and are not considered to be load-transferring joints. They may be formed by use of a bond breaker between concrete placements, discontinuing reinforcing steel, forming or sawing a partial depth groove, or by a combination of these methods. Keys will not be used in contraction joints.

- Control joints are a form of contraction joint often used specifically for environmental engineering structures. They are usually not employed as load transferring joints, but do have a limited capacity for load transfer, and can be used as such with caution. A bondbreaker is applied to the joint plane and only 50 percent of the reinforcing steel passes through the joint. Keys will not be used in control joints.

- Construction joints are formed joints between adjacent concrete placements and are designed to be load-transferring joints. Bond between the placements is promoted and reinforcing steel is continuous through the joint so that the section behaves as though it was monolithically constructed. The surface of the first placement will be roughened to promote bond. Keys will not be used unless project requirements dictate and use is approved.

The jointing system layout will be determined at the beginning of preliminary design. Joint types, locations, and related criteria will be selected. All joints will go through the entire structure in one plane whenever possible. Staggers and offsets will not be used for expansion, control and contraction joints, and avoided for construction joints unless absolutely necessary.

5.6.3.2 Joints - Environmental Engineering Structures

All joints will be specifically located on the drawings, including steps, offsets and staggers, if required. Unless an analysis of temperature and shrinkage effects is performed, the layout will be developed in accordance with the following guidelines for normal cements and service conditions.

- Expansion joints: Expansion joints will be provided at approximately 120 feet on center in each direction, unless a greater spacing is approved. Where possible, expansion joints will be located at points of zero shear transfer across the joint. For expansion joints through and perpendicular to spanning systems, independent supports will be provided on each side of the joint. A seated expansion joint for spanning members will not be used unless project conditions prohibit the use of the double supports.

- Contraction joints: Contraction joints will not be used in environmental engineering structures.

- Control joints: Control joints will be provided at approximately 30 feet on centers in each direction, unless otherwise approved. If used other than parallel to one-way spanning elements, the effects of discontinuity on the design will be considered. Control joints will not be "dead-ended" except at an expansion or isolation joint.

- Construction joints: Construction joints will be provided as required for constructability. Reinforcing will be extended and developed through the joint. Lap splices will be staggered were possible.

5.6.3.3 Waterstops

Continuous waterstops will be provided in all joints in walls, slabs, and other elements separating the following spaces. Additional installations may be required by special project conditions.

- Between liquid containing areas and dry, habitable areas.
- Between liquid containing areas and external areas (air, water, or soil).
- Between below-grade dry, habitable areas and external areas (water or soil).
- Between adjacent liquid containing areas when one can be drained while the other remains full.

Waterstops in vertical joints will be extended to 4 inches below the top of the wall, or to the first horizontal joint above the design process liquid or groundwater level, whichever is lower. For horizontal joints at the intersection of walls and slabs, starter walls will be provided as required to avoid interference between the waterstop and horizontal reinforcing. For new construction, waterstops will be ribbed PVC, 9 inches wide with a center bulb at expansion joints and 6 inches wide at control and construction joints.

5.6.3.4 Reinforcement - General

The following design criteria will be used for reinforcement:

- Spacing: In general, 6 inches and 12 inches will be used as the basic spaces for detailing on continuous elements such as walls and slabs unless other spacing provides cost savings.
- Splices: Splices in deformed reinforcing bars will be lap splices conforming to ACI 318, unless otherwise indicated. For tension members, full penetration welded splices will be used. In circular tanks designed for ring tension, splice locations will be staggered. Mechanical splicers will be used only in noncritical applications where failure of the splice would not result in structural failure. When used, they will be the threaded-type mechanical splicers.
- Bends: Straight longitudinal bars will be used rather than bent longitudinal bars whenever possible for beams, slabs, joists and similar members.
- Preferred Reinforcing: The preferred (outermost) reinforcing in continuous members (slabs and walls) within a system will remain consistent even if the spanning direction of the various members within the system varies to the extent possible.

5.6.3.5 Reinforcement - Environmental Engineering Structures

The minimum area of reinforcement is mainly a function of the distance between the movement joints (those which dissipate shrinkage and temperature stresses) in the direction of the reinforcement. It is also a function of the concrete mix, element thickness, and environmental conditions.

A minimum total area of reinforcement will be provided in accordance with the recommendations of ACI 350R for normal cement and service conditions. Reinforcement will be provided on each face of the element equal to not less than half of the minimum total area. A minimum bar size of #5 (except for ties and stirrups) and a maximum spacing of 12 inches will be used for all elements functioning as continuous liquid containment elements.

5.6.3.6 Anchors and Embedments

Design will be performed using the following anchor types:

- Cast-in anchors are set prior to casting of the concrete. Anchor bolts are the most common type, used in applications such as anchoring of steel columns. Other types include bolts with embedded plates, strap anchors, and headed anchor studs.
- Expansion anchors are generally drilled-in bolts that engage the concrete substrate by using a sloping mandrel to force wedges into the sides of the hole during tightening.
- Adhesive anchors are generally drilled-in bolts that engage the concrete substrate through the chemical bonding by a resin. Reinforcing dowels may also be anchored in this manner.

Cast-in anchors generally provide the greatest assurance of adequacy and will be used whenever practical. Cast-in inserts (threaded receptacles set below the concrete surface) will be avoided unless necessary, due to the difficulty of verifying adequate thread engagement. Drilled-in anchors will be used when greater flexibility is required in positioning the anchored elements. Expansion anchors will be used in non-critical applications only and not for tensile or vibratory loads.

Anchor bolts may be designed using the allowable loads and location restrictions provided in the concrete provisions of the Uniform Building Code. Otherwise, design for allowable loads will be performed by either an analysis that that considers the controlling failure mode (including anchor failure, bond failure, and substrate failure), or in accordance with the results of an independent testing program. In determining allowable loads, the effects of anchor spacing, edge distance, and combined loadings will be considered.

5.6.3.7 Waterproofing

Waterproofing will be provided on walls separating dry, habitable areas from either liquid-containing areas or exterior water or groundwater. Apply to wet or dry side, as appropriate for the particular waterproofing used.

5.6.3.8 Concrete Fill

Concrete fill (f'c = 2500 psi) will be used mainly in environmental engineering structures to contour liquid containing spaces for flow and drainage purposes, unless it is more expedient or economical to contour the structural concrete. Concrete fill will not be considered as a structural element for resisting stresses or providing support. However, it will be considered as permanent dead load for the resistance of hydrostatic uplift.

5.6.4 Systems and Elements

5.6.4.1 Elevated Slabs

Structural slabs less than 8 inches in thickness will be designed with a single grid of reinforcing steel. Structural slabs 8 inches or greater in thickness will be designed with two grids of reinforcing steel unless the cover and bar sizes required would result in concrete placement problems.

5.6.4.2 Walls

Walls less than 10 inches in thickness will be designed with a single grid of reinforcing steel; walls 10 inches and greater will be designed with two grids. Walls less than 12 inches thick will be restricted to less than 10 feet high for any one placement, to avoid concrete placement and consolidation. A minimum thickness of 12 inches will be used for walls continuously containing liquid.

5.6.4.3 Slabs-on-Grade

Slabs-on-grade, other than those in environmental engineering structures, will be designed for the following minimum criteria, assuming construction on competent bearing material with a 12 inch thick (minimum) layer of structural fill or as recommended by final geotechnical report. Additional analysis and design will be performed for special loading conditions, particularly large concentrated loads.

In general, spacing of joints will be limited to 30 feet or less, with maximum area per placement equal to or less than 900 square feet. Increases in joint spacing and pour area necessitated by project requirements will be specially designed.

5.6.4.4 Circular Tanks

Circular, non-prestressed concrete tanks will be designed using PCA ST-57. Design will be performed for the largest forces, moments and shears obtained by considering both fixed and pinned base conditions unless the degree of fixity provided at the base of the wall is established based upon the wall, base slab, and subgrade interaction. Negative moment reinforcing for a fixed base condition will be developed into the base slab.

5.7 Masonry Design

5.7.1 Scope

The size and layout of all loadbearing masonry elements (exterior walls, bearing walls, shearwalls, pilasters, columns, beams, and lintels) as designed by the architectural discipline will be reviewed to ensure a continuous and stable loadbearing system. Design of all loadbearing and non-loadbearing elements (such as partition walls and veneer) and their connections will be performed in accordance with applicable criteria.

5.7.2 General Criteria

5.7.2.1 Codes and Standards

Design of masonry structures, elements, and details will be performed in accordance with ACI 530 and ACI 530.1.

5.7.2.2 Materials and Design Strengths

Design will be performed for the specified strengths and properties of the following materials:

- Masonry Units
  - Concrete masonry units — ASTM C90, Type I (1900 psi)
  - Hollow brick units — ASTM C652, Grade SW, Type HBX
  - Face brick units — ASTM C216, Grade SW, Type FBS
  - Concrete brick units — ASTM C55, Grade N, Type 1
  - Ceramic glazed structural units — ASTM C126
- Mortar and Grout:
  - Mortar — ASTM C270, Type S (1800 psi)
  - Grout — ASTM C476, Fine Grout (2500 psi)
- Reinforcement:
  - Deformed Bars — ASTM A615, Grade 60
  - Joint Reinforcing — ASTM A82

The specified compressive strength of masonry, f'_m, will be as follows:

- Concrete masonry — 1500 psi

5.7.2.3 Design Methods

Design will be performed for all masonry elements and their components in accordance with Allowable Stress Design (ASD) methods specified in the applicable codes and standards. Elements may be designed using specified empirical methods where approved.

5.7.3 General Design and Detailing

5.7.3.1 Reinforcing

Deformed bar reinforcing will be provided in loadbearing and exterior masonry. All courses and cells containing bars will be fully grouted. Horizontal joint reinforcing will be provided spaced at a maximum of 16 inches vertically to control cracking in all masonry. Horizontal joint reinforcing will be considered to be part of the total horizontal reinforcing where required. Joint reinforcing will be hot-dip galvanized and consist of two parallel 9-gauge wires with 9-gauge connecting diagonal cross-rods or box ties welded to them at 16 inch maximum spacing.

5.7.3.2 Below Grade and Submerged Applications

Masonry will not be used in either below ground or submerged applications unless dictated by project requirements and approved. Solid or fully grouted hollow units will be used with an appropriate coating for protection and leak prevention when required.

5.7.3.3 Veneer

Non-structural masonry veneers will be selected, detailed and specified by the architectural discipline. The structural adequacy of veneer attachments and the weights used in dead load calculations will be verified.

5.7.3.4 Control Joints

In general, the spacing of control joints in masonry walls will be controlled by other building components and architectural requirements. The layout of control joints will be reviewed for its effect on the structural design of the masonry, particularly in regard to structural elements such as masonry lintels bond beams functioning as tension chords in "box system" buildings.

5.8 Structural Metal Design

5.8.1 Scope

Design of the following structures and elements will be performed by the fabricator or vendor, in accordance with criteria provided in the contract documents.

- Access hatches.
- Pre-engineered buildings and stairways.
- Castings, such as manhole covers and trench grates.
- Piping, ductwork, and conduit hangers and supports.
- Patented track for monorails and underhung bridge cranes.

Design of structural metal structures, systems, elements and details, will be performed, except as indicated in Section 5.8.2.

5.8.2 General Criteria

5.8.2.1 Codes and Standards

Design of metal structures and elements will be performed in accordance with the following:

▪ Structural and miscellaneous steel:	AISC Specification – ASD (unless otherwise noted)
▪ Steel joists and joist girders:	SJI Specification
▪ Steel deck, general:	SDI Manual
▪ Steel deck, diaphragms:	SDI Diaphragm Manual
▪ Aluminum:	AA Aluminum Design Manual
▪ Stainless steel:	AISI
▪ Welding, steel:	AWS D1.1
▪ Welding, aluminum:	AWS D1.2

- Welding, stainless steel: AWS D1.6

5.8.2.2 Design Strengths

Design will be performed for the specified strengths and properties of the following materials:

- Steel:
  - Structural steel wide flange shapes: ASTM A 992
  - Other structural steel shapes; plate; and bars: ASTM A 36
- Structural steel tubing: ASTM A500, Grade B
- Structural steel pipe: ASTM A53
- High strength steel bolts: ASTM A 325-SC
- Anchor bolts and threaded rods: ASTM A 307
- Welding electrodes: AWS E70XX
- Aluminum:
  - Aluminum extruded shapes: ASTM B221, 6061-T6
  - Aluminum sheet and plate: ASTM B209, 6061-T6
  - Aluminum extruded pipe: ASTM B429, 6063-T6 or 6061-T6
- Stainless Steel:
  - Stainless steel shapes: ASTM A276, Type 316
  - Stainless steel plate and sheet: ASTM A167, Type 304 or 316
  - Stainless steel bolts ASTM A276, Type 316

5.8.2.3 Design Methods

Design of structural metals will be performed in accordance with Allowable Stress Design (ASD) methods or Load Factor and Resistance Design methods (LRFD). The following methods shall be used:

- Steel Deck: Deck sizes, profiles and connections will be selected from load tables in the referenced standards.
- Joists and Joist Girders: Sizes will be selected from load tables in the referenced standards. Design loads will be provided in the contract documents. For loads other than uniform loads, a load diagram will be provided.
- Gratings: Sizes of metal gratings will be selected in accordance with the manufacturer's load tables for uniform loads and limited concentrated loads defined in the tables. For other loads, design will be performed in accordance with ASD methods specified in the appropriate material standards.

5.8.3 General Design and Detailing – Structural Steel

5.8.3.1 Types of Construction

Steel structures will be designed as one of two types defined by the AISC Specification. In Type 1 construction, commonly referred to as "rigid frame," it is assumed that beam-to-column connections have sufficient rigidity to hold virtually unchanged the original angles between intersecting members. In Type 2 construction, commonly referred to as "conventional" or "simple" framing (unrestrained, free-ended) it is assumed that, for gravity load, the ends of beams and girder are connected for shear only, and are free to rotate under load.

5.8.3.2 Connections

Ensuring the design of connections for strength will be the responsibility of the design engineer. Structural steel connections which can be detailed by the fabricator directly from the AISC Manual will be so noted on the Drawings. Standard framed beam connections (bolted clip angles) will be specified to be designed by the fabricator using Part 4, Table II for one half the total uniform allowable load for the given span from the Allowable Loads on Beams Tables in Part 2. Similarly, pure tension or compression bolted connections, such as for bracing, will be designed using Part 4, Table 1 for the force noted on the Drawings. All other connections will be designed and detailed in the contract documents. Whenever possible, shop welded - field bolted connections will be used. Where possible, 3/4-inch diameter high strength bolts, 1-inch diameter anchor bolts, and 3/16-inch (minimum) fillet welds will be used.

5.8.3.3 Lateral Support

Bracing of the compression flange against lateral-torsional buckling will be considered adequate when design and details provide resistance equal to or greater than 2-1/2 percent of the flange force. This will normally be considered provided by welded or screwed metal decks designed as diaphragms. Metal grating will not be considered to provide bracing.

5.8.3.4 Column Bases

Steel column plates will be designed and detailed using anchor bolts with shims or leveling nuts and shop welded base plates. Field welding of base plates will not be used if avoidable. Nonshrink, flowable grout will be provided under base plates.

5.8.4 General Design and Detailing – Steel Roof Deck

Where possible, 1-1/2 inch Type WR (wide rib), 20-gauge (minimum) deck will be used. For diaphragm action, welded or screwed connections will be provided in a minimum 36/3 pattern at supports and at 18-inches on center at sidelaps.

5.8.5 General Design and Detailing – Steel Joists

Bridging will be provided at all joists in accordance with SJI provisions. Concentrated loads will only be allowed at panel points of the joists.

5.9 Modification of Existing Structures

5.9.1 Scope

The adequacy of existing structures, elements, and details will be verified for modifications (alterations, repairs, and additions) as required by the governing code. New structural elements will be designed as required by the proposed modifications in accordance with applicable criteria.

5.9.2 General Criteria

The Florida Building Code Existing Structures – 2010 Edition will be used.

5.9.3 General Design and Detailing

Design and detailing of modifications to existing structures will conform to the criteria provided for the specific materials involved.

5.10 Performance Specification Design

5.10.1 Scope

Criteria, standards, quality and submittal requirements will be developed for the design, fabrication, and construction of permanent structures designed by the contractor, subcontractor, manufacturer or vendor.

Submittals required for review and approval during construction will include selected drawings and material data, design criteria, as well as reaction loads and connection details for those items supported by or connected to other structural elements for the following items. Design calculations will not be reviewed.

- Pre-engineered metal buildings.
- Prestressed concrete tanks.

Section 6

Electrical Basis of Design

6.1 Existing Conditions

The facility is fed from two Florida Power & Light (FP&L) pad mounted transformers located north of the main electrical service building in the northwest section of the facility. Each three phase transformer is rated 2000 kVA, 13.2kV primary voltage, 480/277V secondary voltage.

The 480/277-volt output of each FP&L transformer is fed to two Square D 3000A main service entrance switchgears, denoted as Switchgear 1 and Switchgear 2, located in the main electrical service building. Switchgear 1 includes a 1600A tie breaker and circuit to feed Switchgear 2. Standby power is provided from Generator No. 1, which is a Cummins 1000 kW, 480/277-volt diesel generator located in an outdoor enclosure with a sub-base fuel tank. Provisions are included to connect a portable Generator No. 2 (1000 kW) to Switchgear 2.

A two section Square D switchboard is directly connected to Switchgear 1. This switchboard feeds the following:

- MCC-3 (600A) - Quonset Hut
- MCC-4A (800A) – Main Service Building
- Filter Feed Pump VFD No. 1 and No. 3 (125A) - Main Service Building
- Transfer Pump RVSS No. 1 and No. 3 (250A) - Main Service Building
- Filter Blower RVSS No. 1 (250A) - Main Service Building
- Injection Pump VFD No. 2 and No. 4 (250A) - Main Service Building
- NPW Pump VFD No. 1 (100A) - Main Service Building
- MCC-1 (200A) - Front Office
- Provisions for 4 - 800A Breakers

A two section Square D switchboard is directly connected to Switchgear 2. This switchboard feeds the following:

- MCC-2A (600A) - Quonset Hut
- MCC-4B (800A) - Main Service Building
- Filter Feed Pump VFD No. 2 and Future No. 4 (125A) - Main Service Building
- Transfer Pump RVSS No. 2 and Future No. 4 (250A) - Main Service Building
- Filter Blower RVSS No. 2 (250A) - Main Service Building

- Injection Pump VFD No. 1 and No. 3 (250A) - Main Service Building
- NPW Pump VFD No. 2 (100A) - Main Service Building
- Provisions for 4 - 800A Breakers

There are two other major electrical distribution locations at the site that are sub-fed from the main electrical service building. The first is referred to as the "Quonset Hut" which is the building construction type. The Quonset Hut is located in the northeast section of the site. Insulation and air conditioning has been added to this structure to contain electrical distribution equipment. This structure contains MCC-2A, MCC-2B, and MCC-3. Power for the headworks area, oxidation ditches, sludge holding tanks, and dewatering building comes from these motor control centers.

The second sub-fed electrical distribution area is at MCC-1 located in the small building just east of the Operations Building at the southwest section of the site. This is primarily used to feed the Operations Building and fed with only a 200 ampere circuit provided from Switchboard 1 in the Main Service Building.

Motor Control Centers (MCCs) MCC-4A and MCC-4B provide power for the In-Plant Pump Station, RAS/WAS Pump Station, Clarifiers 5 and 6, and the deep bed filters.

Review of the current one line diagrams and panel schedules, coupled with a one day site inspection on October 8, 2013, resulted in an estimated total connected load of approximately 3,300 amps at 480 volts equating to 2,745 kVA.

Electric utility bills from October 24, 2011 through September 24, 2013 showed a maximum monthly demand of 625 kW, a minimum monthly demand of 466 kW, and an average monthly demand of 522 kW. An instantaneous reading of the main switchgear meters at 3 PM on October 8, 2013 showed a demand of 444 kW. In order to convert kilowatts (kW) to kilovolt-amps (kVA), the power factor must be known. Power factor is not easily measured and is typically 0.8 for facilities with motor loads as their primary connected load source. Calculated kVA loading is the kilowatts divided by the power factor. The values for the Three Oaks WWTP are then:

- 781 kVA billing maximum
- 583 kVA billing minimum
- 653 kVA billing average
- 555 kVA instantaneous on October 8, 2013

The main service building and equipment appears relatively new and in excellent condition and has the ability to add at least 375 kW / 469 kVA of additional load without needing to install a second 1000 kW generator.

6.2 Improvements for 6 MGD ADF Capacity

Loads are increased on the east section of the site for the 6 MGD ADF expansion. The existing electrical distribution in this section of the site is out of the Quonset Hut with MCC-2A, MCC-2B and MCC-3. The modifications to the buckets and layout are extensive even though the capacity of these motor control centers is adequate to handle the increase in loads. All three MCCs will be replaced.

The Quonset Hut is currently air conditioned. The size of the current air conditioning should be reviewed for adequacy with the additional loads being added and the heat generated from the variable frequency drives.

Table 6-1 shows the additional process motor loads that will be added to the Quonset Hut power distribution system.

Table 6-1 Quonset Hut Power Distribution System Summary

Process Load Addition	Horsepower
Oxidation Ditch 1 – new brush aerator	30
Oxidation Ditch 2 – new brush aerator	30
Oxidation Ditch 3 – replacement of 50 HP with 60 HP motors (4 brush aerators)	40
New Clarifier (3/4 HP drive) and two scum pumps (3 HP)	6.75
Existing RAS/WAS Pump Station – two 20 HP pumps on VFDs	40
Dewatering Building – new belt filter press and associated drives and pumps on VFDs	100
Total horsepower addition	246.75

The available capacity of the Quonset Hut equipment is exceeded and a new electrical room or building is required with the addition of Oxidation Ditch 4. This new building will be designated as the new MCC Electrical Building in this report. This new power distribution area would be located on the east or southeast section of the site to optimize the wire sizing for voltage drop to the associated motor loads. The building would be sized to accommodate future Oxidation Ditch 5 and associated loads. Paired motor control centers MCC-5A and MCC-5B would be planned with MCC-5A being fed from Switchboard 1 in the main electrical service building and MCC-5B being fed from Switchboard 2 in the main electrical service building. There would be a tie circuit between MCC-5A and MCC-5B to comply with Class I reliability according to the Environmental Protection Agency document "Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability" for municipal wastewater treatment facilities. The building will be air conditioned to provide humidity control and maximize electrical equipment life.

Table 6-2 shows the additional process motor loads that will be added to the new MCC electrical building power distribution system at the 6 MGD capacity.

Table 6-2 New MCC Electrical Building Power Distribution – MCC-5A and MCC-5B

Process Load Addition	Horsepower
New Oxidation Ditch 4 – with three 75 HP brush aerators	225
Two new clarifiers (3/4 HP drive) and two scum pumps (3 HP)	7.5
New RAS/WAS Pump Station – three 20 HP RAS pumps on VFDs, two 5 HP WAS pumps	70
Total Horsepower Addition	302.5

There are no additional process loads being fed out the electrical service building power distribution for the 6 MGD ADF build out.

Total additional process load along with facilities loads associated with increased site lighting for new structures and building loading increases the connected plant load by 726 kVA. This will load the existing 1000 kW generator to 828 kW at peak demand based on the two-year calculated demand factor. The second generator would not be required to be added at this phase unless a redundant generator is desired by LCU.

6.3 Improvements for 8 MGD ADF Capacity

Oxidation Ditch 5, a sixth secondary clarifier and a fourth RAS pump to the new process train is added along with a new filter feed pump, deep bed filter, chlorine contact tank, transfer pumping, and effluent pumping. Additional loads from the Quonset Hut distribution are not being added. Process loads are added at the 6 MGD ADF new MCC electrical building and the Main Service Building.

Table 6-3 shows the additional process motor loads that will be added to the MCC electrical building power distribution system.

Table 6-3 Additional Loading to New MCC Electrical Building Power Distribution – MCC-5A and MCC-5B

Process Load Addition	Horsepower
New Oxidation Ditch 5 – with three 75 HP brush aerators	225
New clarifier (3/4 HP drive) and scum pump (3 HP)	3.75
Additional 20 HP RAS pump on VFD	20
Total Horsepower Addition	248.75

Table 6-4 shows the process motor loads that will be added to the Main Service Building for the 8 MGD build out.

Table 6-4 Main Service Building Power Distribution – Switchboards and MCC-4A and MCC-4B

Process Load Addition	Horsepower
New Filter Feed Pump No. 4 on VFD	75
New Transfer Pump No. 4 on VFD or reduced voltage starter	125
New Injection Pump No. 5 on VFD	100
New flash mixer at new chlorine contact	5
Total Horsepower Addition	305

The peak demand (defined as connected load times a historical demand factor) for the plant is calculated to be 975 kW. It would be prudent to plan on providing the second 1000 kW generator in this phase even though this is still under the 1000 kW generator capacity. A more thorough analysis will need to be completed to further vet this out. The construction cost estimate at 8 MGD will assume a new generator for planning purposes.

6.4 Design Criteria

6.4.1 Codes, Standards, and References

All electrical work will be designed in accordance with the latest editions of the National Electrical Code (NEC) and Local Electrical Codes. The following are the pertinent codes, standards and references that will govern the design.

National Fire Protection Association (NFPA), with the most relevant codes and standards including:

- NFPA 70 – National Electrical Code
- NFPA 72 – National Fire Alarm Code
- NFPA 110 – Standard for Emergency and Standby Power Systems
- NFPA 780 – Standard for the Installation of Lightning Protection Systems

- NFPA 820 – Standard for Fire Protection in Wastewater Treatment and Collection Facilities

Environmental Protection Agency (Wastewater)

- Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability

Florida Statutes (Wastewater)

- Chapter 62-600 – Domestic Wastewater Facilities

Other relevant codes and standards include:

- National Electrical Safety Code (NESC)
- Occupational Safety and Health Administration (OSHA)
- National Electrical Manufacturers Association (NEMA)
- American National Standards Institute (ANSI)
- Insulated Cable Engineers Association (ICEA)
- International Society of Automation (ISA)
- Underwriters Laboratories (UL)
- Factory Mutual (FM)
- International Electrical Testing Association (NETA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Florida Building Code (FBC)

The electrical design will include the requirement that a short circuit, coordination and arc flash study be completed by the Contractor for all modified and new electrical equipment. Project specific arc flash labeling will be part of the Contractor's responsibility.

All electrical equipment and materials shall be listed by Underwriters Laboratories, and shall bear the appropriate UL listing mark or classification marking. Equipment, materials, etc. utilized not bearing a UL certification shall be field or factory UL certified prior to equipment acceptance and use.

6.4.2 Electrical Materials and Equipment

6.4.2.1 Electrical Enclosures

NEMA enclosure, area and equipment classifications shall be as follows:

- NEMA 1, 1A and 12 for dry areas such as electrical or non-process rooms above grade.
- Use NEMA 4 (and 3R minimum rating) for wet, hosedown, watertight (and weatherproof or raintight) which will be for interior and/or exterior areas.

- Use NEMA 4X for wet, hosedown, watertight areas which are corrosive which will be interior and/or exterior areas. Enclosures shall be type 316 stainless steel, powder coated white with a sunshield for all exterior areas.

- Use NEMA 7 for classified hazardous areas as per National Electrical Code. Class, Division and Group shall be determined during detailed design.

6.4.2.2 Raceways

Rigid aluminum conduit will be used in interior dry and wet locations. Corrosive areas shall use PVC schedule 80. Direct buried underground conduits will be PVC type Schedule 80 with rigid aluminum conduit elbows. Concrete ductbanks will be provided for selected major underground conduit installations, generally for large feeders and/or multi-conductor cables between structures.

The minimum size of conduit allowed will be ¾ inches. Conduits will be concealed in the slab, in walls or the ceiling to the greatest extent possible. All underground conduits will be provided with a warning tape above the conduits. Underground electrical conduits will be placed at least 24 inches below grade. Working clearances between underground electrical utilities and other nonelectric underground utilities should be 12 inches (minimum) in addition to other specific equipment requirements.

6.4.2.3 Conductors

All wire and cables will be run in conduit. Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper. All conductors shall be stranded, except that lighting and receptacle wiring may be solid. Power wiring, rated 600V and less shall be NEC type THWN-2 for #10 AWG and smaller and NEC type XHHW-2 for #8 AWG and larger. The minimum conductor size for power wiring shall be No. 12 AWG.Control wiring shall be No. 14 AWG Type THWN-2, stranded.

6.4.2.4 Motors

All motors will be of the high efficiency, squirrel cage induction type. Motors used in conjunction with VFDs will be rated for inverter duty and be in strict accordance with the latest NEMA MG-1, Part 31 standard. Reduced voltage soft start shall be used for motors 100 HP or larger. VFD control by its nature can be considered soft start. Any two speed motor would be of the two winding type.

Unless otherwise noted, all motors ½ HP through 100 HP shall be rated 230/460 volt, 3-phase, 60 Hertz A.C., motors 125 HP and above shall be rated 460 volts, 3-phase, 60 Hertz A.C., and motors below ½ HP shall be rated 115/230 volt, 1-phase, 60 Hertz A.C.

Motors 20 HP and larger shall have a 120 volt space heater for moisture control. Motors 100 HP and larger, not on variable frequency drives, shall have power factor correction capacitors.

All motors shall have a local disconnect switch at the motor, including motors on VFDs. Motors on VFDs shall have a local/remote selector switch at the motor. If the available fault current at a motor disconnect is greater than 10kAIC, a circuit breaker shall be used rather than a fusible disconnect switch.

6.4.2.5 Motor Control and Communication

Solid state motor overloads will be used. Motor control will be via hardwired with control wires. Ethernet cabling will be provided for data communication only. Power monitors will be provided at each motor control center and connected to the SCADA system.

6.4.2.6 Variable Frequency Drives

Variable frequency drives will be used to provide energy efficient operation of various equipment. All VFD's will utilize Pulse Width Modulated (PWM) technology using IGBT semiconductor devices for power conversion. Motors 100 HP and larger shall use 18-pulse type with phase shift transformers to mitigate harmonics imposed on the power distribution system.

6.4.2.7 Power for Lighting, Receptacles, and Miscellaneous Loads

Miscellaneous power required for HVAC, controls, instruments, receptacles, lights, and motors under ½ HP will be provided by via 480/277V panelboards and 208/120V panelboards.

The lighting plans developed for new buildings will locate lighting fixtures, receptacles, telephone jacks and any other 120 volt circuits. Interior emergency and egress lighting, exit signs, etc., will be provided with 1 1/2 hour battery backup packs/units.

6.4.2.8 Lighting

Interior lighting in rooms with ceilings will be recessed fluorescents or LED type. In rooms without ceilings, lighting fixtures will be industrial fluorescent, LED, or metal halide low bay type, depending on the floor-to-ceiling height. Fixtures will be rated 120V or 277V. All ballasts will be high-efficiency core and coil type or as required by national energy standards.

Lighting fixtures mounted more than 15 feet may be LED or Metal Halide (with quartz lamp backups and standby system when initially energized).

Illumination levels will be approximately 50 foot candles in electric rooms and office areas, 30 foot candles in process areas, 1 to 10 foot candles for exterior areas or as required.

Interior lighting control shall be via individual switches. Outdoor lighting will be controlled by a combination of photocell and time control circuits.

Exterior egress lighting for door entrances and exits shall be provided on the exterior of the new buildings. Additional site lighting will be provided as required.

6.4.2.9 Telecommunications Systems

A basic telephone conduit system will be provided in any new administration type building with the minimum requirements such as empty wall boxes (telephone jacks) set up for push button stations for wall and desk top sets and a telephone terminal cabinet for service location. Data and page/party intercom systems will not be provided, unless otherwise requested.

6.4.2.10 Lightning and Surge Protection

A Franklin rod lightning protection system will be included for new buildings. Other structures and equipment will not be included unless otherwise specifically indicated and requested by LCU. The lightning system will be coordinated and designed by a licensed lightning protection system supplier based on the performance specification prepared during final design.

System protection will be tied to the building grounding grid. Surge protective devices (SPDs) will be provided on all equipment including the motor control centers, panelboards and VFD's. SPDs devices will be utilized in the new distribution system to control transient disturbances caused by power system surges and lightning transients.

6.4.2.11 Grounding and Bonding

The ground source for the new MCC electrical building will have a maximum resistance to ground of five (5) ohms and will consist of a combination of underground main water service piping, incoming service ground conductor, exterior driven ¾" x 20' copper clad ground rods interconnected in a ring around building perimeters and connected to the building steel. All inaccessible connections will be exothermically welded.

Neutrals of 480-208Y/120V transformers will be connected to an approved grounding electrode as required by the National Electric Code for separately derived systems. In addition, the neutral must be bonded to the transformer enclosure. A grounding conductor shall be run with the supply conductors from the distribution ground bus to the transformer enclosure.

All conductive non-current carrying components of the electrical system such as raceways and enclosures will be grounded. A separate ground conductor will be installed with the phase conductors in all feeder and branch circuits. A separate ground conductor shall be installed with 120V control circuit conductors.

6.4.2.12 Fire Alarm, Security, and CCTV Systems

Fire alarm systems for new buildings and structures shall be provided as required to meet local codes and NFPA 820. The fire alarm system will be coordinated and designed by a licensed professional engineer based on the performance specification prepared during final design.

Additional monitoring added to the existing CCTV system must be specifically requested by the client. These requirements will be provided by performance specifications with minimal locations and risers shown on the drawings.

6.4.2.13 Identification and Marking

All electrical equipment and conductors will be identified. In general equipment identification nameplates will be provided for all components of the distribution system such as circuit breakers, switches, transformers, panelboards, motor control centers, starters, etc. Panelboards will have typed directories.

Wire and cable for feeders and branch circuits will be color coded to conform to existing facility standards. Color coding should differentiate between 480/277 Volt systems and 208/120 Volt systems. Unless existing facility standards are different, color coding will be: Brown, Orange, Yellow, Gray (A,B,C,N) for 480/277V systems and Black, Blue, Red, White (A,B,C,N) for 208/120V systems. Equipment ground will be identified by the color green exclusively.

In general the phase orientation for disconnects, starters and panel boards will be phased "A", "B", and "C" either top to bottom or left to right. Clockwise rotation is required. Correction of rotating loads shall be done at the motor.

6.4.2.14 Equipment Preferences

Published LCU electrical design standards (dated 2/10/2000) may not represent current County preferences. Based on our site visit with LCU staff, the preferred suppliers of major electrical equipment include the following:

Motor Control Centers and Control Products: Square D or Allen-Bradley. Smart MCCs are not preferred, solid state overloads are acceptable.

Panelboards, Transformers, Disconnect Switches: Square D.

Variable Frequency Drives: Square D or Allen-Bradley.

Generators: Cummins.

Section 7

Automation Basis of Design

7.1 Existing Conditions and Concerns

The Three Oaks Wastewater Treatment Plant currently uses the Modicon Quantum series programmable logic controllers (PLCs) which were installed in 2007. The PLCs communicate to the main control room via multi-mode fiber. Communication is achieved using the Modbus TCP/IP communication protocol. Stride fiber optic convertors and N-tron Ethernet switches are being used for Ethernet communication between the PLCs and the control room. There were no issues raised with PLCs or communication networks.

The existing PLCs panels are located indoors and code violations were not found. PLC-1A and PLC-2 contain spare inputs and outputs (I/O), if needed, for future expansion. The existing belt filter press PLC is an Allen-Bradley MicroLogix and is currently not on the plant fiber optic network. There are several hardwired signals that run back to PLC-1A for monitoring but all signals have not been made available on the network.

The existing clarifiers have sludge blanket level detectors but are reportedly very unreliable. LCU requested that options for new sludge blanket detectors be researched. The dissolved oxygen (DO) probes being used in the oxidation ditches are Hach LDO probes which are connected to Hach SC100 and SC200 transmitters. The probes do not work well and are unreliable. Dissolved oxygen measurements were originally intended to control the brush aerators but now operate based on timers.

The control room has only one human-machine interface (HMI) screen for plant operators. There is very little room for additional workstations or screens if future expansion is desired. LCU expressed the need for additional screens for monitoring equipment around the plant and possibly well sites in the future.

The RAS and WAS pump stations for the existing peripheral clarifiers are currently not monitored or controlled on the SCADA system. RAS flow is controlled by an operator entered flow set point with feedback coming from a flow meter on the discharge of the RAS pumps. They can also be manually controlled by an operator. WAS pumps are currently controlled by an operator entered set point indicating quantity of sludge to be wasted that day. Both RAS and WAS systems have duty and standby pumps. It was requested by LCU to have the RAS and WAS systems controlled from the SCADA.

7.2 Improvements for 6 MGD ADF Capacity

One of the main goals as part of the expansion is to achieve a higher level of automation with any new equipment being installed. Automating equipment will optimize equipment runtimes which will reduce plant power usage. DO and ORP probes will be installed in the new oxidation ditches.

The operators will have the ability to set a desired DO set point within the oxidation ditches. A PID control loop will control the aerators. This will allow the variable frequency drives to ramp up and down during changes in oxygen demand. The oxidation ditch manufacturer will be providing the VFDs and a PLC control panel. Analytical instruments installed with the oxidation ditches will be manufactured by Hach or an approved equal.

The County stated that new VFDs would have control and monitoring signals (Run, Start/Stop, In Remote) hardwired to the PLC while an additional Ethernet connection would be made to monitor ancillary signals. Viewing of additional signals from the VFD (such as phase voltage, power usage, internal temperature) will help staff with the operations and maintenance of the equipment. This information should also be trended.

LCU stated that new PLCs added as part of the project would be manufactured by Allen-Bradley. An Allen Bradley CompactLogix series PLC would provide adequate processing power to be able to monitor and control any new equipment. The new PLC panel would have a fiber run back to the main control room and would communicate via Ethernet. New network equipment within the PLC panel would be the same manufacturer as what is currently onsite for standardization. The panel would also include an uninterruptable power supply (UPS) and a local operator interface for monitoring and control of equipment. It would need to be determined, depending on selected equipment and existing space within existing PLC panels, if a new PLC panel is required. Instrumentation for the new clarifier would be a float switch in the scum well for control of the scum pumps, a torque alarm for the clarifier drive, and a new sludge blanket detector. **Table 7-1** summarizes the available spare input/outputs for the existing PLCs on-site.

Table 7-1 Summary of Available Spare Inputs/Outputs at Existing PLCs

	Digital Inputs	Digital Outputs	Analog Inputs	Analog Outputs
PLC-1A	17	9	7	3
PLC-2	40	8	11	7

Flow and pressure instrumentation for the new RAS and WAS pumping systems would be used for monitoring and control of the new pumps. Flow meters would be located on the discharge headers of both the WAS and RAS systems to be used for control. LCU currently uses Endress+Hauser flow meters at the facility. Limit switches would be located on the discharge check valves for monitoring of pump failures. In addition, pressure gauges with diaphragm seals would be located at the discharge of each pump.

A new 2-meter belt filter press will be installed as part of the 6 MGD expansion. The existing Belt Filter Press has hardwired signals going back to PLC-1A. The available spares in PLC-1A would need to be evaluated to determine if the new belt filter press can be monitored at that location. The new belt filer press would come with PLC cabinets provided by the belt filter manufacturer for control.

Sludge blanket detectors historically have been unreliable. Advancements in sludge blanket detection by manufacturers such as Cerlic have made this form of measurement more reliable. Measurement of the sludge blanket is achieved by submersing a suspended solids sensor into the clarifier which will provide a better, more reliable reading of sludge blanket level. The Cerlic unit automatically removes the sensor when the clarifier arm rotates around.

LCU also indicated that there are several minor issues with the SCADA system and would like them incorporated into this 6 MGD expansion. These include:

- Grit pumps are incorrectly numbered on the HMI screen.

- The reading from the pH analyzer on the main page needs to be updated to read in hundredths.
- The waste sludge batch total and the batch set point need to be displayed on the main screen.
- Effluent transfer pumps do not alternate properly.
- The mudwell automatic flow controls need to be updated to read mudwell discharge flow more frequently for better flow correction to the In-Plant Pump Station.
- The PLCs do not change to daylight savings time.
- Effluent transfer pump runtimes need to be displayed in tenths of an hour.
- Auto runtime function for control of WAS pumps is not working.
- Reuse tank #4 needs a “Full Condition” button added.
- RAS and WAS control screens at the peripheral clarifiers need to be added to the HMI.

7.3 Improvements for 8 MGD ADF Capacity

A second oxidation ditch would be installed adjacent to the one installed in the 6 MGD expansion. A third secondary clarifier would be added to support this process train. At this expansion stage it is not anticipated to add any new PLC panels. A new PLC panel, if needed, would be provided during the 6 MGD expansion. The PLC panel would be sized with consideration of new equipment to be installed in the future.

The instrumentation and controls for the new oxidation ditch, clarifier, scum pumping, and RAS/WAS pumping would be identical as installed in the 6 MGD expansion. Instrumentation within the new clarifier would be a float switch in the scum well for control of the scum pumps, torque switches, and a new sludge blanket detector.

The new deep bed filter will need to be controlled by the existing PLC for the filters. The PLC panel is connected into the plant fiber network at PLC-2 located adjacent to the filters. In addition a chlorine contact chamber will be added. Any new signals required with the addition of the contact chamber can be wired to spare I/O in PLC-2 as it is not anticipated that there will be many I/O points associated with this.

Section 8

Opinion of Probable Construction Cost

This section provides a Level 2 estimate as defined by the American Society of Professional Estimators. A Level 2 estimate is utilized for projects at a definition level of up to 15 percent. The expected accuracy of this estimate is within 20 to 30 percent of the actual project price.

8.1 Upgrades to 4 MGD ADF

Table 8-1 summarizes the planning level cost estimate for the 4 MGD ADF facility.

Table 8-1 Conceptual Cost Evaluation for Upgrades to 4 MGD ADF

Parameter	Cost
Sitework and demolition	$281,000
Supplemental aeration for Ditches 1-3	$756,000
New 85-foot diameter secondary clarifier for existing process train	$256,000
New RAS pumping and clarifier splitter box modifications for existing clarifiers	$235,000
Instrumentation and controls	$77,000
Electrical	$262,000
SUBTOTAL	$1,868,000
Painting allowance	$15,000
MOPO allowance	$50,000
Permits/sales tax/insurance/liability/bonds	$176,000
Contractor overhead and profit	$436,000
Contingency	$655,000
Escalation until bidding	$128,000
TOTAL	$3,328,000

8.2 Upgrades to 4 MGD ADF and Expansion to 6 MGD ADF

Table 8-2 summarizes the planning level cost estimate for the upgrades to 4 MGD ADF and expansion to a 6 MGD ADF facility.

Table 8-2 Conceptual Cost Evaluation for Upgrades to 4 MGD ADF and Expansion to 6 MGD ADF

Parameter	Cost
Sitework and demolition	$317,000
Headworks modifications	$165,000
Supplemental aeration for Ditches 1-3	$235,000
New 85-foot diameter secondary clarifier for existing process train	$756,000
New RAS pumping and clarifier splitter box modifications for existing clarifiers	$256,000
New 2 MGD ADF oxidation ditch process train	$2,251,000
New clarifier splitter box for new 2 MGD process train	$281,000
Two new 85-foot diameter secondary clarifiers for new 2 MGD process train	$1,465,000
New RAS/WAS pump station for new 2 MGD process train	$352,000
Modifications to sodium hypochlorite system	$71,000

Parameter	Cost
1.2 MG prestressed ground storage tank	$730,000
Solids handling improvements	$545,000
New administration building	$1,625,000
New electrical building	$80,000
Instrumentation and controls	$418,000
Electrical	$1,421,000
SUBTOTAL	$10,074,000
Painting allowance	$83,000
MOPO allowance	$50,000
Permits/sales tax/insurance/liability/bonds	$856,000
Contractor overhead and profit	$2,256,000
Contingency	$3,384,000
Escalation until bidding	$668,000
TOTAL	$17,371,000

8.3 Upgrades to 4 MGD ADF and Expansion to 8 MGD ADF

Table 8-3 summarizes the planning level cost estimate for the upgrades to 4 MGD ADF and expansion to an 8 MGD ADF facility.

Table 8-3 Conceptual Cost Evaluation for Upgrades to 4 MGD ADF and Expansion to 8 MGD ADF

Parameter	Cost
Sitework and demolition	$528,000
Headworks modifications	$165,000
Supplemental aeration for Ditches 1-3	$235,000
New 85-foot diameter secondary clarifier for existing process train	$756,000
New RAS pumping and clarifier splitter box modifications for existing clarifiers	$256,000
Two new 2 MGD ADF oxidation ditch process train	$4,509,000
New clarifier splitter box for new 4 MGD process train	$281,000
Three new 85-foot diameter secondary clarifiers for new 4 MGD process train	$2,232,000
New RAS/WAS pump station for new 4 MGD process train	$422,000
Deep bed filter modifications	$703,000
Modifications to sodium hypochlorite system	$325,000
Chlorine contact tank modifications	$71,000
Effluent pump station modifications	$87,000
1.2 MG prestressed ground storage tank	$730,000
Solids handling improvements	$545,000
New administration building	$750,000
New electrical building	$80,000
New 1,000 kW generator	$473,000
Instrumentation and controls	$654,000
Electrical	$2,223,000
SUBTOTAL	$16,025,000
Painting allowance	$131,000
MOPO allowance	$50,000
Permits/sales tax/insurance/liability/bonds	$1,331,000

Parameter	Cost
Contractor overhead and profit	$3,563,000
Contingency	$5,345,000
Escalation until bidding	$1,058,000
TOTAL	$27,503,000

8.4 Items Not Included in Cost Estimates

Several items were identified by either CDM Smith or LCU staff as being preferred as part of the facility upgrades. These costs are not included in the estimates above but are presented for the County's consideration. A contingency of 25 percent is being used that may accommodate these items. These items include:

- Ballasting new concrete structures against flotation.
- Expanding the plant non-potable water (NPW) system. Oxidation Ditch No.2 does not have hose bibs. Oxidation Ditch No.3 has non-potable water but there is not adequate pressure. The NPW pumps also have a wiring issue that causes the second pump to operate even when demand is low.
- Replacing the existing belt filter press cake pump. The pump was identified as a bottle neck because it does not move solids fast enough. Operations staff indicated that a new auger system may address this issue. The new auger system can be designed in a way that the cake from the existing and new belt filter press can be handled together.
- New in-plant drain pump station for the new process train(s).
- Modifications to the outfall structure at Oxidation Ditch No. 3.
- Major site changes, storm sewers, and structures to mitigate any new requirements from FDEP for stormwater treatment and storage.

Section 9

Constructability and Maintenance of Operation Considerations

This basis of design report has disclosed a number of upgrades required in order to meet current and future capacity needs.   A handful of items have been identified as potential constructability and/or maintenance of operation during construction concerns while developing these options. This list is not meant to be complete at this point as others will arise during preliminary design and subsurface underground exploration; however, it does provide a means to begin the thought process between the engineer and LCU staff on how to address these concerns during construction. **Table 9-1** summarizes the concerns and potential means to mitigate.

Table 9-1 Identified Constructability and/or MOPO Items

Issue	Phase	Problem	Potential Solution
Siting new clarifiers for 2.0 MGD oxidation ditch	6.0 MGD upgrades	Influent force main runs through site in this location. May interfere and taking this out of service may present a challenge.	Non-issue if subsurface exploration indicates clarifier footprint does not infringe on pipe. If relocation is required, use of the bypass line around the influent flow meter can be done (with use of a strap on meter for flow recording) which will allow for isolation of piping at the meter via plug valves. This can be disassembled and new piping can be routed to avoid the new clarifiers. A wet tap to tie-in the new piping to the existing force main will be needed unless an outage can occur. This construction activity would have to start after the demolition work of the mothballed tanks on the south side of the site but before the new clarifiers are poured.
Expanding headworks discharge structure	6.0 MGD upgrades	Existing headworks was not designed for future piping leaving it to be routed to new process tanks.	Construct add-on to discharge boxes and bulkhead existing channel to keep headworks in operation while tie-in work is being completed.
Tieing in new clarified effluent piping to existing wall pipe in filter feed pump station wet well.	6.0 MGD upgrades	Pipe appears to be plugged with no valve. Tie in will require outage of the filter feed pump station which will require flow from all clarifiers to be ceased	Have piping in place before tie in. Use new ditch as influent storage while seeding it for startup.
Increasing pipe size between chlorine contact tank and filter clearwell	8.0 MGD upgrades	Pipe and flowmeter need to be upsized from 24" to 30" due to excessive headloss	Bypass pump from clearwell to chlorine contact tank.
Getting effluent from Chlorine Contact Tank #3 to the transfer pump station	8.0 MGD upgrades	Wet well doesn't sit next to tank. Tank #3 will have to connect hydraulically Tank #1.	Take Tank #1 out of service for tie-in.

Lee County Utilities
Three Oaks Wastewater Treatment Plant
Basis of Design Report

Engineer's Opinion of Probable Cost

Appendix A

Lee County, FL
Three Oaks WWTP Expansion - 4.0 MGD Alternate
Opinion of Probable Construction Cost, October 2013, Concept Design

Project name	Three Oaks WWTP Ft. Myers FL USA
Client	CDM Smith
Estimator	Barker, Chad
Labor rate table	FL13 Labor Sarasota
Equipment rate table	00 13 Equip Rate BOF
Job size	4000000 GAL
Project	WWTP
Major Process	Environmental
Secondary Process	41 24 14 Wastewater
Major Structure	0- Not Applicable
OPCC Type	OPCC
Definable field 09	Orlando, FL
Definable field 10	OPC-000 (Budget)
Reviewed by	DB 7.0
ENR 20 City CCI	Oct 2013: 9688.96
Notes	This is an Opinion of Probable Construction Cost (OPCC) only, as defined by the documents provided at the level of design indicated above. CDM Smith has no control over the cost of labor, materials, equipment, or services furnished, over schedules, over contractor's methods of determining prices, competitive bidding (at least 3 each - both prime bidders and major subcontractors), market conditions or negotiating terms. CDM Smith does not guarantee that this opinion will not vary from actual cost, or contractor's bids. There are not any costs provided for: Change Orders, Design Engineering, Construction Oversight, Client Costs, Finance or Funding Costs, Legal Fees, Impact Fees, Land Acquisition or temporary/permanent Easements, Operations, or any other costs associated with this project that are not specifically part of the bidding contractor's proposed scope. Assumptions: No rock excavation is required. Only nominal dewatering is needed. No consideration for contaminated groundwater/soils or hazardous materials is included (i.e. asbestos, lead, etc). Temporary parking/storage/staging is available within the limits of construction. Based on a normal 40 hour work week with no overtime.
Report format	Sorted by 'Area/95CSI Sctn/Element' 'Detail' summary Allocate addons

EXECUTIVE SUMMARY

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
05 SITEWORK	1.00 LS	65,701		132,100	40,685	43,000	281,486.58 /LS	281,487
18 SECONDARY CLARIFIER #7 (85' DIA.)	1.00 EA	200,222	503,569	8,411	39,369	4,244	755,814.75 /EA	755,815
38 EXISTING SPLITTER BOX & RAS/WAS MODIFICATIONS	1.00 LS	34,240	206,269	319	12,030	3,224	256,081.90 /LS	256,082
80 EXISTING OXIDATION DITCH MODIFICATIONS	1.00 LS	15,682	218,760		1,052		235,494.69 /LS	235,495
90 INSTRUMENTATION & CONTROLS	1.00 LS			77,028			77,027.74 /LS	77,028
100 ELECTRICAL	1.00 LS			261,894			261,894.28 /LS	261,894

ESTIMATE DETAIL

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
05 SITEWORK								
02000 Sitework								
02000.4605 Sitework Allowance	1.00 ls					25,000	25,000.00 /ls	25,000
02000 Sitework						25,000		25,000
02220 Demolition								
02220.4605 Demolish Existing Tanks & Structures	1.00 ls			132,100			132,100.00 /ls	132,100
02220.4610 Remove Existing Mechanical Equipment	1.00 ls	38,819			8,563		47,382.33 /ls	47,382
02220.4615 Remove Existing Underground Piping	1.00 ls	26,882			32,122	18,000	77,004.25 /ls	77,004
02220 Demolition		65,701		132,100	40,685	18,000		256,487
05 SITEWORK	**1.00 LS**	**65,701**		**132,100**	**40,685**	**43,000**	**281,486.58 /LS**	**281,487**
18 SECONDARY CLARIFIER #7 (85' DIA.)								
02300 Earthwork								
20.02300.4640 Structural Excavation & Backfill - Clarifier	4,500.00 cy	4,552			11,756		3.62 /cy	16,308
02300 Earthwork		4,552			11,756			16,308
02500 Yard Piping								
02501.4631 20" DIP-CE-Clarifier #7 to Filter Feed PS	20.00 lf	460	4,310	27	738		276.75 /lf	5,535
02511.4699 36" x 20" Connection (including 20" Valve)	1.00 ea	1,770	28,923		1,472		32,165.40 /ea	32,165
02500 Yard Piping		2,230	33,233	27	2,210			37,700
03212 Concrete Walls								
03325.0013 Clarifier Walls (267'x16.25'x12")	160.69 cy	54,226	56,303	2,625	5,901	376	743.24 /cy	119,431
03325.0025 Launderer Walls (267'x3'x12")	29.67 cy	27,575	13,779	485	5,180	69	1,587.02 /cy	47,087
03325.0030 Clarifier Walls -Exterior (12'x21'x12")	9.78 cy	5,504	4,846	160	1,065	23	1,185.79 /cy	11,597
03212 Concrete Walls		87,304	74,928	3,269	12,146	468		178,115
03310 Concrete Slab on Grade								
03325.0010 Clarifier Bottom Slab	345.00 cy	49,916	82,917	1,353	119	808	391.63 /cy	135,112
03325.0015 Clarifier Hopper	28.18 cy	5,703	8,064	276		66	500.68 /cy	14,109
03310 Concrete Slab on Grade		55,619	90,982	1,629	119	873		149,221
03314 Concrete Elevated Slabs								
03325.0020 Launderer Slab (267'x2'x12")	19.78 cy	9,231	7,455	3,343	490	46	1,039.65 /cy	20,564
03314 Concrete Elevated Slabs		9,231	7,455	3,343	490	46		20,564
03600 Grout								
03325.0035 Clairifier Grout (2")	35.70 cy	2,712	5,355		1,696	2,856	353.48 /cy	12,619
03600 Grout		2,712	5,355		1,696	2,856		12,619
05500 Metal Fabrications								
05500.1802-05-0010 Aluminum Guardrail with Toe Board	300.00 lf	4,149	22,872				90.07 /lf	27,021
05500.1806-05-0010 Aluminum Stair and Rail	34.00 trd	2,047	6,349		732		268.47 /trd	9,128
05500 Metal Fabrications		6,196	29,221		732			36,149
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	16.00 sf	150	1,112				78.85 /sf	1,262
48-05500.2605 Fabricated Walkway	168.00 sf		11,368				67.67 /sf	11,368
05530 Grating & Planks		150	12,480					12,630
05531 Traffic Grates & Castings								
0531.1838-05-0010 Effluent Box Grate	16.00 sf	26	1,800		13		114.95 /sf	1,839
0531.1840-05-0010 Scum Collection Trough	16.00 sf	176	1,980		13		135.61 /sf	2,170
05531 Traffic Grates & Castings		202	3,780		27			4,009
06600 Plastic Fabrications								
48-06610.2605 FRP Weir, 85' Dia. Clarifier	1.00 ea	6,025	15,000				21,025.48 /ea	21,025
06600 Plastic Fabrications		6,025	15,000					21,025
11060 Submersible Wastewater Pumps								
48-11310.2600 Submersible Scum Pumps	1.00 ea	863	25,307				26,169.68 /ea	26,170
11060 Submersible Wastewater Pumps		863	25,307					26,170
11225 Clarifiers								
48-11225.2601 Half Bridge Secondary Clarifier Mechanism (85' Dia.)	1.00 ea	16,461	156,066	91	7,701		180,318.83 /ea	180,319

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
11225 Clarifiers		16,461	156,066	91	7,701			180,319
15000 Process Mechanical								
48-15210.2600 24" DIP-ML-Clarifier Feed	1.00 ls	2,737	17,339	35	1,436		21,547.14 /ls	21,547
48-15210.2601 14" DIP-RAS-Return Line	1.00 ls	1,594	8,359	17	718		10,687.52 /ls	10,688
48-15210.2602 24" DIP-SE-From Collection Box	1.00 ls	984	7,573		340		8,897.11 /ls	8,897
48-15210.2603 4" DIP-SC-Scum Pump Discharge Pump #1	1.00 ls	1,347	9,499				10,846.45 /ls	10,846
48-15210.2604 Scum Pump Valving	1.00 ls	875	4,217				5,091.91 /ls	5,092
48-15240.2600 Tank Spray Diffuser	1.00 ls	1,140	2,775				3,914.89 /ls	3,915
15000 Process Mechanical		8,677	49,762	52	2,494			60,985
18 SECONDARY CLARIFIER #7 (85' DIA.)	**1.00 EA**	**200,222**	**503,569**	**8,411**	**39,369**	**4,244**	**755,814.75 /EA**	**755,815**
38 EXISTING SPLITTER BOX & RAS/WAS MODIFICATIONS								
02500 Yard Piping								
58.02501.4608 12" DIP-RAS-Pump Station to Existing 16" RAS	200.00 lf	7,421	10,446	146	10,505		142.59 /lf	28,517
02500 Yard Piping		7,421	10,446	146	10,505			28,517
03000 Concrete								
03330.0020 RAS Splitter Box Slab - Add for Clarifier #7	5.25 cy	659	1,016		6		320.22 /cy	1,681
03330.0025 RAS Splitter Box Walls - Add for Clarifier #7	7.43 cy	4,541	2,971	121	41	17	1,035.25 /cy	7,692
03330.0029 RAS Pump Station Slab	15.90 cy	1,997	3,079		19		320.47 /cy	5,095
03335.0020 Equipment Pads	2.67 cy	1,656	1,134	52	5	6	1,068.83 /cy	2,854
03000 Concrete		8,854	8,199	174	72	24		17,322
05500 Metal Fabrications								
05500.1802-03-0010 Aluminum Guardrail 3 Line with Toe Board	20.00 lf	276	1,470				87.29 /lf	1,746
05500 Metal Fabrications		276	1,470					1,746
05530 Grating & Planks								
05530.1825-03-0012 Aluminum Grating and Steel Angle - Add for Clarifier #7	80.00 sf	1,042	12,250		93		167.32 /sf	13,385
05530 Grating & Planks		1,042	12,250		93			13,385
11210 Water Supply & Treatment Pumps								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	147	1,406				1,553.80 /ls	1,554
11210 Water Supply & Treatment Pumps		147	1,406					1,554
11211 Centrifugal Pumps								
50-11211.2600 RAS Pumps, 20HP	2.00 ea	2,385	58,490		680	3,200	32,377.72 /ea	64,755
11211 Centrifugal Pumps		2,385	58,490		680	3,200		64,755
11282 Slide Gates								
49-11280.2605 Weir Gate - Add for Clarifier #7	1.00 ea	2,960	48,738		680		52,378.75 /ea	52,379
11282 Slide Gates		2,960	48,738		680			52,379
15000 Process Mechanical								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	1,193	1,046				2,238.62 /ls	2,239
50-15210.2606 14" RAS Suction Pipe to Pump #1	1.00 ea	1,978	11,995				13,973.32 /ea	13,973
50-15210.2607 14" RAS Suction Pipe to Pump #2	1.00 ea	1,940	11,995				13,934.65 /ea	13,935
50-15210.2610 10" RAS Discharge to Manifold Pump #1	1.00 ea	1,492	10,463				11,955.43 /ea	11,955
50-15210.2611 10" RAS Discharge to Manifold Pump #2	1.00 ea	1,467	10,463				11,930.23 /ea	11,930
50-15210.2614 RAS Discharge Manifold	1.00 ea	2,548	16,323				18,871.75 /ea	18,872
50-15220.2600 ARV On RAS Pump Discharge Pump #1	1.00 ea	268	1,492				1,759.75 /ea	1,760
50-15220.2601 ARV On RAS Pump Discharge Pump #2	1.00 ea	268	1,492				1,759.75 /ea	1,760
15000 Process Mechanical		11,154	65,270					76,424
38 EXISTING SPLITTER BOX & RAS/WAS MODIFICATIONS	**1.00 LS**	**34,240**	**206,269**	**319**	**12,030**	**3,224**	**256,081.90 /LS**	**256,082**
80 EXISTING OXIDATION DITCH MODIFICATIONS								
11200 Water Treatment Equipment								
11300.040.030 Modify Existing Aerators - Existing Reactor 3	4.00 ea	8,333	104,720		702		28,438.72 /ea	113,755
11300.040.032 New Surface Aerators - Existing Reactors 1 & 2	2.00 ea	7,349	114,040		351		60,869.92 /ea	121,740
11200 Water Treatment Equipment		15,682	218,760		1,052			235,495
80 EXISTING OXIDATION DITCH MODIFICATIONS	**1.00 LS**	**15,682**	**218,760**		**1,052**		**235,494.69 /LS**	**235,495**
90 INSTRUMENTATION & CONTROLS								

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
13400 Measurement & Control Instrumentation								
13400.4605 Instrumentation & Control Allowance	1.00 ls			77,028			77,027.74 /ls	77,028
13400 Measurement & Control Instrumentation				77,028				77,028
90 INSTRUMENTATION & CONTROLS	**1.00 LS**			**77,028**			**77,027.74 /LS**	**77,028**
100 ELECTRICAL								
16000 Electrical Allowance/Miscellaneous								
16000.4605 Electrical Allowance	1.00 ls			261,894			261,894.28 /ls	261,894
16000 Electrical Allowance/Miscellaneous				261,894				261,894
100 ELECTRICAL	**1.00 LS**			**261,894**			**261,894.28 /LS**	**261,894**

ESTIMATE

TOTALS

Estimate Totals

Description	Amount	Totals	Hours	Rate
Labor	315,845		7,712 hrs	
Material	928,598			
Subcontract	479,752			
Equipment	93,137		1,421 hrs	
Other	50,468			
	1,867,800	1,867,800		
Project Allowances				
MOPO Allowance	50,000			
Painting & Caulking Allowance	15,406			1.00 %
Subtotal Direct Costs:	65,406	1,933,206		
Permits	10,028			0.50 %
Sales Tax (MEO)-Lee County	66,467			6.00 %
Bldr's Risk Ins (% total cost)	16,643			0.50 %
Gen Liab Ins (% total cost)	33,285			1.00 %
GC Bonds (% total cost)	49,928			1.50 %
Subtotal Prior to OH&P:	176,351	2,109,557		
GC General Conditions	218.189			10.00 %
Contractor Total OH&P	218.189			10.00 %
Subtotal with OH&P:	436,378	2,545,935		
Construction Contingency	654,566			25.00 %
Total Cost at Today's Dollars:	654,566	3,200,501		
Escalation - Start Construction (10/2014)	128.020			4.00 %
Total Cost with Escalation:	128,020	3,328,521		
OPCC Total:		***3,328,521***		

Lee County, FL
Three Oaks WWTP Expansion - 6.0 MGD Alternate
Opinion of Probable Construction Cost, December 2013, Concept Design

Project name	Three Oaks WWTP Ft. Myers FL USA
Client	CDM Smith
Estimator	Barker, Chad
Labor rate table	FL13 Labor Sarasota
Equipment rate table	00 13 Equip Rate BOF
Job size	6000000 Gal
Project	WWTP
Major Process	Environmental
Secondary Process	41 24 14 Wastewater
Major Structure	0- Not Applicable
OPCC Type	OPCC
Reviewed by	CAG
ENR 20 City CCI	Dec 2013: 9667.77
Notes	This is an Opinion of Probable Construction Cost (OPCC) only, as defined by the documents provided at the level of design indicated above. CDM Smith has no control over the cost of labor, materials, equipment, or services furnished, over schedules, over contractor's methods of determining prices, competitive bidding (at least 3 each - both prime bidders and major subcontractors), market conditions or negotiating terms. CDM Smith does not guarantee that this opinion will not vary from actual cost, or contractor's bids. There are not any costs provided for: Change Orders, Design Engineering, Construction Oversight, Client Costs, Finance or Funding Costs, Legal Fees, Impact Fees, Land Acquisition or temporary/permanent Easements, Operations, or any other costs associated with this project that are not specifically part of the bidding contractor's proposed scope. Assumptions: No rock excavation is required. Only nominal dewatering is needed. No consideration for contaminated groundwater/soils or hazardous materials is included (i.e. asbestos, lead, etc). Temporary parking/storage/staging is available within the limits of construction. Based on a normal 40 hour work week with no overtime.
Report format	Sorted by 'Area/95CSI Sctn/Element' 'Detail' summary Allocate addons

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
05 SITEWORK								
02000 Sitework								
02000.4605 Sitework Allowance	1.00 ls					35,000	35,000.00 /ls	35,000
02000 Sitework						35,000		35,000
02220 Demolition								
02220.4605 Demolish Existing Tanks & Structures	1.00 ls			154,180			154,180.00 /ls	154,180
02220.4610 Remove Existing Mechanical Equipment	1.00 ls	38,819			8,563		47,382.34 /ls	47,382
02220.4615 Remove Existing Underground Piping	1.00 ls	27,490			34,119	18,600	80,209.52 /ls	80,210
02220 Demolition		66,309		154,180	42,683	18,600		281,772
05 SITEWORK	**1.00 LS**	**66,309**		**154,180**	**42,683**	**53,600**	**316,771.86 /LS**	**316,772**
08 HEADWORKS UPGRADES								
02220 Demolition								
02220.4680 Demo Existing Concrete Walls	1,080.00 sf	4,447			5,567		9.27 /sf	10,014
02220 Demolition		4,447			5,567			10,014
02500 Yard Piping								
02501.4683 12" DIP-FM-Relocated Plant PS Discharge	70.00 lf	3,438	4,179	27	4,241		169.81 /lf	11,886
02501.4688 18" DIP-RS-Replace Existing 6" RS Piping	25.00 lf	879	2,953	15	1,191		201.52 /lf	5,038
02500 Yard Piping		4,318	7,132	42	5,433			16,925
03212 Concrete Walls								
03325.0083 Flow Splitter Box Walls (56'x18.5'x14")	44.89 cy	15,152	15,732	733	1,649	105	743.40 /cy	33,371
03212 Concrete Walls		15,152	15,732	733	1,649	105		33,371
03310 Concrete Slab on Grade								
03325.0080 Flow Splitter Box Slab (30'x16'x24")	35.56 cy	5,141	8,541	139	12	83	391.37 /cy	13,917
03310 Concrete Slab on Grade		5,141	8,541	139	12	83		13,917
05500 Metal Fabrications								
05500.040.030 Landing Platform	16.00 sf	161	1,289		1		90.71 /sf	1,451
05500.1802-05-0010 Aluminum Guardrail with Toe Board	65.00 lf	896	4,800				87.63 /lf	5,696
05500.1806-05-0010 Aluminum Stair and Rail	24.00 trd	1,636	5,341		516		312.22 /trd	7,493
05500 Metal Fabrications		2,693	11,430		517			14,641
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	60.00 sf	562	3,773				72.25 /sf	4,335
05530 Grating & Planks		562	3,773					4,335
11200 Water Treatment Equipment								
11300.040.068 Weir Gates	2.00 ea	4,891	45,638	1,000	1,673	800	27,000.88 /ea	54,002
11200 Water Treatment Equipment		4,891	45,638	1,000	1,673	800		54,002
15000 Process Mechanical								
15210.4651 16" DIP-RAS-Relocated	50.00 lf	3,678	11,657		680		320.31 /lf	16,016
15000 Process Mechanical		3,678	11,657		680			16,016
08 HEADWORKS UPGRADES	**1.00 LS**	**40,882**	**103,904**	**1,915**	**15,531**	**988**	**163,220.01 /LS**	**163,220**
10 OXIDATION DITCH #4 (2 MGD)								
02300 Earthwork								
02300.4640 Structural Excavation & Backfill - Ox Ditch	10,000.00 cy	14,232			36,221		5.05 /cy	50,453
02300 Earthwork		14,232			36,221			50,453
02600 Yard Piping								
02501.4601 42" DIP - MLSS -Ox Ditch Effluent to Splitter Box	50.00 lf	2,313	16,850	109	3,557		456.58 /lf	22,829
02501.4604 30" DIP-FE-Intake Manifold (Buried)	75.00 ls	2,249	24,408	131	3,075		398.18 /ls	29,863
02501.4612 30" DIP - RS - Headworks to Ox Ditch Influent	100.00 lf	2,795	22,569	218	4,148		297.31 /lf	29,731
02600.040.005 8" & 12" DIP - Basin Drain	340.00 lf	12,905	20,944		5,245	1,000	117.92 /lf	40,094
02600 Yard Piping		20,262	84,770	459	16,025	1,000		122,516
02700 Base & Pavements								
02700.040.0100 Stone Base around Tanks for Construction of Prestressed Ox Ditch	1,100.00 sy	3,335	6,111		1,892		10.31 /sy	11,337
02700 Base & Pavements		3,335	6,111		1,892			11,337
03000 Concrete								

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
03000.040.024 12" Pads (35'x25') - 2ea	19.45 cy	3,268	4,051	212	41	38	391.22 /cy	7,609
03000 Concrete		3,268	4,051	212	41	38		7,609
03400 Precast Concrete								
50.03400.4605 Prestressed Aeration Basin Structure	19,019.00 sf			1,900,000			99.90 /sf	1,900,000
03400 Precast Concrete				1,900,000				1,900,000
05500 Metal Fabrications								
05500.040.010 Aluminum Grating and Handrails	1,850.00 lf	21,297	64,890			1,854	47.59 /lf	88,041
05500.040.020 Stairs	31.00 trd	1,160	11,592		7	48	413.12 /trd	12,807
05500.040.030 Landing Platform	36.00 sf	416	4,416		3		134.32 /sf	4,836
05500 Metal Fabrications		22,873	80,898		10	1,902		105,684
11200 Water Treatment Equipment								
11300.040.060 Oxidation Ditch Gates	2.00 ea	4,251	45,638	1,000	1,475	700	26,531.88 /ea	53,064
11200 Water Treatment Equipment		4,251	45,638	1,000	1,475	700		53,064
10 OXIDATION DITCH #4 (2 MGD)	**1.00 EA**	**68,220**	**221,469**	**1,901,670**	**55,663**	**3,640**	**2,250,662.98 /EA**	**2,250,663**
18 SECONDARY CLARIFIER #7 (85' DIA.)								
02300 Earthwork								
20.02300.4640 Structural Excavation & Backfill - Clarifier		4,552			11,756		/cy	16,308
02300 Earthwork		4,552			11,756			16,308
02500 Yard Piping								
02501.4631 20" DIP-CE-Clarifier #7 to Filter Feed PS	20.00 lf	460	4,310	27	738		276.75 /lf	5,535
02511.4699 36" x 20" Connection (including 20" Valve)	1.00 ea	1,875	28,923		1,472		32,269.80 /ea	32,270
02500 Yard Piping		2,334	33,233	27	2,210			37,805
03212 Concrete Walls								
03325.0013 Clarifier Walls (267'x16.25'x12")	160.69 cy	54,226	56,303	2,625	5,901	376	743.24 /cy	119,431
03325.0025 Launderer Walls (267'x3'x12")	29.67 cy	27,575	13,779	485	5,180	69	1,587.03 /cy	47,087
03325.0030 Clarifier Walls -Exterior (12'x21'x12")	9.78 cy	5,504	4,846	160	1,065	23	1,185.79 /cy	11,597
03212 Concrete Walls		87,304	74,928	3,269	12,146	468		178,115
03310 Concrete Slab on Grade								
03325.0010 Clarifier Bottom Slab	345.00 cy	49,916	82,917	1,353	119	808	391.63 /cy	135,112
03325.0015 Clarifier Hopper	28.18 cy	5,703	8,064	276		66	500.68 /cy	14,109
03310 Concrete Slab on Grade		55,619	90,982	1,629	119	873		149,221
03314 Concrete Elevated Slabs								
03325.0020 Launderer Slab (267'x2'x12")	19.78 cy	9,231	7,455	3,343	490	46	1,039.65 /cy	20,564
03314 Concrete Elevated Slabs		9,231	7,455	3,343	490	46		20,564
03600 Grout								
03325.0035 Clairifier Grout (2")	35.70 cy	2,712	5,355		1,696	2,856	353.48 /cy	12,619
03600 Grout		2,712	5,355		1,696	2,856		12,619
05500 Metal Fabrications								
05500.1802-05-0010 Aluminum Guardrail with Toe Board	300.00 lf	4,149	22,872				90.07 /lf	27,021
05500.1806-05-0010 Aluminum Stair and Rail	34.00 trd	2,047	6,349		732		268.47 /trd	9,128
05500 Metal Fabrications		6,196	29,221		732			36,149
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	16.00 sf	150	1,112				78.85 /sf	1,262
48-05500.2605 Fabricated Walkway	168.00 sf		11,368				67.67 /sf	11,368
05530 Grating & Planks		150	12,480					12,630
05531 Traffic Grates & Castings								
0531.1838-05-0010 Effluent Box Grate	16.00 sf	26	1,800		13		114.95 /sf	1,839
0531.1840-05-0010 Scum Collection Trough	16.00 sf	176	1,980		13		135.61 /sf	2,170
05531 Traffic Grates & Castings		202	3,780		27			4,009
06600 Plastic Fabrications								
48-06610.2605 FRP Weir, 85' Dia. Clarifier	1.00 ea	6,025	15,000				21,025.48 /ea	21,025
06600 Plastic Fabrications		6,025	15,000					21,025
11060 Submersible Wastewater Pumps								

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
48-11310.2600 Submersible Scum Pumps	1.00 ea	863	25,307				26,169.68 /ea	26,170
11060 Submersible Wastewater Pumps		863	25,307					26,170
11225 Clarifiers								
48-11225.2601 Half Bridge Secondary Clarifier Mechanism (85' Dia.)	1.00 ea	16,461	156,066	91	7,701		180,318.83 /ea	180,319
11225 Clarifiers		16,461	156,066	91	7,701			180,319
15000 Process Mechanical								
48-15210.2600 24" DIP-ML-Clarifier Feed	1.00 ls	2,737	17,339	35	1,436		21,547.14 /ls	21,547
48-15210.2601 14" DIP-RAS-Return Line	1.00 ls	1,594	8,359	17	718		10,687.52 /ls	10,688
48-15210.2602 24" DIP-SE-From Collection Box	1.00 ls	984	7,573		340		8,897.11 /ls	8,897
48-15210.2603 4" DIP-SC-Scum Pump Discharge Pump #1	1.00 ls	1,347	9,499				10,846.45 /ls	10,846
48-15210.2604 Scum Pump Valving	1.00 ls	875	4,217				5,091.91 /ls	5,092
48-15240.2600 Tank Spray Diffuser	1.00 ls	1,140	2,775				3,914.89 /ls	3,915
15000 Process Mechanical		8,677	49,762	52	2,494			60,985
18 SECONDARY CLARIFIER #7 (85' DIA.)	**1.00 EA**	**200,326**	**503,569**	**8,411**	**39,369**	**4,244**	**755,919.14 /EA**	**755,919**
20 SECONDARY CLARIFIER #8 (85' DIA.)								
02300 Earthwork								
20.02300.4640 Structural Excavation & Backfill - Clarifier	4,500.00 cy	4,552			11,756		3.62 /cy	16,308
02300 Earthwork		4,552			11,756			16,308
02500 Yard Piping								
02501.4636 20" DIP-CE-Clarifier #8 to Filter Feed PS	20.00 lf	460	4,310	27	738		276.75 /lf	5,535
02500 Yard Piping		460	4,310	27	738			5,535
03212 Concrete Walls								
03325.0013 Clarifier Walls (267'x16.25'x12")	160.69 cy	54,226	56,303	2,625	5,901	376	743.24 /cy	119,431
03325.0025 Launderer Walls (267'x3'x12")	29.67 cy	27,575	13,779	485	5,180	69	1,587.02 /cy	47,087
03325.0030 Clarifier Walls -Exterior (12'x21'x12")	9.78 cy	5,504	4,846	160	1,065	23	1,185.79 /cy	11,597
03212 Concrete Walls		87,304	74,928	3,269	12,146	468		178,115
03310 Concrete Slab on Grade								
03325.0010 Clarifier Bottom Slab	345.00 cy	49,916	82,917	1,353	119	808	391.63 /cy	135,112
03325.0015 Clarifier Hopper	28.15 cy	5,703	8,064	276		66	501.22 /cy	14,109
03310 Concrete Slab on Grade		55,619	90,982	1,629	119	873		149,221
03314 Concrete Elevated Slabs								
03325.0020 Launderer Slab (267'x2'x12")	19.78 cy	9,231	7,455	3,343	490	46	1,039.65 /cy	20,564
03314 Concrete Elevated Slabs		9,231	7,455	3,343	490	46		20,564
03600 Grout								
03325.0035 Clairifier Grout (2")	35.70 cy	2,712	5,355		1,696	2,856	353.48 /cy	12,619
03600 Grout		2,712	5,355		1,696	2,856		12,619
05500 Metal Fabrications								
05500.1802-05-0010 Aluminum Guardrail with Toe Board	300.00 lf	4,149	22,872				90.07 /lf	27,021
05500.1806-05-0010 Aluminum Stair and Rail	34.00 trd	2,047	6,349		732		268.47 /trd	9,128
05500 Metal Fabrications		6,196	29,221		732			36,149
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	16.00 sf	150	1,112				78.85 /sf	1,262
48-05500.2605 Fabricated Walkway	168.00 sf		11,368				67.67 /sf	11,368
05530 Grating & Planks		150	12,480					12,630
05531 Traffic Grates & Castings								
0531.1838-05-0010 Effluent Box Grate	16.00 sf	26	1,800		13		114.96 /sf	1,839
0531.1840-05-0010 Scum Collection Trough	16.00 sf	176	1,980		13		135.61 /sf	2,170
05531 Traffic Grates & Castings		202	3,780		27			4,009
06600 Plastic Fabrications								
48-06610.2605 FRP Weir, 85' Dia. Clarifier	1.00 ea	6,025	15,000				21,025.47 /ea	21,025
06600 Plastic Fabrications		6,025	15,000					21,025
11060 Submersible Wastewater Pumps								
48-11310.2600 Submersible Scum Pumps	1.00 ea	863	25,307				26,169.68 /ea	26,170

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
11060 Submersible Wastewater Pumps		863	25,307					26,170
11225 Clarifiers								
48-11225.2601 Half Bridge Secondary Clarifier Mechanism (85' Dia.)	1.00 ea	16,461	156,066	91	7,701		180,318.83 /ea	180,319
11225 Clarifiers		16,461	156,066	91	7,701			180,319
15000 Process Mechanical								
48-15210.2600 24" DIP-ML-Clarifier Feed	1.00 ls	2,737	17,339	35	1,436		21,547.14 /ls	21,547
48-15210.2601 14" DIP-RAS-Return Line	1.00 ls	1,594	8,359	17	718		10,687.52 /ls	10,688
48-15210.2602 24" DIP-SE-From Collection Box	1.00 ls	984	7,573		340		8,897.11 /ls	8,897
48-15210.2603 4" DIP-SC-Scum Pump Discharge Pump #1	1.00 ls	1,347	9,499				10,846.45 /ls	10,846
48-15210.2604 Scum Pump Valving	1.00 ls	875	4,217				5,091.91 /ls	5,092
48-15240.2600 Tank Spray Diffuser	1.00 ls	1,140	2,775				3,914.89 /ls	3,915
15000 Process Mechanical		8,677	49,762	52	2,494			60,985
20 SECONDARY CLARIFIER #8 (85' DIA.)	**1.00 EA**	**198,451**	**474,646**	**8,411**	**37,897**	**4,244**	**723,649.35 /EA**	**723,649**
22 SECONDARY CLARIFIER #9 (85' DIA.)								
02300 Earthwork								
20.02300.4640 Structural Excavation & Backfill - Clarifier	4,500.00 cy	4,552			11,756		3.62 /cy	16,308
02300 Earthwork		4,552			11,756			16,308
02500 Yard Piping								
02501.4638 20" DIP-CE-Clarifier #9 to Filter Feed PS	120.00 lf	3,977	13,501	218	5,899		196.63 /lf	23,596
02500 Yard Piping		3,977	13,501	218	5,899			23,596
03212 Concrete Walls								
03325.0013 Clarifier Walls (267'x16.25'x12")	160.69 cy	54,226	56,303	2,625	5,901	376	743.24 /cy	119,431
03325.0025 Launderer Walls (267'x3'x12")	29.67 cy	27,575	13,779	485	5,180	69	1,587.03 /cy	47,087
03325.0030 Clarifier Walls -Exterior (12'x21'x12")	9.78 cy	5,504	4,846	160	1,065	23	1,185.79 /cy	11,597
03212 Concrete Walls		87,304	74,928	3,269	12,146	468		178,115
03310 Concrete Slab on Grade								
03325.0010 Clarifier Bottom Slab	345.00 cy	49,916	82,917	1,353	119	808	391.63 /cy	135,112
03325.0015 Clarifier Hopper	28.15 cy	5,703	8,064	276		66	501.22 /cy	14,109
03310 Concrete Slab on Grade		55,619	90,982	1,629	119	873		149,221
03314 Concrete Elevated Slabs								
03325.0020 Launderer Slab (267'x2'x12")	19.78 cy	9,231	7,455	3,343	490	46	1,039.65 /cy	20,564
03314 Concrete Elevated Slabs		9,231	7,455	3,343	490	46		20,564
03600 Grout								
03325.0035 Clairifier Grout (2")	35.70 cy	2,712	5,355		1,696	2,856	353.48 /cy	12,619
03600 Grout		2,712	5,355		1,696	2,856		12,619
05500 Metal Fabrications								
05500.1802-05-0010 Aluminum Guardrail with Toe Board	300.00 lf	4,149	22,872				90.07 /lf	27,021
05500.1806-05-0010 Aluminum Stair and Rail	34.00 trd	2,047	6,349		732		268.47 /trd	9,128
05500 Metal Fabrications		6,196	29,221		732			36,149
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	16.00 sf	150	1,112				78.85 /sf	1,262
48-05500.2605 Fabricated Walkway	168.00 sf		11,368				67.67 /sf	11,368
05530 Grating & Planks		150	12,480					12,630
05531 Traffic Grates & Castings								
0531.1838-05-0010 Effluent Box Grate	16.00 sf	26	1,800		13		114.95 /sf	1,839
0531.1840-05-0010 Scum Collection Trough	16.00 sf	176	1,980		13		135.61 /sf	2,170
05531 Traffic Grates & Castings		202	3,780		27			4,009
06600 Plastic Fabrications								
48-06610.2605 FRP Weir, 85' Dia. Clarifier	1.00 ea	6,025	15,000				21,025.48 /ea	21,025
06600 Plastic Fabrications		6,025	15,000					21,025
11060 Submersible Wastewater Pumps								
48-11310.2600 Submersible Scum Pumps	1.00 ea	863	25,307				26,169.68 /ea	26,170
11060 Submersible Wastewater Pumps		863	25,307					26,170
11225 Clarifiers								

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
48-11225.2601 Half Bridge Secondary Clarifier Mechanism (85' Dia.)	1.00 ea	16,461	156,066	91	7,701		180,318.83 /ea	180,319
11225 Clarifiers		16,461	156,066	91	7,701			180,319
15000 Process Mechanical								
48-15210.2600 24" DIP-ML-Clarifier Feed	1.00 ls	2,737	17,339	35	1,436		21,547.14 /ls	21,547
48-15210.2601 14" DIP-RAS-Return Line	1.00 ls	1,594	8,359	17	718		10,687.52 /ls	10,688
48-15210.2602 24" DIP-SE-From Collection Box	1.00 ls	984	7,573		340		8,897.11 /ls	8,897
48-15210.2603 4" DIP-SC-Scum Pump Discharge Pump #1	1.00 ls	1,347	9,499				10,846.45 /ls	10,846
48-15210.2604 Scum Pump Valving	1.00 ls	875	4,217				5,091.91 /ls	5,092
48-15240.2600 Tank Spray Diffuser	1.00 ls	1,140	2,775				3,914.89 /ls	3,915
15000 Process Mechanical		8,677	49,762	52	2,494			60,985
22 SECONDARY CLARIFIER #9 (85' DIA.)	**1.00 EA**	**201,969**	**483,837**	**8,602**	**43,059**	**4,244**	**741,710.38 /EA**	**741,710**
30 CLARIFIER SPLITTER BOX								
02300 Earthwork								
20.02300.4642 Structural Excavation & Backfill - Splitter Box	300.00 cy	479			1,201		5.60 /cy	1,680
02300 Earthwork		479			1,201			1,680
03000 Concrete								
03330.0010 RAS Splitter Box Slab (30' x19' x14")	15.90 cy	1,997	3,079		19		320.47 /cy	5,095
03330.0015 RAS Splitter Box Walls (110'x10'x12")	39.12 cy	23,902	15,638	639	217	92	1,034.95 /cy	40,487
03000 Concrete		25,899	18,717	639	236	92		45,583
05120 Structural Steel								
05120.1841-05-0015 Stair Landing Grate	32.00 sf	2,744	5,040		1,434		288.06 /sf	9,218
05120 Structural Steel		2,744	5,040		1,434			9,218
05500 Metal Fabrications								
05500.1802-03-0010 Aluminum Guardrail 3 Line with Toe Board	82.00 lf	1,130	6,228				89.74 /lf	7,358
05500.1806-03-0010 Aluminum Stair and Rail	21.00 trd	1,553	5,057		452		336.29 /trd	7,062
05500 Metal Fabrications		2,684	11,285		452			14,420
05530 Grating & Planks								
05530.1825-03-0010 Aluminum Grating and Steel Angle	250.00 sf	3,253	38,259		289		167.21 /sf	41,801
05530 Grating & Planks		3,253	38,259		289			41,801
11282 Slide Gates								
49-11280.2600 Weir Gates	2.00 ea	5,921	97,476		1,361		52,378.76 /ea	104,758
11282 Slide Gates		5,921	97,476		1,361			104,758
15210 Ductile Iron Pipe								
49-15210.2600 42" DIP-ML-Influent Bottom Feed Pipe	1.00 ea	2,379	25,043		680		28,103.05 /ea	28,103
49-15210.2601 24" DIP-ML-Clairifier Feed #8, #9 & #10	3.00 ea	2,844	10,708		1,020		4,857.59 /ea	14,573
49-15210.2603 24" DIP-ML-Clairifer Discharge #8, #9 & #10	3.00 ea	2,844	10,708		1,020		4,857.59 /ea	14,573
49-15210.2610 20" DIP-SE-Clarifier #8 & #9	2.00 ea	2,095	2,891		1,361		3,173.55 /ea	6,347
15210 Ductile Iron Pipe		10,163	49,351		4,082			63,596
30 CLARIFIER SPLITTER BOX	**1.00 LS**	**51,143**	**220,128**	**639**	**9,054**	**92**	**281,055.61 /LS**	**281,056**
35 RAS/WAS MODIFICATIONS								
03000 Concrete								
03335.0010 12" RAS Pump Station Slab	41.47 cy	5,862	10,008	186	31	111	390.57 /cy	16,197
03335.0020 Equipment Pads	5.33 cy	3,312	2,265	105	10	12	1,070.25 /cy	5,704
03000 Concrete		9,174	12,273	290	41	123		21,901
11210 Water Supply & Treatment Pumps								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	221	2,110				2,330.69 /ls	2,331
50-11210-2630 Seal Water System for WAS Pumps	1.00 ls	147	1,406				1,553.80 /ls	1,554
99-11210.2601 Sump Pumps	1.00 ea	276	1,686				1,962.47 /ea	1,962
11210 Water Supply & Treatment Pumps		645	5,202					5,847
11211 Centrifugal Pumps								
50-11211.2600 RAS Pumps, 20HP	3.00 ea	3,592	88,002		1,020	4,800	32,471.31 /ea	97,414
50-11211.2601 WAS Pumps, 5 HP	2.00 ea	2,368	27,260		680	3,200	16,754.28 /ea	33,509

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
11211 Centrifugal Pumps		5,960	115,262		1,701	8,000		130,922
15210 Ductile Iron Pipe								
50-05500.2600 Fabricated Pipe Supports for RAS Discharge Manifold	4.00 ea	328	235				140.86 /ea	563
50-15210.2600 14" RAS Manifold for Clairifier #8 Buried Piping	1.00 ea	720	4,921	9	359		6,008.93 /ea	6,009
50-15210.2601 14" RAS Manifold for Clairifier #9 Buried Piping	1.00 ea	720	4,921	9	359		6,008.93 /ea	6,009
50-15210.2603 14" RAS From Buried Upturn to Pump Cross Connection Clairifier #8	1.00 ea	686	4,363				5,048.83 /ea	5,049
50-15210.2604 14" RAS From Buried Upturn to Pump Cross Connection Clairifier #9	1.00 ea	686	4,363				5,048.83 /ea	5,049
50-15210.2606 14" RAS Suction Pipe to Pump #1	1.00 ea	1,978	11,995				13,973.32 /ea	13,973
50-15210.2607 14" RAS Suction Pipe to Pump #2	1.00 ea	1,940	11,995				13,934.65 /ea	13,935
50-15210.2608 14" RAS Suction Pipe to Pump #3	1.00 ea	1,940	11,995				13,934.65 /ea	13,935
50-15210.2610 10" RAS Discharge to Manifold Pump #1	1.00 ea	1,492	10,463				11,955.43 /ea	11,955
50-15210.2611 10" RAS Discharge to Manifold Pump #2	1.00 ea	1,467	10,463				11,930.23 /ea	11,930
50-15210.2612 10" RAS Discharge to Manifold Pump #3	1.00 ea	1,467	10,463				11,930.23 /ea	11,930
50-15210.2614 RAS Discharge Manifold	1.00 ea	4,235	32,474				36,708.50 /ea	36,709
50-15210.2615 WAS Pumps Suction Connection to RAS Discharge	1.00 ea	2,075	12,799				14,873.93 /ea	14,874
50-15210.2616 WAS Pump #1 Suction Line From Manifold	1.00 ea	879	2,802				3,680.64 /ea	3,681
50-15210.2617 WAS Pump #2 Suction Line From Manifold	1.00 ea	879	2,802				3,680.64 /ea	3,681
50-15210.2618 WAS Pump Discharge To Discharge Manifold Pump #1	1.00 ea	834	5,408				6,242.55 /ea	6,243
50-15210.2619 WAS Pump Discharge To Discharge Manifold Pump #2	1.00 ea	834	5,408				6,242.55 /ea	6,243
50-15210.2620 WAS Discharge Manifold to Yard Piping Connection	1.00 ea	2,085	6,090				8,175.03 /ea	8,175
15210 Ductile Iron Pipe		25,245	153,961	17	718			179,941
15220 Steel Pipe								
50-15220.2600 ARV On RAS Pump Discharge Pump #1	1.00 ea	268	1,492				1,759.75 /ea	1,760
50-15220.2601 ARV On RAS Pump Discharge Pump #2	1.00 ea	268	1,492				1,759.75 /ea	1,760
50-15220.2602 ARV On RAS Pump Discharge Pump #3	1.00 ea	268	1,492				1,759.75 /ea	1,760
15220 Steel Pipe		803	4,476					5,279
15221 Stainless Steel Pipe								
50-15221.2602 Instrument Piping RAS Pumps	1.00 ls	1,191	3,759				4,949.67 /ls	4,950
15221 Stainless Steel Pipe		1,191	3,759					4,950
15224 Copper Pipe								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	596	523				1,119.31 /ls	1,119
50-11210-2630 Seal Water System for WAS Pumps	1.00 ls	298	261				559.66 /ls	560
15224 Copper Pipe		895	784					1,679
15241 PVC Pipe & Fittings								
50-15240.2610 Sump Piping	1.00 ls	572	713				1,284.30 /ls	1,284
15241 PVC Pipe & Fittings		572	713					1,284
35 RAS/WAS MODIFICATIONS	**1.00 LS**	**44,484**	**296,430**	**308**	**2,460**	**8,123**	**351,804.29 /LS**	**351,804**
38 EXISTING SPLITTER BOX & RAS/WAS MODIFICATIONS								
02500 Yard Piping								
58.02501.4608 12" DIP-RAS-Pump Station to Existing 16" RAS	200.00 lf	7,421	10,446	146	10,505		142.59 /lf	28,517
02500 Yard Piping		7,421	10,446	146	10,505			28,517
03000 Concrete								
03330.0020 RAS Splitter Box Slab - Add for Clarifier #7	5.25 cy	659	1,016		6		320.23 /cy	1,681
03330.0025 RAS Splitter Box Walls - Add for Clarifier #7	7.43 cy	4,541	2,971	121	41	17	1,035.25 /cy	7,692
03330.0029 RAS Pump Station Slab	15.90 cy	1,997	3,079		19		320.47 /cy	5,095
03335.0020 Equipment Pads	2.67 cy	1,656	1,134	52	5	6	1,068.83 /cy	2,854
03000 Concrete		8,854	8,199	174	72	24		17,322
05500 Metal Fabrications								
05500.1802-03-0010 Aluminum Guardrail 3 Line with Toe Board	20.00 lf	276	1,470				87.29 /lf	1,746
05500 Metal Fabrications		276	1,470					1,746
05530 Grating & Planks								
05530.1825-03-0012 Aluminum Grating and Steel Angle - Add for Clarifier #7	80.00 sf	1,042	12,250		93		167.32 /sf	13,385
05530 Grating & Planks		1,042	12,250		93			13,385
11210 Water Supply & Treatment Pumps								

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	147	1,406				1,553.80 /ls	1,554
11210 Water Supply & Treatment Pumps		147	1,406					1,554
11211 Centrifugal Pumps								
50-11211.2600 RAS Pumps, 20HP	2.00 ea	2,385	58,490		680	3,200	32,377.72 /ea	64,755
11211 Centrifugal Pumps		2,385	58,490		680	3,200		64,755
11282 Slide Gates								
49-11280.2605 Weir Gate - Add for Clarifier #7	1.00 ea	2,960	48,738		680		52,378.75 /ea	52,379
11282 Slide Gates		2,960	48,738		680			52,379
15000 Process Mechanical								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	1,193	1,046				2,238.62 /ls	2,239
50-15210.2606 14" RAS Suction Pipe to Pump #1	1.00 ea	1,978	11,995				13,973.32 /ea	13,973
50-15210.2607 14" RAS Suction Pipe to Pump #2	1.00 ea	1,940	11,995				13,934.65 /ea	13,935
50-15210.2610 10" RAS Discharge to Manifold Pump #1	1.00 ea	1,492	10,463				11,955.43 /ea	11,955
50-15210.2611 10" RAS Discharge to Manifold Pump #2	1.00 ea	1,467	10,463				11,930.23 /ea	11,930
50-15210.2614 RAS Discharge Manifold	1.00 ea	2,548	16,323				18,871.75 /ea	18,872
50-15220.2600 ARV On RAS Pump Discharge Pump #1	1.00 ea	268	1,492				1,759.75 /ea	1,760
50-15220.2601 ARV On RAS Pump Discharge Pump #2	1.00 ea	268	1,492				1,759.75 /ea	1,760
15000 Process Mechanical		11,154	65,270					76,424
38 EXISTING SPLITTER BOX & RAS/WAS MODIFICATIONS	**1.00 LS**	**34,240**	**206,269**	**319**	**12,030**	**3,224**	**256,081.90 /LS**	**256,082**
40 BIOSOLIDS UPGRADES								
03000 Concrete								
03335.0012 Belt Filter Press Feed Pump Slab	2.37 cy	293	501	9	2	6	342.23 /cy	811
03335.0020 Equipment Pads	1.33 cy	768	491	26	3	3	970.07 /cy	1,290
03000 Concrete		1,061	992	35	4	9		2,101
11000 Equipment								
11000.4605 Course Bubble Diffusers & Slide Gates - ALLOWANCE	1.00 ls					50,000	50,000.00 /ls	50,000
11000 Equipment						50,000		50,000
11350 Sludge Dewatering Equipment								
70-11350.2601 Belt Filter Press Feed Pump	1.00 ea	1,174	17,700				18,873.51 /ea	18,874
70-11350.2604 Dewatered Cake Pump	1.00 ea	1,174	77,200				78,373.51 /ea	78,374
80-11350.2600 Belt Filter Press	1.00 ea	5,621	351,426		340		357,386.72 /ea	357,387
80-11350.2620 Polymer Feed System for Dewatering Press	1.00 ea	2,397	17,432				19,828.71 /ea	19,829
11350 Sludge Dewatering Equipment		10,364	463,758		340			474,462
15210 Ductile Iron Pipe								
80-15210.2630 BFP #1 Feed Piping	1.00 ea	1,814	7,000				8,813.54 /ea	8,814
15210 Ductile Iron Pipe		1,814	7,000					8,814
15221 Stainless Steel Pipe								
80-15221.2640 Instrument Piping	1.00 ls	1,786	5,638				7,424.51 /ls	7,425
15221 Stainless Steel Pipe		1,786	5,638					7,425
15240 PVC Pipe								
80-15240.2600 Poly Storage Tank to Polyblend Manifold	1.00 ea	500	232				731.21 /ea	731
80-15240.2604 Poly Suction	1.00 ea	511	264				775.38 /ea	775
80-15240.2610 Poly Feed	1.00 ea	626	291				916.99 /ea	917
15240 PVC Pipe		1,637	787					2,424
40 BIOSOLIDS UPGRADES	**1.00 LS**	**16,662**	**478,175**	**35**	**344**	**50,009**	**545,225.35 /LS**	**545,225**
65 SODIUM HYPO SYSTEM MODIFICATIONS								
03000 Concrete								
03000.4655 12" Concrete Tank Pads	6.55 cy	1,411	2,435		192		616.46 /cy	4,038
03000 Concrete		1,411	2,435		192			4,038
13000 Special Construction								
13000.4601 Remove Existing Canopy	512.00 sf			5,120			10.00 /sf	5,120
13000.4605 Aluminum Canopy, 20' Eve Height	760.00 sf			26,600			35.00 /sf	26,600

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
13000 Special Construction				31,720				31,720
13200 Tanks								
13200.4605 FRP Sodium Hypo Tank, 5000 Gallon	2.00 ea	3,905	20,020		1,200	128	12,626.53 /ea	25,253
13200.4688 Remove Existing HDPE Tank	2.00 ea	1,639		140	247		1,012.72 /ea	2,025
13200 Tanks		5,544	20,020	140	1,447	128		27,279
15000 Process Mechanical								
15000.4624 Piping Modifications @ Sodium Hypo Tanks - Allowance	1.00 ls	2,000	5,600		400		8,000.00 /ls	8,000
15000 Process Mechanical		2,000	5,600		400			8,000
65 SODIUM HYPO SYSTEM MODIFICATIONS	**1.00 LS**	**8,955**	**28,055**	**31,860**	**2,039**	**128**	**71,036.32 /LS**	**71,036**
75 NEW EQUALIZATION TANK								
03000 Concrete								
03000.4680 18" Concrete Slab-on-Grade Foundation (95' Dia.)	393.79 cy	63,662	118,137		11,568		491.04 /cy	193,368
03000 Concrete		63,662	118,137		11,568			193,368
13210 Prestressed Concrete Tank								
13210.4605 1.20 MGD Prestressed Concrete Tank	1.00 ea	318	2,739	500,852	353		504,262.81 /ea	504,263
13210 Prestressed Concrete Tank		318	2,739	500,852	353			504,263
15210 Ductile Iron Pipe								
49-15210.4602 Mechanical Piping @ Eq Tank - Allowance	1.00 ls	7,935	21,560		3,401		32,896.26 /ls	32,896
15210 Ductile Iron Pipe		7,935	21,560		3,401			32,896
75 NEW EQUALIZATION TANK	**1.00 LS**	**71,915**	**142,437**	**500,852**	**15,323**		**730,527.10 /LS**	**730,527**
80 EXISTING OXIDATION DITCH MODIFICATIONS								
11200 Water Treatment Equipment								
11300.040.030 Modify Existing Aerators - Existing Reactor 3	4.00 ea	8,333	104,720		702		28,438.72 /ea	113,755
11300.040.032 New Surface Aerators - Existing Reactors 1 & 2	2.00 ea	7,349	114,040		351		60,869.92 /ea	121,740
11200 Water Treatment Equipment		15,682	218,760		1,052			235,495
80 EXISTING OXIDATION DITCH MODIFICATIONS	**1.00 LS**	**15,682**	**218,760**		**1,052**		**235,494.69 /LS**	**235,495**
90 INSTRUMENTATION & CONTROLS								
13400 Measurement & Control Instrumentation								
13400.4605 Instrumentation & Control Allowance	1.00 ls			413,839			413,839.35 /ls	413,839
13400 Measurement & Control Instrumentation				413,839				413,839
90 INSTRUMENTATION & CONTROLS	**1.00 LS**			**413,839**			**413,839.35 /LS**	**413,839**
100 ELECTRICAL								
16000 Electrical Allowance/Miscellaneous								
16000.4605 Electrical Allowance	1.00 ls			1,407,054			1,407,053.75 /ls	1,407,054
16000 Electrical Allowance/Miscellaneous				1,407,054				1,407,054
100 ELECTRICAL	**1.00 LS**			**1,407,054**			**1,407,053.75 /LS**	**1,407,054**
110 ADMINISTRATION BUILDING								
01200 Building Allowance								
01200.4605 Administration Building Allowance	3,000.00 sf					750,000	250.00 /sf	750,000
01200 Building Allowance						750,000		750,000
110 ADMINISTRATION BUILDING	**3,000.00 SF**					**750,000**	**250.00 /SF**	**750,000**
120 ELECTRICAL BUILDING								
01200 Building Allowance								
01200.4610 Electrical Building Allowance	400.00 sf					80,000	200.00 /sf	80,000
01200 Building Allowance						80,000		80,000
120 ELECTRICAL BUILDING	**400.00 SF**					**80,000**	**200.00 /SF**	**80,000**

Estimate Totals

Description	Amount	Totals	Hours	Rate
Labor	1,019,239		23,743 hrs	
Material	3,377,677			
Subcontract	4,438,094			
Equipment	276,506		4,372 hrs	
Other	962,535			
	10,074,051	10,074,051		
Project Allowances				
MOPO Allowance	50,000			
Painting & Caulking Allowance	82,768			1.00 %
Subtotal Direct Costs:	132,768	10,206,819		
Indirect Costs				
Permits	52,127			0.50 %
Sales Tax (MEO)-Lee County	282,397			6.00 %
Bldr's Risk Ins (% total cost)	86,855			0.50 %
Gen Liab Ins (% total cost)	173,711			1.00 %
GC Bonds (% total cost)	260,566			1.50 %
Subtotal Prior to OH&P:	855,656	11,062,475		
GC General Conditions	1,128,097			10.00 %
Contractor Total OH&P	1,128,097			10.00 %
Subtotal with OH&P:	2,256,194	13,318,669		
Construction Contingency	3,384,290			25.00 %
Total Cost at Today's Dollars:	3,384,290	16,702,959		
Escalation - Start Construction (10/2014)	668,118			4.00 %
Total Cost with Escalation:	668,118	17,371,077		
OPCC Total:		***17,371,077***		

Lee County, FL
Three Oaks WWTP Expansion - 8.0 MGD Alternate
Opinion of Probable Construction Cost, December 2013, Concept Design

Project name	Three Oaks WWTP Ft. Myers FL USA
Client	CDM Smith
Estimator	Barker, Chad
Labor rate table	FL13 Labor Sarasota
Equipment rate table	00 13 Equip Rate BOF
Job size	8000000 Gal
Project	WWTP
Major Process	Environmental
Secondary Process	41 24 14 Wastewater
Major Structure	0- Not Applicable
OPCC Type	OPCC
Reviewed by	CAG
ENR 20 City CCI	Dec 2013: 9667.77
Notes	This is an Opinion of Probable Construction Cost (OPCC) only, as defined by the documents provided at the level of design indicated above. CDM Smith has no control over the cost of labor, materials, equipment, or services furnished, over schedules, over contractor's methods of determining prices, competitive bidding (at least 3 each - both prime bidders and major subcontractors), market conditions or negotiating terms. CDM Smith does not guarantee that this opinion will not vary from actual cost, or contractor's bids. There are not any costs provided for: Change Orders, Design Engineering, Construction Oversight, Client Costs, Finance or Funding Costs, Legal Fees, Impact Fees, Land Acquisition or temporary/permanent Easements, Operations, or any other costs associated with this project that are not specifically part of the bidding contractor's proposed scope. Assumptions: No rock excavation is required. Only nominal dewatering is needed. No consideration for contaminated groundwater/soils or hazardous materials is included (i.e. asbestos, lead, etc). Temporary parking/storage/staging is available within the limits of construction. Based on a normal 40 hour work week with no overtime.
Report format	Sorted by 'Area/95CSI Sctn/Element' 'Detail' summary Allocate addons

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
05 SITEWORK								
02000 Sitework								
02000.4605 Sitework Allowance	1.00 ls					50,000	50,000.00 /ls	50,000
02000 Sitework						50,000		50,000
02220 Demolition								
02220.4605 Demolish Existing Tanks & Structures	1.00 ls			154,180			154,180.00 /ls	154,180
02220.4610 Remove Existing Mechanical Equipment	1.00 ls	38,819			8,563		47,382.34 /ls	47,382
02220.4615 Remove Existing Underground Piping	1.00 ls	27,490			34,119	18,600	80,209.52 /ls	80,210
02220 Demolition		66,309		154,180	42,683	18,600		281,772
02500 Yard Piping								
02501.4628 36" DIP-CE-Clarifiers to Filter Feed PS	460.00 lf	16,872	155,406	988	23,038		426.75 /lf	196,305
02500 Yard Piping		16,872	155,406	988	23,038			196,305
05 SITEWORK	**1.00 LS**	**83,181**	**155,406**	**155,168**	**65,721**	**68,600**	**528,076.42 /LS**	**528,076**
08 HEADWORKS UPGRADES								
02220 Demolition								
02220.4680 Demo Existing Concrete Walls	1,080.00 sf	4,447			5,567		9.27 /sf	10,014
02220 Demolition		4,447			5,567			10,014
02500 Yard Piping								
02501.4683 12" DIP-FM-Relocated Plant PS Discharge	70.00 lf	3,438	4,179	27	4,241		169.81 /lf	11,886
02501.4688 18" DIP-RS-Replace Existing 6" RS Piping	25.00 lf	879	2,953	15	1,191		201.52 /lf	5,038
02500 Yard Piping		4,318	7,132	42	5,433			16,925
03212 Concrete Walls								
03325.0083 Flow Splitter Box Walls (56'x18.5'x14")	44.89 cy	15,152	15,732	733	1,649	105	743.40 /cy	33,371
03212 Concrete Walls		15,152	15,732	733	1,649	105		33,371
03310 Concrete Slab on Grade								
03325.0080 Flow Splitter Box Slab (30'x16'x24")	35.56 cy	5,141	8,541	139	12	83	391.37 /cy	13,917
03310 Concrete Slab on Grade		5,141	8,541	139	12	83		13,917
05500 Metal Fabrications								
05500.040.030 Landing Platform	16.00 sf	161	1,289		1		90.71 /sf	1,451
05500.1802-05-0010 Aluminum Guardrail with Toe Board	65.00 lf	896	4,800				87.63 /lf	5,696
05500.1806-05-0010 Aluminum Stair and Rail	24.00 trd	1,636	5,341		516		312.22 /trd	7,493
05500 Metal Fabrications		2,693	11,430		517			14,641
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	60.00 sf	562	3,773				72.25 /sf	4,335
05530 Grating & Planks		562	3,773					4,335
11200 Water Treatment Equipment								
11300.040.068 Weir Gates	2.00 ea	4,891	45,638	1,000	1,673	800	27,000.88 /ea	54,002
11200 Water Treatment Equipment		4,891	45,638	1,000	1,673	800		54,002
15000 Process Mechanical								
15210.4651 16" DIP-RAS-Relocated	50.00 lf	3,678	11,657		680		320.31 /lf	16,016
15000 Process Mechanical		3,678	11,657		680			16,016
08 HEADWORKS UPGRADES	**1.00 LS**	**40,882**	**103,904**	**1,915**	**15,531**	**988**	**163,220.01 /LS**	**163,220**
10 OXIDATION DITCH #4 (2 MGD)								
02300 Earthwork								
02300.4640 Structural Excavation & Backfill - Ox Ditch	10,000.00 cy	14,232			36,221		5.05 /cy	50,453
02300 Earthwork		14,232			36,221			50,453
02600 Yard Piping								
02501.4601 42" DIP - MLSS -Ox Ditch Effluent to Splitter Box	50.00 lf	2,313	16,850	109	3,557		456.58 /lf	22,829
02501.4604 30" DIP-FE-Intake Manifold (Buried)	75.00 ls	2,249	24,408	131	3,075		398.18 /ls	29,863
02501.4612 30" DIP - RS - Headworks to Ox Ditch Influent	100.00 lf	2,795	22,569	218	4,148		297.31 /lf	29,731
02600.040.005 8" & 12" DIP - Basin Drain	340.00 lf	12,905	20,944		5,245	1,000	117.92 /lf	40,094
02600 Yard Piping		20,262	84,770	459	16,025	1,000		122,516
02700 Base & Pavements								

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
02700.040.0100 Stone Base around Tanks for Construction of Prestressed Ox Ditch	1,100.00 sy	3,335	6,111		1,892		10.31 /sy	11,337
02700 Base & Pavements		3,335	6,111		1,892			11,337
03000 Concrete								
03000.040.024 12" Pads (35'x25') - 2ea	19.45 cy	3,268	4,051	212	41	38	391.22 /cy	7,609
03000 Concrete		3,268	4,051	212	41	38		7,609
03400 Precast Concrete								
50.03400.4605 Prestressed Aeration Basin Structure	19,019.00 sf			1,900,000			99.90 /sf	1,900,000
03400 Precast Concrete				1,900,000				1,900,000
05500 Metal Fabrications								
05500.040.010 Aluminum Grating and Handrails	1,850.00 lf	21,297	64,890			1,854	47.59 /lf	88,041
05500.040.020 Stairs	31.00 trd	1,160	11,592		7	48	413.12 /trd	12,807
05500.040.030 Landing Platform	36.00 sf	416	4,416		3		134.32 /sf	4,836
05500 Metal Fabrications		22,873	80,898		10	1,902		105,684
11200 Water Treatment Equipment								
11300.040.060 Oxidation Ditch Gates	2.00 ea	4,251	45,638	1,000	1,475	700	26,531.88 /ea	53,064
11200 Water Treatment Equipment		4,251	45,638	1,000	1,475	700		53,064
10 OXIDATION DITCH #4 (2 MGD)	**1.00 EA**	**68,220**	**221,469**	**1,901,670**	**55,663**	**3,640**	**2,250,662.98 /EA**	**2,250,663**
12 OXIDATION DITCH #5 (2 MGD)								
02300 Earthwork								
02300.4640 Structural Excavation & Backfill - Ox Ditch	10,000.00 cy	14,232			36,221		5.05 /cy	50,453
02300 Earthwork		14,232			36,221			50,453
02600 Yard Piping								
02501.4604 30" DIP-FE-Intake Manifold (Buried)	220.00 ls	5,418	41,019	480	8,066		249.92 /ls	54,983
02501.4612 30" DIP - RS - Headworks to Ox Ditch Influent	120.00 lf	3,233	26,799	218	4,654		290.87 /lf	34,904
02600.040.005 8" & 12" DIP - Basin Drain	340.00 lf	12,905	20,944		5,245	1,000	117.92 /lf	40,094
02600 Yard Piping		21,555	88,761	699	17,965	1,000		129,981
02700 Base & Pavements								
02700.040.0100 Stone Base around Tanks for Construction of Prestressed Ox Ditch	1,100.00 sy	3,335	6,111		1,892		10.31 /sy	11,337
02700 Base & Pavements		3,335	6,111		1,892			11,337
03000 Concrete								
03000.040.024 12" Pads (35'x25') - 2ea	19.45 cy	3,268	4,051	212	41	38	391.22 /cy	7,609
03000 Concrete		3,268	4,051	212	41	38		7,609
03400 Precast Concrete								
50.03400.4605 Prestressed Aeration Basin Structure	19,019.00 sf			1,900,000			99.90 /sf	1,900,000
03400 Precast Concrete				1,900,000				1,900,000
05500 Metal Fabrications								
05500.040.010 Aluminum Grating and Handrails	1,850.00 lf	21,297	64,890			1,854	47.59 /lf	88,041
05500.040.020 Stairs	31.00 trd	1,160	11,592		7	48	413.12 /trd	12,807
05500.040.030 Landing Platform	36.00 sf	416	4,416		3		134.32 /sf	4,836
05500 Metal Fabrications		22,873	80,898		10	1,902		105,684
11200 Water Treatment Equipment								
11300.040.060 Oxidation Ditch Gates	2.00 ea	4,251	45,638	1,000	1,475	700	26,531.88 /ea	53,064
11200 Water Treatment Equipment		4,251	45,638	1,000	1,475	700		53,064
12 OXIDATION DITCH #5 (2 MGD)	**1.00 EA**	**69,514**	**225,460**	**1,901,911**	**57,603**	**3,640**	**2,258,127.23 /EA**	**2,258,127**
18 SECONDARY CLARIFIER #7 (85' DIA.)								
02300 Earthwork								
20.02300.4640 Structural Excavation & Backfill - Clarifier		4,552			11,756		/cy	16,308
02300 Earthwork		4,552			11,756			16,308
02500 Yard Piping								
02501.4631 20" DIP-CE-Clarifier #7 to Filter Feed PS	20.00 lf	460	4,310	27	738		276.75 /lf	5,535
02511.4699 36" x 20" Connection (including 20" Valve)	1.00 ea	1,875	28,923		1,472		32,269.80 /ea	32,270
02500 Yard Piping		2,334	33,233	27	2,210			37,805
03212 Concrete Walls								

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
03325.0013 Clarifier Walls (267'x16.25'x12")	160.69 cy	54,226	56,303	2,625	5,901	376	743.24 /cy	119,431
03325.0025 Launderer Walls (267'x3'x12")	29.67 cy	27,575	13,779	485	5,180	69	1,587.03 /cy	47,087
03325.0030 Clarifier Walls -Exterior (12'x21'x12")	9.78 cy	5,504	4,846	160	1,065	23	1,185.79 /cy	11,597
03212 Concrete Walls		87,304	74,928	3,269	12,146	468		178,115
03310 Concrete Slab on Grade								
03325.0010 Clarifier Bottom Slab	345.00 cy	49,916	82,917	1,353	119	808	391.63 /cy	135,112
03325.0015 Clarifier Hopper	28.18 cy	5,703	8,064	276		66	500.68 /cy	14,109
03310 Concrete Slab on Grade		55,619	90,982	1,629	119	873		149,221
03314 Concrete Elevated Slabs								
03325.0020 Launderer Slab (267'x2'x12")	19.78 cy	9,231	7,455	3,343	490	46	1,039.65 /cy	20,564
03314 Concrete Elevated Slabs		9,231	7,455	3,343	490	46		20,564
03600 Grout								
03325.0035 Clairifier Grout (2")	35.70 cy	2,712	5,355		1,696	2,856	353.48 /cy	12,619
03600 Grout		2,712	5,355		1,696	2,856		12,619
05500 Metal Fabrications								
05500.1802-05-0010 Aluminum Guardrail with Toe Board	300.00 lf	4,149	22,872				90.07 /lf	27,021
05500.1806-05-0010 Aluminum Stair and Rail	34.00 trd	2,047	6,349		732		268.47 /trd	9,128
05500 Metal Fabrications		6,196	29,221		732			36,149
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	16.00 sf	150	1,112				78.85 /sf	1,262
48-05500.2605 Fabricated Walkway	168.00 sf		11,368				67.67 /sf	11,368
05530 Grating & Planks		150	12,480					12,630
05531 Traffic Grates & Castings								
0531.1838-05-0010 Effluent Box Grate	16.00 sf	26	1,800		13		114.95 /sf	1,839
0531.1840-05-0010 Scum Collection Trough	16.00 sf	176	1,980		13		135.61 /sf	2,170
05531 Traffic Grates & Castings		202	3,780		27			4,009
06600 Plastic Fabrications								
48-06610.2605 FRP Weir, 85' Dia. Clarifier	1.00 ea	6,025	15,000				21,025.47 /ea	21,025
06600 Plastic Fabrications		6,025	15,000					21,025
11060 Submersible Wastewater Pumps								
48-11310.2600 Submersible Scum Pumps	1.00 ea	863	25,307				26,169.68 /ea	26,170
11060 Submersible Wastewater Pumps		863	25,307					26,170
11225 Clarifiers								
48-11225.2601 Half Bridge Secondary Clarifier Mechanism (85' Dia.)	1.00 ea	16,461	156,066	91	7,701		180,318.83 /ea	180,319
11225 Clarifiers		16,461	156,066	91	7,701			180,319
15000 Process Mechanical								
48-15210.2600 24" DIP-ML-Clarifier Feed	1.00 ls	2,737	17,339	35	1,436		21,547.14 /ls	21,547
48-15210.2601 14" DIP-RAS-Return Line	1.00 ls	1,594	8,359	17	718		10,687.52 /ls	10,688
48-15210.2602 24" DIP-SE-From Collection Box	1.00 ls	984	7,573		340		8,897.11 /ls	8,897
48-15210.2603 4" DIP-SC-Scum Pump Discharge Pump #1	1.00 ls	1,347	9,499				10,846.45 /ls	10,846
48-15210.2604 Scum Pump Valving	1.00 ls	875	4,217				5,091.91 /ls	5,092
48-15240.2600 Tank Spray Diffuser	1.00 ls	1,140	2,775				3,914.89 /ls	3,915
15000 Process Mechanical		8,677	49,762	52	2,494			60,985
18 SECONDARY CLARIFIER #7 (85' DIA.)	**1.00 EA**	**200,326**	**503,569**	**8,411**	**39,369**	**4,244**	**755,919.14 /EA**	**755,919**
20 SECONDARY CLARIFIER #8 (85' DIA.)								
02300 Earthwork								
20.02300.4640 Structural Excavation & Backfill - Clarifier	4,500.00 cy	4,552			11,756		3.62 /cy	16,308
02300 Earthwork		4,552			11,756			16,308
02500 Yard Piping								
02501.4636 20" DIP-CE-Clarifier #8 to Filter Feed PS	20.00 lf	460	4,310	27	738		276.75 /lf	5,535
02500 Yard Piping		460	4,310	27	738			5,535
03212 Concrete Walls								
03325.0013 Clarifier Walls (267'x16.25'x12")	160.69 cy	54,226	56,303	2,625	5,901	376	743.24 /cy	119,431

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
03325.0025 Launderer Walls (267'x3'x12")	29.67 cy	27,575	13,779	485	5,180	69	1,587.03 /cy	47,087
03325.0030 Clarifier Walls -Exterior (12'x21'x12")	9.78 cy	5,504	4,846	160	1,065	23	1,185.79 /cy	11,597
03212 Concrete Walls		87,304	74,928	3,269	12,146	468		178,115
03310 Concrete Slab on Grade								
03325.0010 Clarifier Bottom Slab	345.00 cy	49,916	82,917	1,353	119	808	391.63 /cy	135,112
03325.0015 Clarifier Hopper	28.15 cy	5,703	8,064	276		66	501.22 /cy	14,109
03310 Concrete Slab on Grade		55,619	90,982	1,629	119	873		149,221
03314 Concrete Elevated Slabs								
03325.0020 Launderer Slab (267'x2'x12")	19.78 cy	9,231	7,455	3,343	490	46	1,039.65 /cy	20,564
03314 Concrete Elevated Slabs		9,231	7,455	3,343	490	46		20,564
03600 Grout								
03325.0035 Clairifier Grout (2")	35.70 cy	2,712	5,355		1,696	2,856	353.48 /cy	12,619
03600 Grout		2,712	5,355		1,696	2,856		12,619
05500 Metal Fabrications								
05500.1802-05-0010 Aluminum Guardrail with Toe Board	300.00 lf	4,149	22,872				90.07 /lf	27,021
05500.1806-05-0010 Aluminum Stair and Rail	34.00 trd	2,047	6,349		732		268.47 /trd	9,128
05500 Metal Fabrications		6,196	29,221		732			36,149
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	16.00 sf	150	1,112				78.85 /sf	1,262
48-05500.2605 Fabricated Walkway	168.00 sf		11,368				67.67 /sf	11,368
05530 Grating & Planks		150	12,480					12,630
05531 Traffic Grates & Castings								
0531.1838-05-0010 Effluent Box Grate	16.00 sf	26	1,800		13		114.95 /sf	1,839
0531.1840-05-0010 Scum Collection Trough	16.00 sf	176	1,980		13		135.61 /sf	2,170
05531 Traffic Grates & Castings		202	3,780		27			4,009
06600 Plastic Fabrications								
48-06610.2605 FRP Weir, 85' Dia. Clarifier	1.00 ea	6,025	15,000				21,025.48 /ea	21,025
06600 Plastic Fabrications		6,025	15,000					21,025
11060 Submersible Wastewater Pumps								
48-11310.2600 Submersible Scum Pumps	1.00 ea	863	25,307				26,169.68 /ea	26,170
11060 Submersible Wastewater Pumps		863	25,307					26,170
11225 Clarifiers								
48-11225.2601 Half Bridge Secondary Clarifier Mechanism (85' Dia.)	1.00 ea	16,461	156,066	91	7,701		180,318.83 /ea	180,319
11225 Clarifiers		16,461	156,066	91	7,701			180,319
15000 Process Mechanical								
48-15210.2600 24" DIP-ML-Clarifier Feed	1.00 ls	2,737	17,339	35	1,436		21,547.14 /ls	21,547
48-15210.2601 14" DIP-RAS-Return Line	1.00 ls	1,594	8,359	17	718		10,687.52 /ls	10,688
48-15210.2602 24" DIP-SE-From Collection Box	1.00 ls	984	7,573		340		8,897.11 /ls	8,897
48-15210.2603 4" DIP-SC-Scum Pump Discharge Pump #1	1.00 ls	1,347	9,499				10,846.45 /ls	10,846
48-15210.2604 Scum Pump Valving	1.00 ls	875	4,217				5,091.91 /ls	5,092
48-15240.2600 Tank Spray Diffuser	1.00 ls	1,140	2,775				3,914.89 /ls	3,915
15000 Process Mechanical		8,677	49,762	52	2,494			60,985
20 SECONDARY CLARIFIER #8 (85' DIA.)	**1.00 EA**	**198,451**	**474,646**	**8,411**	**37,897**	**4,244**	**723,649.35 /EA**	**723,649**
22 SECONDARY CLARIFIER #9 (85' DIA.)								
02300 Earthwork								
20.02300.4640 Structural Excavation & Backfill - Clarifier	4,500.00 cy	4,552			11,756		3.62 /cy	16,308
02300 Earthwork		4,552			11,756			16,308
02500 Yard Piping								
02501.4638 20" DIP-CE-Clarifier #9 to Filter Feed PS	120.00 lf	3,977	13,501	218	5,899		196.63 /lf	23,596
02500 Yard Piping		3,977	13,501	218	5,899			23,596
03212 Concrete Walls								
03325.0013 Clarifier Walls (267'x16.25'x12")	160.69 cy	54,226	56,303	2,625	5,901	376	743.24 /cy	119,431
03325.0025 Launderer Walls (267'x3'x12")	29.67 cy	27,575	13,779	485	5,180	69	1,587.03 /cy	47,087

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
03325.0030 Clarifier Walls -Exterior (12'x21'x12")	9.78 cy	5,504	4,846	160	1,065	23	1,185.79 /cy	11,597
03212 Concrete Walls		87,304	74,928	3,269	12,146	468		178,115
03310 Concrete Slab on Grade								
03325.0010 Clarifier Bottom Slab	345.00 cy	49,916	82,917	1,353	119	808	391.63 /cy	135,112
03325.0015 Clarifier Hopper	28.15 cy	5,703	8,064	276		66	501.22 /cy	14,109
03310 Concrete Slab on Grade		55,619	90,982	1,629	119	873		149,221
03314 Concrete Elevated Slabs								
03325.0020 Launderer Slab (267'x2'x12")	19.78 cy	9,231	7,455	3,343	490	46	1,039.65 /cy	20,564
03314 Concrete Elevated Slabs		9,231	7,455	3,343	490	46		20,564
03600 Grout								
03325.0035 Clairifier Grout (2")	35.70 cy	2,712	5,355		1,696	2,856	353.48 /cy	12,619
03600 Grout		2,712	5,355		1,696	2,856		12,619
05500 Metal Fabrications								
05500.1802-05-0010 Aluminum Guardrail with Toe Board	300.00 lf	4,149	22,872				90.07 /lf	27,021
05500.1806-05-0010 Aluminum Stair and Rail	34.00 trd	2,047	6,349		732		268.47 /trd	9,128
05500 Metal Fabrications		6,196	29,221		732			36,149
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	16.00 sf	150	1,112				78.85 /sf	1,262
48-05500.2605 Fabricated Walkway	168.00 sf		11,368				67.67 /sf	11,368
05530 Grating & Planks		150	12,480					12,630
05531 Traffic Grates & Castings								
0531.1838-05-0010 Effluent Box Grate	16.00 sf	26	1,800		13		114.96 /sf	1,839
0531.1840-05-0010 Scum Collection Trough	16.00 sf	176	1,980		13		135.61 /sf	2,170
05531 Traffic Grates & Castings		202	3,780		27			4,009
06600 Plastic Fabrications								
48-06610.2605 FRP Weir, 85' Dia. Clarifier	1.00 ea	6,025	15,000				21,025.48 /ea	21,025
06600 Plastic Fabrications		6,025	15,000					21,025
11060 Submersible Wastewater Pumps								
48-11310.2600 Submersible Scum Pumps	1.00 ea	863	25,307				26,169.68 /ea	26,170
11060 Submersible Wastewater Pumps		863	25,307					26,170
11225 Clarifiers								
48-11225.2601 Half Bridge Secondary Clarifier Mechanism (85' Dia.)	1.00 ea	16,461	156,066	91	7,701		180,318.83 /ea	180,319
11225 Clarifiers		16,461	156,066	91	7,701			180,319
15000 Process Mechanical								
48-15210.2600 24" DIP-ML-Clarifier Feed	1.00 ls	2,737	17,339	35	1,436		21,547.14 /ls	21,547
48-15210.2601 14" DIP-RAS-Return Line	1.00 ls	1,594	8,359	17	718		10,687.52 /ls	10,688
48-15210.2602 24" DIP-SE-From Collection Box	1.00 ls	984	7,573		340		8,897.11 /ls	8,897
48-15210.2603 4" DIP-SC-Scum Pump Discharge Pump #1	1.00 ls	1,347	9,499				10,846.45 /ls	10,846
48-15210.2604 Scum Pump Valving	1.00 ls	875	4,217				5,091.91 /ls	5,092
48-15240.2600 Tank Spray Diffuser	1.00 ls	1,140	2,775				3,914.89 /ls	3,915
15000 Process Mechanical		8,677	49,762	52	2,494			60,985
22 SECONDARY CLARIFIER #9 (85' DIA.)	**1.00 EA**	**201,969**	**483,837**	**8,602**	**43,059**	**4,244**	**741,710.38 /EA**	**741,710**
24 SECONDARY CLARIFIER #10 (85' DIA.)								
02300 Earthwork								
20.02300.4640 Structural Excavation & Backfill - Clarifier	4,500.00 cy	4,552			11,756		3.62 /cy	16,308
02300 Earthwork		4,552			11,756			16,308
02500 Yard Piping								
02501.4632 20" DIP-CE-Clarifier #10 to Filter Feed PS	160.00 lf	4,896	40,231	218	7,375		329.51 /lf	52,721
02500 Yard Piping		4,896	40,231	218	7,375			52,721
03212 Concrete Walls								
03325.0013 Clarifier Walls (267'x16.25'x12")	160.69 cy	54,226	56,303	2,625	5,901	376	743.24 /cy	119,431
03325.0025 Launderer Walls (267'x3'x12")	29.67 cy	27,575	13,779	485	5,180	69	1,587.03 /cy	47,087
03325.0030 Clarifier Walls -Exterior (12'x21'x12")	9.78 cy	5,504	4,846	160	1,065	23	1,185.79 /cy	11,597

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
03212 Concrete Walls		87,304	74,928	3,269	12,146	468		178,115
03310 Concrete Slab on Grade								
03325.0010 Clarifier Bottom Slab	345.00 cy	49,916	82,917	1,353	119	808	391.63 /cy	135,112
03325.0015 Clarifier Hopper	28.15 cy	5,703	8,064	276		66	501.22 /cy	14,109
03310 Concrete Slab on Grade		55,619	90,982	1,629	119	873		149,221
03314 Concrete Elevated Slabs								
03325.0020 Launderer Slab (267'x2'x12")	19.78 cy	9,231	7,455	3,343	490	46	1,039.65 /cy	20,564
03314 Concrete Elevated Slabs		9,231	7,455	3,343	490	46		20,564
03600 Grout								
03325.0035 Clairifier Grout (2")	35.70 cy	2,712	5,355		1,696	2,856	353.48 /cy	12,619
03600 Grout		2,712	5,355		1,696	2,856		12,619
05500 Metal Fabrications								
05500.1802-05-0010 Aluminum Guardrail with Toe Board	300.00 lf	4,149	22,872				90.07 /lf	27,021
05500.1806-05-0010 Aluminum Stair and Rail	34.00 trd	2,047	6,349		732		268.47 /trd	9,128
05500 Metal Fabrications		6,196	29,221		732			36,149
05530 Grating & Planks								
05530.1825-05-0010 Aluminum Grating and Steel Angle	16.00 sf	150	1,112				78.85 /sf	1,262
48-05500.2605 Fabricated Walkway	168.00 sf		11,368				67.67 /sf	11,368
05530 Grating & Planks		150	12,480					12,630
05531 Traffic Grates & Castings								
0531.1838-05-0010 Effluent Box Grate	16.00 sf	26	1,800		13		114.95 /sf	1,839
0531.1840-05-0010 Scum Collection Trough	16.00 sf	176	1,980		13		135.61 /sf	2,170
05531 Traffic Grates & Castings		202	3,780		27			4,009
06600 Plastic Fabrications								
48-06610.2605 FRP Weir, 85' Dia. Clarifier	1.00 ea	6,025	15,000				21,025.47 /ea	21,025
06600 Plastic Fabrications		6,025	15,000					21,025
11060 Submersible Wastewater Pumps								
48-11310.2600 Submersible Scum Pumps	1.00 ea	863	25,307				26,169.68 /ea	26,170
11060 Submersible Wastewater Pumps		863	25,307					26,170
11225 Clarifiers								
48-11225.2601 Half Bridge Secondary Clarifier Mechanism (85' Dia.)	1.00 ea	16,461	156,066	91	7,701		180,318.83 /ea	180,319
11225 Clarifiers		16,461	156,066	91	7,701			180,319
15000 Process Mechanical								
48-15210.2600 24" DIP-ML-Clarifier Feed	1.00 ls	2,737	17,339	35	1,436		21,547.14 /ls	21,547
48-15210.2601 14" DIP-RAS-Return Line	1.00 ls	1,594	8,359	17	718		10,687.52 /ls	10,688
48-15210.2602 24" DIP-SE-From Collection Box	1.00 ls	984	3,569		340		4,893.79 /ls	4,894
48-15210.2603 4" DIP-SC-Scum Pump Discharge Pump #1	1.00 ls	1,347	9,499				10,846.45 /ls	10,846
48-15210.2604 Scum Pump Valving	1.00 ls	875	4,217				5,091.91 /ls	5,092
48-15240.2600 Tank Spray Diffuser	1.00 ls	1,140	2,775				3,914.89 /ls	3,915
15000 Process Mechanical		8,677	45,759	52	2,494			56,982
24 SECONDARY CLARIFIER #10 (85' DIA.)	**1.00 EA**	**202,888**	**506,564**	**8,602**	**44,534**	**4,244**	**766,831.75 /EA**	**766,832**
30 CLARIFIER SPLITTER BOX								
02300 Earthwork								
20.02300.4642 Structural Excavation & Backfill - Splitter Box	300.00 cy	479			1,201		5.60 /cy	1,680
02300 Earthwork		479			1,201			1,680
03000 Concrete								
03330.0010 RAS Splitter Box Slab (30' x19' x14")	15.90 cy	1,997	3,079		19		320.47 /cy	5,095
03330.0015 RAS Splitter Box Walls (110'x10'x12")	39.12 cy	23,902	15,638	639	217	92	1,034.95 /cy	40,487
03000 Concrete		25,899	18,717	639	236	92		45,583
05120 Structural Steel								
05120.1841-05-0015 Stair Landing Grate	32.00 sf	2,744	5,040		1,434		288.06 /sf	9,218
05120 Structural Steel		2,744	5,040		1,434			9,218
05500 Metal Fabrications								

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
05500.1802-03-0010 Aluminum Guardrail 3 Line with Toe Board	82.00 lf	1,130	6,228				89.74 /lf	7,358
05500.1806-03-0010 Aluminum Stair and Rail	21.00 trd	1,553	5,057		452		336.29 /trd	7,062
05500 Metal Fabrications		2,684	11,285		452			14,420
05530 Grating & Planks								
05530.1825-03-0010 Aluminum Grating and Steel Angle	250.00 sf	3,253	38,259		289		167.21 /sf	41,801
05530 Grating & Planks		3,253	38,259		289			41,801
11282 Slide Gates								
49-11280.2600 Weir Gates	2.00 ea	5,921	97,476		1,361		52,378.76 /ea	104,758
11282 Slide Gates		5,921	97,476		1,361			104,758
15210 Ductile Iron Pipe								
49-15210.2600 42" DIP-ML-Influent Bottom Feed Pipe	1.00 ea	2,379	25,043		680		28,103.05 /ea	28,103
49-15210.2601 24" DIP-ML-Clairifier Feed #8, #9 & #10	3.00 ea	2,844	10,708		1,020		4,857.59 /ea	14,573
49-15210.2603 24" DIP-ML-Clairifer Discharge #8, #9 & #10	3.00 ea	2,844	10,708		1,020		4,857.59 /ea	14,573
49-15210.2610 20" DIP-SE-Clarifier #8 & #9	2.00 ea	2,095	2,891		1,361		3,173.55 /ea	6,347
15210 Ductile Iron Pipe		10,163	49,351		4,082			63,596
30 CLARIFIER SPLITTER BOX	**1.00 LS**	**51,143**	**220,128**	**639**	**9,054**	**92**	**281,055.60 /LS**	**281,056**
35 RAS/WAS MODIFICATIONS								
03000 Concrete								
03335.0010 12" RAS Pump Station Slab	41.47 cy	5,862	10,008	186	31	111	390.57 /cy	16,197
03335.0020 Equipment Pads	5.33 cy	3,312	2,265	105	10	12	1,070.25 /cy	5,704
03000 Concrete		9,174	12,273	290	41	123		21,901
11210 Water Supply & Treatment Pumps								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	295	2,813				3,107.59 /ls	3,108
50-11210-2630 Seal Water System for WAS Pumps	1.00 ls	147	1,406				1,553.80 /ls	1,554
99-11210.2601 Sump Pumps	1.00 ea	276	1,686				1,962.47 /ea	1,962
11210 Water Supply & Treatment Pumps		718	5,906					6,624
11211 Centrifugal Pumps								
50-11211.2600 RAS Pumps, 20HP	4.00 ea	4,770	115,980		1,361	6,400	32,127.72 /ea	128,511
50-11211.2601 WAS Pumps, 5 HP	2.00 ea	2,368	27,260		680	3,200	16,754.28 /ea	33,509
11211 Centrifugal Pumps		7,138	143,240		2,041	9,600		162,019
15210 Ductile Iron Pipe								
50-05500.2600 Fabricated Pipe Supports for RAS Discharge Manifold	4.00 ea	328	235				140.86 /ea	563
50-15210.2600 14" RAS Manifold for Clairifier #8 Buried Piping	1.00 ea	720	4,921	9	359		6,008.93 /ea	6,009
50-15210.2601 14" RAS Manifold for Clairifier #9 Buried Piping	1.00 ea	720	4,921	9	359		6,008.93 /ea	6,009
50-15210.2602 14" RAS Manifold for Clairifier #10 Buried Piping	1.00 ea	614	5,104	9	359		6,085.31 /ea	6,085
50-15210.2603 14" RAS From Buried Upturn to Pump Cross Connection Clairifier #8	1.00 ea	686	4,363				5,048.83 /ea	5,049
50-15210.2604 14" RAS From Buried Upturn to Pump Cross Connection Clairifier #9	1.00 ea	686	4,363				5,048.83 /ea	5,049
50-15210.2605 14" RAS From Buried Upturn to Pump Cross Connection Clairifer #10	1.00 ea	686	2,282				2,967.87 /ea	2,968
50-15210.2606 14" RAS Suction Pipe to Pump #1	1.00 ea	1,978	11,995				13,973.32 /ea	13,973
50-15210.2607 14" RAS Suction Pipe to Pump #2	1.00 ea	1,940	11,995				13,934.65 /ea	13,935
50-15210.2608 14" RAS Suction Pipe to Pump #3	1.00 ea	1,940	11,995				13,934.65 /ea	13,935
50-15210.2609 14" RAS Suction Pipe to Pump #4	1.00 ea	1,940	11,995				13,934.65 /ea	13,935
50-15210.2610 10" RAS Discharge to Manifold Pump #1	1.00 ea	1,492	10,463				11,955.43 /ea	11,955
50-15210.2611 10" RAS Discharge to Manifold Pump #2	1.00 ea	1,467	10,463				11,930.23 /ea	11,930
50-15210.2612 10" RAS Discharge to Manifold Pump #3	1.00 ea	1,467	10,463				11,930.23 /ea	11,930
50-15210.2613 10" RAS Discharge to Manifold Pump #4	1.00 ea	1,467	10,463				11,930.23 /ea	11,930
50-15210.2614 RAS Discharge Manifold	1.00 ea	4,235	32,474				36,708.50 /ea	36,709
50-15210.2615 WAS Pumps Suction Connection to RAS Discharge	1.00 ea	2,075	12,799				14,873.93 /ea	14,874
50-15210.2616 WAS Pump #1 Suction Line From Manifold	1.00 ea	879	2,802				3,680.64 /ea	3,681
50-15210.2617 WAS Pump #2 Suction Line From Manifold	1.00 ea	879	2,802				3,680.64 /ea	3,681
50-15210.2618 WAS Pump Discharge To Discharge Manifold Pump #1	1.00 ea	834	5,408				6,242.55 /ea	6,243
50-15210.2619 WAS Pump Discharge To Discharge Manifold Pump #2	1.00 ea	834	5,408				6,242.55 /ea	6,243
50-15210.2620 WAS Discharge Manifold to Yard Piping Connection	1.00 ea	2,085	6,090				8,175.03 /ea	8,175

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
15210 Ductile Iron Pipe		29,951	183,805	26	1,077			214,859
15220 Steel Pipe								
50-15220.2600 ARV On RAS Pump Discharge Pump #1	1.00 ea	268	1,492				1,759.75 /ea	1,760
50-15220.2601 ARV On RAS Pump Discharge Pump #2	1.00 ea	268	1,492				1,759.75 /ea	1,760
50-15220.2602 ARV On RAS Pump Discharge Pump #3	1.00 ea	268	1,492				1,759.75 /ea	1,760
50-15220.2603 ARV On RAS Pump Discharge Pump #4	1.00 ea	268	1,492				1,759.75 /ea	1,760
15220 Steel Pipe		1,071	5,968					7,039
15221 Stainless Steel Pipe								
50-15221.2602 Instrument Piping RAS Pumps	1.00 ls	1,588	5,012				6,599.56 /ls	6,600
15221 Stainless Steel Pipe		1,588	5,012					6,600
15224 Copper Pipe								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	596	523				1,119.31 /ls	1,119
50-11210-2630 Seal Water System for WAS Pumps	1.00 ls	298	261				559.66 /ls	560
15224 Copper Pipe		895	784					1,679
15241 PVC Pipe & Fittings								
50-15240.2610 Sump Piping	1.00 ls	572	713				1,284.30 /ls	1,284
15241 PVC Pipe & Fittings		572	713					1,284
35 RAS/WAS MODIFICATIONS	**1.00 LS**	**51,107**	**357,701**	**316**	**3,159**	**9,723**	**422,005.87 /LS**	**422,006**
38 EXISTING SPLITTER BOX & RAS/WAS MODIFICATIONS								
02500 Yard Piping								
58.02501.4608 12" DIP-RAS-Pump Station to Existing 16" RAS	200.00 lf	7,421	10,446	146	10,505		142.59 /lf	28,517
02500 Yard Piping		7,421	10,446	146	10,505			28,517
03000 Concrete								
03330.0020 RAS Splitter Box Slab - Add for Clarifier #7	5.25 cy	659	1,016		6		320.23 /cy	1,681
03330.0025 RAS Splitter Box Walls - Add for Clarifier #7	7.43 cy	4,541	2,971	121	41	17	1,035.25 /cy	7,692
03330.0029 RAS Pump Station Slab	15.90 cy	1,997	3,079		19		320.47 /cy	5,095
03335.0020 Equipment Pads	2.67 cy	1,656	1,134	52	5	6	1,068.83 /cy	2,854
03000 Concrete		8,854	8,199	174	72	24		17,322
05500 Metal Fabrications								
05500.1802-03-0010 Aluminum Guardrail 3 Line with Toe Board	20.00 lf	276	1,470				87.29 /lf	1,746
05500 Metal Fabrications		276	1,470					1,746
05530 Grating & Planks								
05530.1825-03-0012 Aluminum Grating and Steel Angle - Add for Clarifier #7	80.00 sf	1,042	12,250		93		167.32 /sf	13,385
05530 Grating & Planks		1,042	12,250		93			13,385
11210 Water Supply & Treatment Pumps								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	147	1,406				1,553.80 /ls	1,554
11210 Water Supply & Treatment Pumps		147	1,406					1,554
11211 Centrifugal Pumps								
50-11211.2600 RAS Pumps, 20HP	2.00 ea	2,385	58,490		680	3,200	32,377.72 /ea	64,755
11211 Centrifugal Pumps		2,385	58,490		680	3,200		64,755
11282 Slide Gates								
49-11280.2605 Weir Gate - Add for Clarifier #7	1.00 ea	2,960	48,738		680		52,378.75 /ea	52,379
11282 Slide Gates		2,960	48,738		680			52,379
15000 Process Mechanical								
50-11210-2620 Seal Water System RAS Pumps	1.00 ls	1,193	1,046				2,238.62 /ls	2,239
50-15210.2606 14" RAS Suction Pipe to Pump #1	1.00 ea	1,978	11,995				13,973.32 /ea	13,973
50-15210.2607 14" RAS Suction Pipe to Pump #2	1.00 ea	1,940	11,995				13,934.65 /ea	13,935
50-15210.2610 10" RAS Discharge to Manifold Pump #1	1.00 ea	1,492	10,463				11,955.43 /ea	11,955
50-15210.2611 10" RAS Discharge to Manifold Pump #2	1.00 ea	1,467	10,463				11,930.23 /ea	11,930
50-15210.2614 RAS Discharge Manifold	1.00 ea	2,548	16,323				18,871.75 /ea	18,872
50-15220.2600 ARV On RAS Pump Discharge Pump #1	1.00 ea	268	1,492				1,759.75 /ea	1,760
50-15220.2601 ARV On RAS Pump Discharge Pump #2	1.00 ea	268	1,492				1,759.75 /ea	1,760
15000 Process Mechanical		11,154	65,270					76,424

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
38 EXISTING SPLITTER BOX & RAS/WAS MODIFICATIONS	**1.00 LS**	**34,240**	**206,269**	**319**	**12,030**	**3,224**	**256,081.91 /LS**	**256,082**
40 BIOSOLIDS UPGRADES								
03000 Concrete								
03335.0012 Belt Filter Press Feed Pump Slab	2.37 cy	293	501	9	2	6	342.22 /cy	811
03335.0020 Equipment Pads	1.33 cy	768	491	26	3	3	970.07 /cy	1,290
03000 Concrete		1,061	992	35	4	9		2,101
11000 Equipment								
11000.4605 Course Bubble Diffusers & Slide Gates - ALLOWANCE	1.00 ls					50,000	50,000.00 /ls	50,000
11000 Equipment						50,000		50,000
11350 Sludge Dewatering Equipment								
70-11350.2601 Belt Filter Press Feed Pump	1.00 ea	1,174	17,700				18,873.51 /ea	18,874
70-11350.2604 Dewatered Cake Pump	1.00 ea	1,174	77,200				78,373.51 /ea	78,374
80-11350.2600 Belt Filter Press	1.00 ea	5,621	351,426		340		357,386.72 /ea	357,387
80-11350.2620 Polymer Feed System for Dewatering Press	1.00 ea	2,397	17,432				19,828.71 /ea	19,829
11350 Sludge Dewatering Equipment		10,364	463,758		340			474,462
15210 Ductile Iron Pipe								
80-15210.2630 BFP #1 Feed Piping	1.00 ea	1,814	7,000				8,813.54 /ea	8,814
15210 Ductile Iron Pipe		1,814	7,000					8,814
15221 Stainless Steel Pipe								
80-15221.2640 Instrument Piping	1.00 ls	1,786	5,638				7,424.51 /ls	7,425
15221 Stainless Steel Pipe		1,786	5,638					7,425
15240 PVC Pipe								
80-15240.2600 Poly Storage Tank to Polyblend Manifold	1.00 ea	500	232				731.21 /ea	731
80-15240.2604 Poly Suction	1.00 ea	511	264				775.38 /ea	775
80-15240.2610 Poly Feed	1.00 ea	626	291				916.99 /ea	917
15240 PVC Pipe		1,637	787					2,424
40 BIOSOLIDS UPGRADES	**1.00 LS**	**16,662**	**478,175**	**35**	**344**	**50,009**	**545,225.33 /LS**	**545,225**
50 DEEP BED FILTER								
03000 Concrete								
03325.0011 Filter Bottom Slab (45'x20'x18")	50.00 cy	49,916	82,917	1,353	119	808	2,702.24 /cy	135,112
03325.0034 Filter Interior Walls (60'x18'x18")	60.00 cy	33,792	29,753	981	6,537	140	1,186.72 /cy	71,203
03325.0036 Filter Interior Walls (28'x5'x8")	3.50 cy	1,844	1,644	57	355	8	1,116.47 /cy	3,908
03335.0014 Filter Bottom Slab (8.5'x5'x18")	2.37 cy	293	501	9	2	6	342.22 /cy	811
03000 Concrete		85,845	114,815	2,400	7,012	962		211,034
05500 Metal Fabrications								
05500.1802-03-0010 Aluminum Guardrail 3 Line with Toe Board	80.00 lf	1,103	6,000				88.79 /lf	7,103
05500 Metal Fabrications		1,103	6,000					7,103
05530 Grating & Planks								
05530.1825-03-0010 Aluminum Grating and Steel Angle	96.00 sf	223	13,987		117		149.24 /sf	14,327
05530 Grating & Planks		223	13,987		117			14,327
11228 Filter Membrane Systems								
98-11228.2606 Filter Feed Pump	1.00 ea	1,311	81,052				82,363.18 /ea	82,363
11228 Filter Membrane Systems		1,311	81,052					82,363
13220 Filter Underdrains & Media								
13220.4605 Deep Bed Filter #5	1.00 ls	15,591			178,633		194,224.16 /ls	194,224
13220 Filter Underdrains & Media		15,591			178,633			194,224
13420 I&C Instruments								
13420.4605 30" Magnetic Flow Meter	1.00 ea	1,311	16,200				17,511.40 /ea	17,511
13420 I&C Instruments		1,311	16,200					17,511
15000 Process Mechanical								
15000.040.045 12" SS Air	1.00 ls	1,965	5,783		1	13	7,762.56 /ls	7,763
15000.065.071 36" DIP - FE - Filter to Manifold	1.00 ls	1,924	8,662		680		11,266.12 /ls	11,266
15000.065.073 20" DIP - FE - Filter to Manifold	1.00 ls	7,640	24,414				32,053.47 /ls	32,053

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
15000.065.074 16" DIP - FE - Filter to Wastewater Trough	1.00 ls	4,109	10,691				14,800.17 /ls	14,800
15000.065.077 12" DIP - FE - Filter to Manifold	1.00 ls	4,932	9,098				14,029.95 /ls	14,030
15000.065.088 4" DIP - Drain	1.00 ls	203	393				596.64 /ls	597
15210.4613 20" DIP-FE-Pump #4 Discharge to Manifold	1.00 ls	2,374	17,544		680		20,598.65 /ls	20,599
15210.4625 30" DIP-FE-Magmeter Piping	1.00 ls	6,594	65,632		1,020		73,246.93 /ls	73,247
15220.4605 ARV @ Discharge Manifold	1.00 ea	268	1,492				1,759.75 /ea	1,760
15000 Process Mechanical		30,008	143,711		2,382	13		176,114
50 DEEP BED FILTER	**1.00 EA**	**135,393**	**375,765**	**2,400**	**188,143**	**975**	**702,676.12 /EA**	**702,676**
60 CHLORINE CONTACT TANK MODIFICATIONS								
03000 Concrete								
03325.0018 CCT Bottom Slab (87'x26'x24")	167.56 cy	24,234	40,256	657	58	392	391.48 /cy	65,597
03325.0019 Rapid Mix Bottom Slab (10'x10'x24")	7.41 cy	1,073	1,783	29	3	17	392.04 /cy	2,905
03325.0045 CCT Tank Exterior Walls (138'x10.5'x14")	62.79 cy	35,339	31,115	1,026	6,837	147	1,185.91 /cy	74,463
03325.0047 CCT Tank Interior Walls (150'x10'x12")	55.56 cy	31,288	27,547	908	6,053	130	1,186.57 /cy	65,926
03000 Concrete		91,934	100,701	2,619	12,950	686		208,891
05530 Grating & Planks								
05530.1825-03-0010 Aluminum Grating and Steel Angle	36.00 sf	107	5,263		56		150.73 /sf	5,426
05530 Grating & Planks		107	5,263		56			5,426
11200 Water Treatment Equipment								
11300.040.010 Mixers	1.00 ea	2,273	13,489	1,000	88	600	17,449.21 /ea	17,449
11200 Water Treatment Equipment		2,273	13,489	1,000	88	600		17,449
11211 Centrifugal Pumps								
98-11211.2608 Effluent Filter Transfer Pump	1.00 ea	1,311	70,002				71,313.18 /ea	71,313
11211 Centrifugal Pumps		1,311	70,002					71,313
15000 Process Mechanical								
15210.4615 20" DIP-FF-Pump #4 Discharge to Manifold	1.00 ls	2,374	17,544		680		20,598.65 /ls	20,599
15220.4605 ARV @ Discharge Manifold	1.00 ea	268	1,492				1,759.75 /ea	1,760
15000 Process Mechanical		2,642	19,036		680			22,358
60 CHLORINE CONTACT TANK MODIFICATIONS	**1.00 LS**	**98,267**	**208,492**	**3,619**	**13,774**	**1,286**	**325,437.65 /LS**	**325,438**
65 SODIUM HYPO SYSTEM MODIFICATIONS								
03000 Concrete								
03000.4655 12" Concrete Tank Pads	6.55 cy	1,411	2,435		192		616.46 /cy	4,038
03000 Concrete		1,411	2,435		192			4,038
13000 Special Construction								
13000.4601 Remove Existing Canopy	512.00 sf			5,120			10.00 /sf	5,120
13000.4605 Aluminum Canopy, 20' Eve Height	760.00 sf			26,600			35.00 /sf	26,600
13000 Special Construction				31,720				31,720
13200 Tanks								
13200.4605 FRP Sodium Hypo Tank, 5000 Gallon	2.00 ea	3,905	20,020		1,200	128	12,626.53 /ea	25,253
13200.4688 Remove Existing HDPE Tank	2.00 ea	1,967		140	296		1,201.32 /ea	2,403
13200 Tanks		5,872	20,020	140	1,497	128		27,656
15000 Process Mechanical								
15000.4624 Piping Modifications @ Sodium Hypo Tanks - Allowance	1.00 ls	2,000	5,600		400		8,000.00 /ls	8,000
15000 Process Mechanical		2,000	5,600		400			8,000
65 SODIUM HYPO SYSTEM MODIFICATIONS	**1.00 LS**	**9,282**	**28,055**	**31,860**	**2,089**	**128**	**71,413.51 /LS**	**71,414**
70 EFFLUENT PUMPING MODIFICATIONS								
03000 Concrete								
03335.0042 Effluent Pump Slab (20'x15'x12")	11.11 cy	1,374	2,345	44	7	26	341.65 /cy	3,796
03335.0044 Pump Pad	3.56 cy	2,212	1,512	70	7	8	1,069.94 /cy	3,809
03000 Concrete		3,585	3,857	113	14	34		7,605
11211 Centrifugal Pumps								
98-11211.2612 Effluent Pump	1.00 ea	1,311	24,952				26,263.18 /ea	26,263

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
11211 Centrifugal Pumps		1,311	24,952					26,263
15000 Process Mechanical								
02501.4604 30" DIP-FE-Intake Manifold (Buried)	1.00 ls	524	6,393	58	1,501		8,475.20 /ls	8,475
02501.4608 16" DIP-FE-Intake Manifold (Buried)	1.00 ls	533	1,603	58	621		2,815.50 /ls	2,816
15210.4680 24" DIP-FE-Pump #5 Discharge Manifold	1.00 ls	2,279	13,484		680		16,443.87 /ls	16,444
15210.4682 16" DIP-FE-Pump #5 Intake & Discharge Manifolds	1.00 ls	4,723	18,092		680		23,494.75 /ls	23,495
15220.4605 ARV @ Discharge Manifold	1.00 ea	268	1,492				1,759.75 /ea	1,760
15000 Process Mechanical		8,326	41,064	116	3,483			52,989
70 EFFLUENT PUMPING MODIFICATIONS	**1.00 LS**	**13,223**	**69,873**	**230**	**3,497**	**34**	**86,856.93 /LS**	**86,857**
75 NEW EQUALIZATION TANK								
03000 Concrete								
03000.4680 18" Concrete Slab-on-Grade Foundation (95' Dia.)	393.75 cy	63,662	118,137		11,568		491.09 /cy	193,368
03000 Concrete		63,662	118,137		11,568			193,368
13210 Prestressed Concrete Tank								
13210.4605 1.20 MGD Prestressed Concrete Tank	1.00 ea	318	2,739	500,852	353		504,262.81 /ea	504,263
13210 Prestressed Concrete Tank		318	2,739	500,852	353			504,263
15210 Ductile Iron Pipe								
49-15210.4602 Mechanical Piping @ Eq Tank - Allowance	1.00 ls	7,935	21,560		3,401		32,896.26 /ls	32,896
15210 Ductile Iron Pipe		7,935	21,560		3,401			32,896
75 NEW EQUALIZATION TANK	**1.00 LS**	**71,915**	**142,437**	**500,852**	**15,323**		**730,527.11 /LS**	**730,527**
80 EXISTING OXIDATION DITCH MODIFICATIONS								
11200 Water Treatment Equipment								
11300.040.030 Modify Existing Aerators - Existing Reactor 3	4.00 ea	8,333	104,720		702		28,438.72 /ea	113,755
11300.040.032 New Surface Aerators - Existing Reactors 1 & 2	2.00 ea	7,349	114,040		351		60,869.92 /ea	121,740
11200 Water Treatment Equipment		15,682	218,760		1,052			235,495
80 EXISTING OXIDATION DITCH MODIFICATIONS	**1.00 LS**	**15,682**	**218,760**		**1,052**		**235,494.69 /LS**	**235,495**
90 INSTRUMENTATION & CONTROLS								
13400 Measurement & Control Instrumentation								
13400.4605 Instrumentation & Control Allowance	1.00 ls			653,911			653,910.89 /ls	653,911
13400 Measurement & Control Instrumentation				653,911				653,911
90 INSTRUMENTATION & CONTROLS	**1.00 LS**			**653,911**			**653,910.89 /LS**	**653,911**
100 ELECTRICAL								
16000 Electrical Allowance/Miscellaneous								
16000.4605 Electrical Allowance	1.00 ls			2,223,297			2,223,297.01 /ls	2,223,297
16000 Electrical Allowance/Miscellaneous				2,223,297				2,223,297
100 ELECTRICAL	**1.00 LS**			**2,223,297**			**2,223,297.01 /LS**	**2,223,297**
110 ADMINISTRATION BUILDING								
01200 Building Allowance								
01200.4605 Administration Building Allowance	3,000.00 sf					750,000	250.00 /sf	750,000
01200 Building Allowance						750,000		750,000
110 ADMINISTRATION BUILDING	**3,000.00 SF**					**750,000**	**250.00 /SF**	**750,000**
120 ELECTRICAL BUILDING								
01200 Building Allowance								
01200.4610 Electrical Building Allowance	400.00 sf					80,000	200.00 /sf	80,000
01200 Building Allowance						80,000		80,000
120 ELECTRICAL BUILDING	**400.00 SF**					**80,000**	**200.00 /SF**	**80,000**
130 GENERATOR 1000KW								
16000 Electrical Allowance/Miscellaneous								
130.16000.4605 Generator, 1000KW w/ATS		7,342	461,689		1,092	2,400		472,523
16000 Electrical Allowance/Miscellaneous		7,342	461,689		1,092	2,400		472,523

Spreadsheet Level	Takeoff Quantity	Labor Amount	Material Amount	Sub Amount	Equip Amount	Other Amount	Total Cost/Unit	Total Amount
130 GENERATOR 1000KW	1.00 EA	7,342	461,689		1,092	2,400	472,523.01 /EA	472,523

Estimate Totals

Description	Amount	Totals	Hours	Rate
Labor	1,569,688		36,615 hrs	
Material	5,442,195			
Subcontract	7,412,168			
Equipment	608,936		7,546 hrs	
Other	991,715			
	16,024,702	16,024,702		
Project Allowances				
MOPO Allowance	50,000			
Painting & Caulking Allowance	130,782			1.00 %
Subtotal Direct Costs:	180,782	16,205,484		
Indirect Costs				
Permits	82,423			0.50 %
Sales Tax (MEO)-Lee County	423,956			6.00 %
Bldr's Risk Ins (% total cost)	137,514			0.50 %
Gen Liab Ins (% total cost)	275,027			1.00 %
GC Bonds (% total cost)	412,541			1.50 %
Subtotal Prior to OH&P:	1,331,461	17,536,945		
GC General Conditions	1.781.598			10.00 %
Contractor Total OH&P	1.781.598			10.00 %
Subtotal with OH&P:	3,563,196	21,100,141		
Construction Contingency	5,344,793			25.00 %
Total Cost at Today's Dollars:	5,344,793	26,444,934		
Escalation - Start Construction (10/2014)	1.057.797			4.00 %
Total Cost with Escalation:	1,057,797	27,502,731		
OPCC Total:		***27,502,731***		