

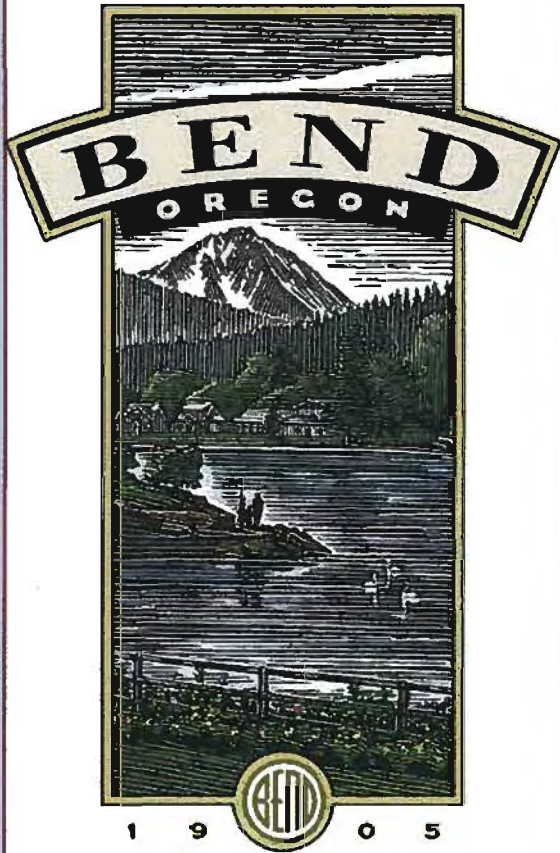
FINAL SCHEMATIC
DESIGN REPORT

Bend Water Reclamation Facility Secondary Expansion Project

OCTOBER 2011

PREPARED BY **CH2MHILL**®
IN ASSOCIATION WITH **WHPacific**





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EXP: 6/30/2013

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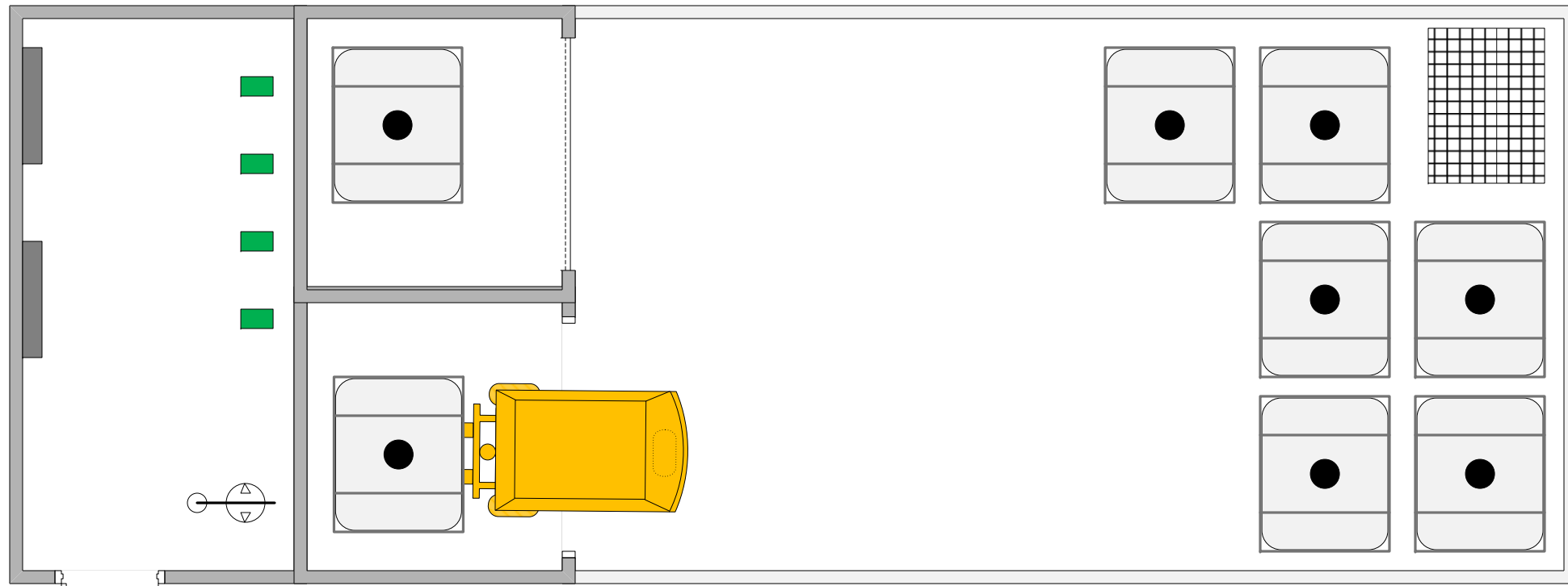
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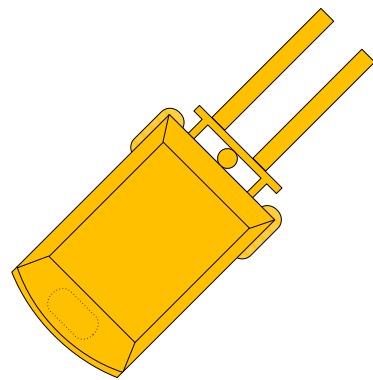
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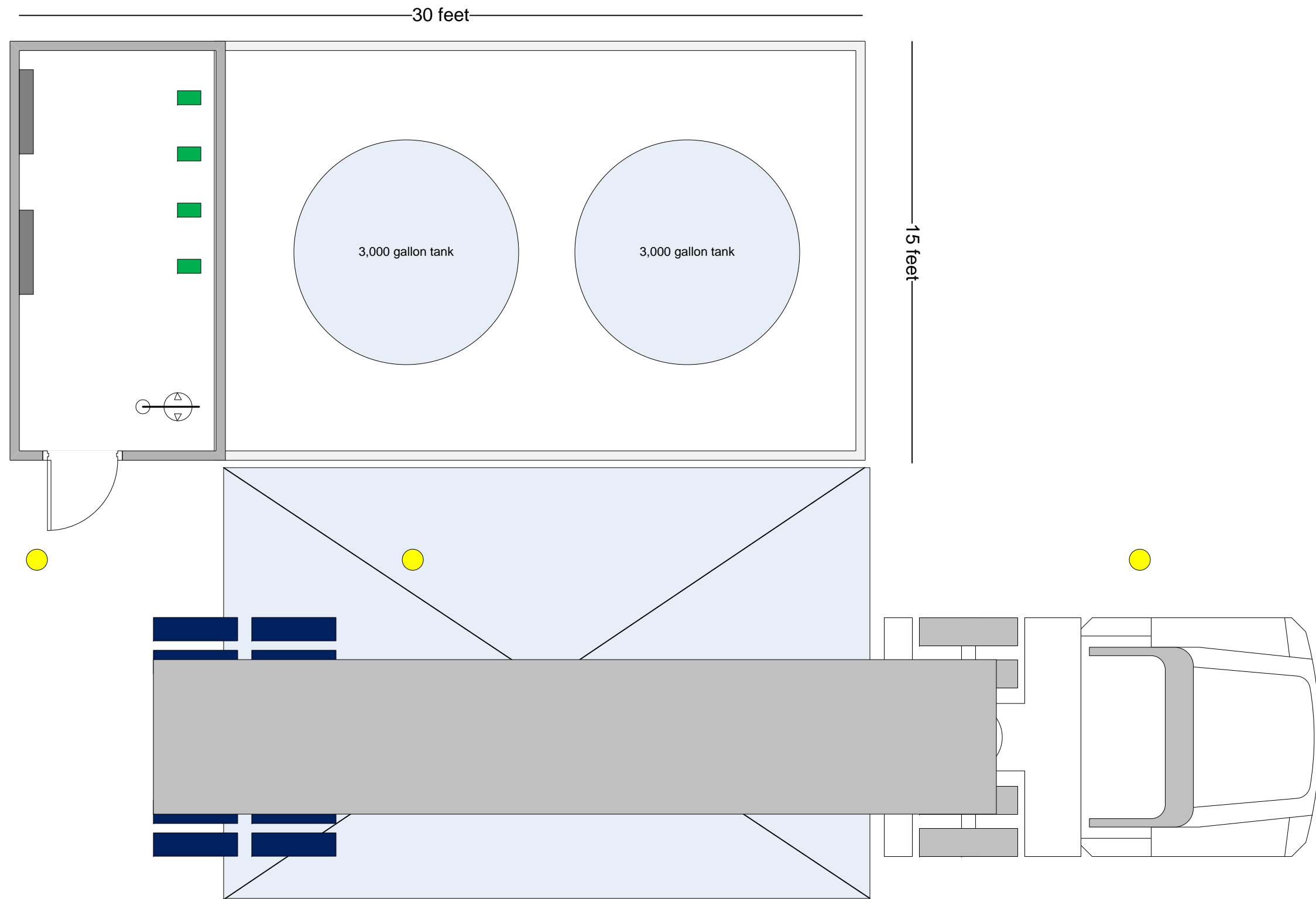
Appendix A—Alternative Layouts

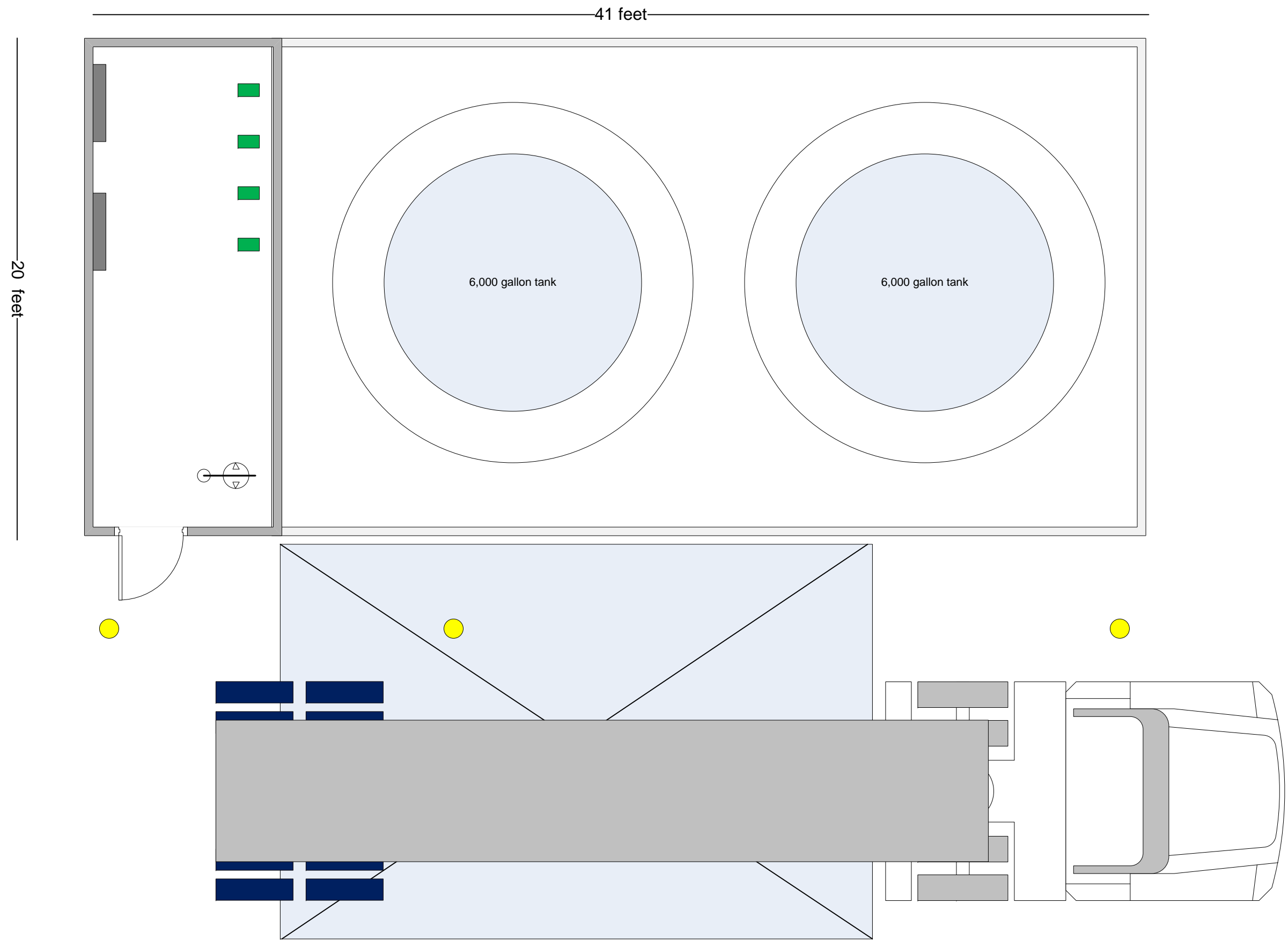
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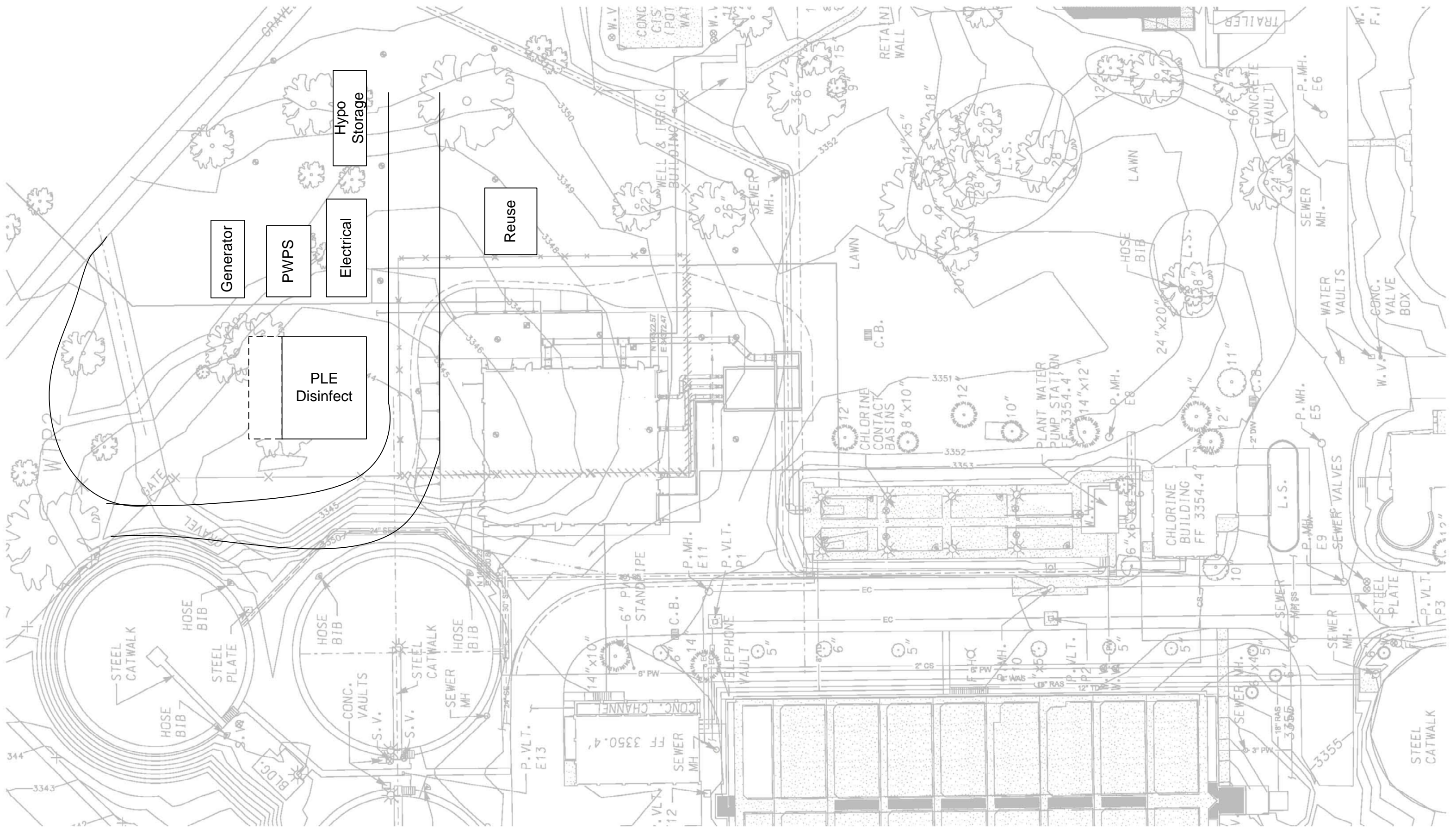
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**Appendix B— Site Plan for UV Disinfection for
Plant Effluent**




PARTIAL SITE PLAN
 1"=20'

Onsite Hypochlorite Generation

ATTACHMENT C TO: TM 6 – Plant Effluent Disinfection, Hypochlorite Facility, and Plant Water Pump Station

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Objective

Evaluate the differences of the present worth between onsite hypochlorite generation and the partial bulk delivery of commercial grade hypochlorite.

Background

The Project Definition Report described a chlorine contact basin for plant effluent and required a large hypochlorite storage facility. During Schematic Design, ultraviolet (UV) disinfection was again considered for disinfecting plant effluent, based on overall present worth costs. With a low pressure high output (LPHO) UV system for plant effluent, a smaller hypochlorite onsite generation and storage system would be required.

Hypochlorite is still required for the following uses:

- Reuse water (W3): chlorine residual
- Plant water (W4): chlorine residual
- Return activated sludge (RAS): biological control (gallons over a 2 day event)
- Offsite: drinking water point uses (gallons per year)

Onsite hypochlorite generation (OSHG) was considered during Project Definition, but was determined to be expensive compared to the alternatives. When the total chlorine demand was reduced, OSHG was reevaluated because the smaller demand may make the system more attractive. This fact sheet presents the economic evaluation between mini-bulk storage of commercial grade hypochlorite and hypochlorite onsite generation and storage.

Design Criteria

Table 1 shows the basic criteria for sizing the hypochlorite delivery and storage systems.

TABLE 1
 Hypochlorite Onsite Generation Design Criteria at Design Condition
City of Bend Water Reclamation Facility

Criterion	Unit	MMF
Class A reuse flow	mgd	2.5
Reuse chlorine residual	mg/L as Cl ₂	2
Plant water flow	mgd	1.5
Plant water Residual	mg/L as Cl ₂	3
RAS chlorine usage	ppd	350
RAS event length	days	2
Offsite usage	pounds per year	913

Cl₂ = chlorine.
 mgd = million gallons per day.
 mg/L = milligrams per liter.
 MMF = Maximum Month Flow.
 ppd = pounds per day

Evaluation of Alternatives

Alternative 1—Mini-Bulk Storage Tanks

Operations

Mini-bulk storage is based on delivery of commercial grade sodium hypochlorite (12.5 percent as chlorine). The hypochlorite will be delivered by a tanker truck. It is assumed that two 3,000-gallon tanks will be used to offload 2,000 to 3,000 gallons at each delivery. A mini-bulk tank system requires limited handling of hypochlorite. The tanker truck will fill the storage tank where it can be metered to the final usage. Mini-bulk storage can be managed to minimize the hypochlorite age, but cost sensitivity may lead to slightly older hypochlorite.

Tanks will be kept under a cover to reduce heating. The tanks and piping will be insulated and heat traced to keep the sodium hypochlorite from freezing during extreme weather.

Cost

The mini-bulk storage facility has a moderate construction cost. Tanks can be provided through the hypochlorite vendor or through the construction contractor. Assuming that the construction contract will provide the tank, replacement of fiberglass tank is required every 8 years. Delivered hypochlorite is estimated to cost \$2.00/gallon including shipping costs.

Facility costs are updated to match the Schematic Design cost estimate for the hypochlorite storage facility (mini-bulk storage tanks).

Advantages

- Minimum equipment to maintain.
- Smaller storage volume than onsite generation.

Disadvantages

- More costly hypochlorite.
- Some risk of hypochlorite degradation before usage.
- Additional exposure to high concentrations of oxidant.

Alternative 2—Onsite Hypo Generation

Operations

The onsite hypochlorite generation system produces a hypochlorite solution (0.08 percent as chlorine) from salt and electricity. Salt will be delivered to the site in 1-ton bulk sacks and loaded into a brine saturator. A water softener provides soft water to the saturator and generator.

The onsite hypochlorite generation system will require a 150 pounds per day (ppd) generator, a brine tank, a water softener and two 6,500-gallon tanks. Storage for hypochlorite is based on the volume required for 24-hour operation of the system during the reuse season including intermittent chlorination of RAS. The required storage is 12,800 gallons to allow for 1 day of disinfection and 2 days accumulation of RAS chlorination. The majority of the required installed storage is based on the RAS chlorination volume of 11,600 gallons.

When RAS chlorination is required, the system will be operated at 150 ppd approximately 6 days before expected RAS chlorination to allow for generation of sufficient volume for 2 days of hypochlorite application.

Offsite application of hypochlorite will also be served by the onsite generation system. The daily requirement is low and does not affect sizing or operation of the system.

Cost

Although a detailed construction estimate has not been completed, the onsite generation and storage facilities have higher construction costs than the mini-bulk storage facility. Salt for brine generation is estimated to cost \$0.06 per pound including estimated shipping costs. Three pounds of salt are required to make a pound of chlorine. Approximately 2 kilowatt-hours (kWh) of electrical power will be required for each pound of chlorine. The onsite equipment is estimated to cost \$190,000 (delivered) based on vendor price quotes.

Advantages

- Lower concentration of hypochlorite reduces safety hazards.
- Limited degradation of hypochlorite due to low concentration.
- Improved hypochlorite metering pump reliability (e.g., limited off-gas)

- Storage could be installed indoors (increases costs).
- Increased shelf life of salt reduces the delivery risk posed by winter weather.

Disadvantages

- Salt handling and manual unloading into brine tank for onsite generation system.
- Higher electrical operating costs than the delivered hypochlorite option.
- Larger building footprint to accommodate hypochlorite and electrical equipment.
- Hypochlorite required for RAS chlorination would have to be anticipated well in advance (6 days) in order to generate enough hypochlorite to address 2 days of demand.
- Offsite drinking water point uses could be impacted by the larger fluid volume of the low strength hypochlorite.

Chlorine Degradation

Delivered chlorine degrades at different rates depending on the batch and temperature. It is generally recommended to retain less than 15 days of storage during warm weather. Onsite generation is a low concentration hypochlorite solution with minimal degradation.

Present Worth Analysis

Table 2 provides the relevant project factors used in the present worth analysis. Table 3 summarizes the present worth analysis used to evaluate the hypochlorite storage alternatives.

TABLE 2
Present Worth Analysis Approach
City of Bend Water Reclamation Facility

Factors	Unit	Value
Power cost	\$/kWh	\$0.041
Labor cost	\$/hour	50
Inflation	Annual %	Not used
Discount rate	Annual %	1%
Time length	Years	20

kWh = kilowatt-hour.

TABLE 3
 Present Worth Analysis—Hypochlorite Storage
City of Bend Water Reclamation Facility

	Alternative 1 Mini-Bulk Storage Tanks	Alternative 2 Onsite Hypochlorite Generation
Capital cost (generation system storage only)	\$641,000	\$1,357,000
Present worth of O&M	\$1,000,000	\$513,000
Total net present worth	\$1,641,000	\$1,870,000

Notes:

Cost for generation calculated using 3 lb salt/lb Cl₂ and 2 kWh/lb Cl₂.

Recommendations

The present worth analysis indicates similar costs for the two alternatives. The analysis indicates that mini-bulk storage is the least cost alternative.

Appendixes

Appendix A—Vendor Catalog Cuts

- ClorTec Onsite Hypochlorite Generation System
- Process Solutions, Inc. Onsite Hypochlorite Generation System
- Wallace and Tiernan Onsite Hypochlorite Generation System

Appendix A—Vendor Catalog Cuts

ClorTec™

Skid Mounted On-Site Sodium Hypochlorite Generation Systems

Midsize systems for 75 to 300 lb/day (34 to 136 kg/day)

Severn Trent Services offers the ClorTec™ On-site Hypochlorite Generating Systems, that easily produce 0.8% sodium hypochlorite by combining three common consumables: salt, water and electricity, to provide a powerful disinfection method for any application; food and beverage, potable water, wastewater, odor and corrosion control, cooling towers, oxidation and swimming pool disinfection.

The ClorTec systems are skid mounted and consist of electrolytic cell(s), power supply/rectifier, control panel/PLC, water softener, brine proportioning pump, hydrogen dilution blower and an optional water chiller/heater, all in one compact unit design conducive to easy installation and start-up. The simple-to-install skid-mounted systems can be fully operational and generating hypochlorite in less than 24 hours.

Features:

- ◆ Compact, skid-mounted system
- ◆ Hypochlorite produced on-site, on demand
- ◆ Superior Warranty
- ◆ NSF 61, ETV certification
- ◆ Eliminates need to store hazardous chemicals onsite
- ◆ Eliminates handling and transportation of hazardous materials



Benefits:

- ◆ Eliminates dependence on chemical suppliers
- ◆ Easy to install and operate
- ◆ Reduced disinfection by-product formation
- ◆ Improved water quality
- ◆ On-demand sodium hypochlorite production
- ◆ Reduced maintenance
- ◆ Exempt from Process Safety Management
- ◆ Exempt from Risk Management Planning



Severn Trent Services

2660 Columbia Street

Torrance, CA 90503

Tel 310 618 9700

Toll Free 800 524 6542

Fax 310 618 1384

info@severntrentservices.com

www.severntrentservices.com

SYSTEM SPECIFICATIONS

Capacities: 75-300 lb/day (34-136 kg/day). Free available chlorine.

Control: Automatic batch, regulated by storage tank status.

Hypochlorite: 0.8% ± 0.05%.

Raw Materials: Per pound of chlorine produced 3 lbs. salt, 2 kwh (DC), 15 gal. (57 L) water.

Water Supply: Potable water @20-50 psi (1.4-3.5 bar) temperature range 65°F-80°F (18°C-27°C).

Salt Quality: 99.7% pure dry weight Morton White Crystal or equivalent.

Electrical Power: 480 VAC 3 Ø, 60 Hz to rectifier, 240 VAC 1 Ø phase 60 Hz to controls. (Other voltages available as an option)

Control Panel: Grey polyester coated NEMA 12 welded steel enclosure.

Operator Interface: Standard: LCD touchscreen

Optional: Color LCD touchscreen industrial computer with data logging and communications capability.

Programmable Logic Controller: Expandable from 8 to 32 discrete I/O channels, 4 to 16 analog inputs and 2 to 8 analog outputs.

Full custom integration available.

Salt Dissolver: HDPE or FRP tank to store minimum of 1 weeks salt supply. (lb/day x 3 x 7 days min).

SODIUM HYPOCHLORITE TANK

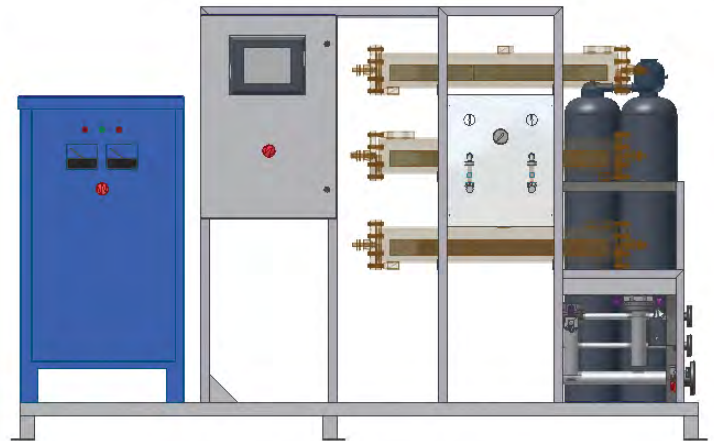
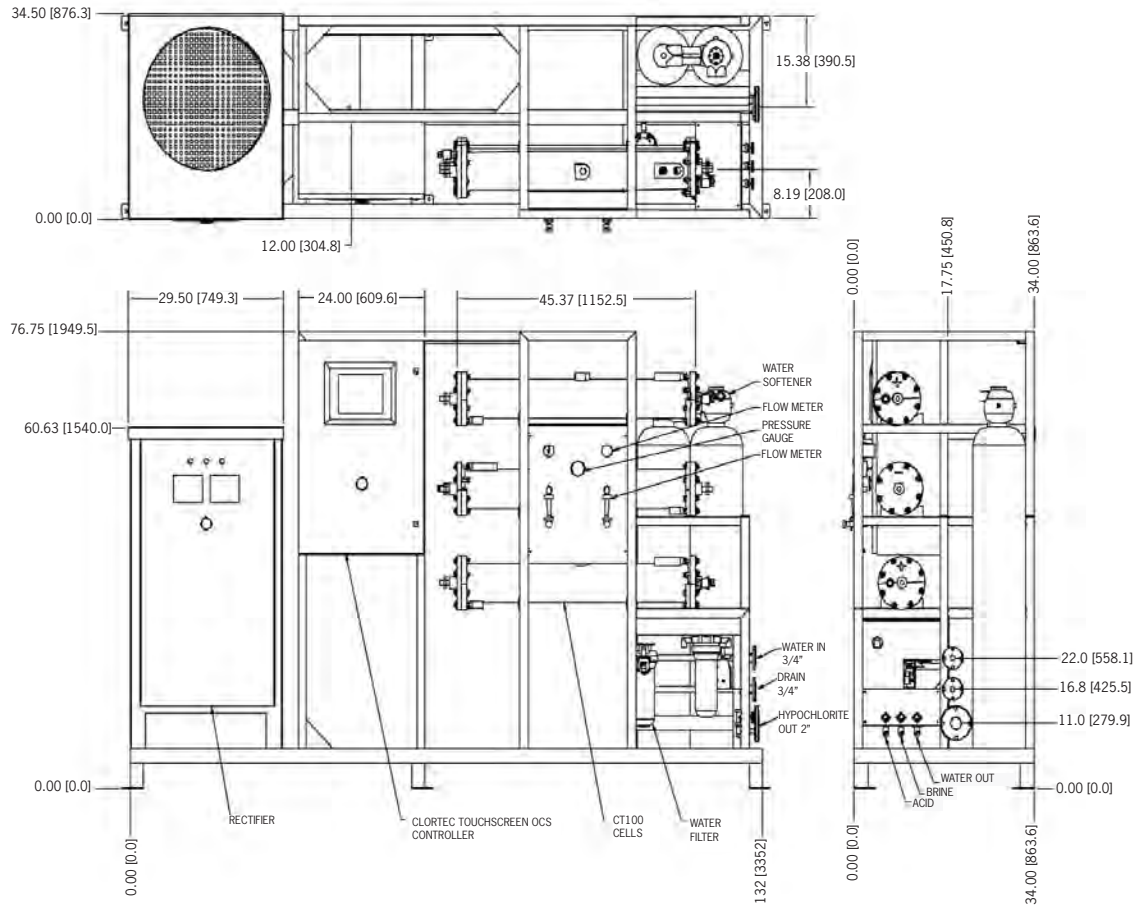
Material: HDXLPE or equivalent
Size: Two days storage recommended (lb/day x 15 gal x 2)

Level Control: Ultrasonic or Mechanical level sensor in tank controls start/stop function of system.

Hydrogen Vent: Waste hydrogen is vented to atmosphere by an active air dilution blower system.

Optional Water Chiller: Air cooled design. Classified by Underwriters Laboratories in accordance with ANSI/NSF 61, 1997b.

Optional Water Heater: UL® and CSA recognized and listed unitized assembly.

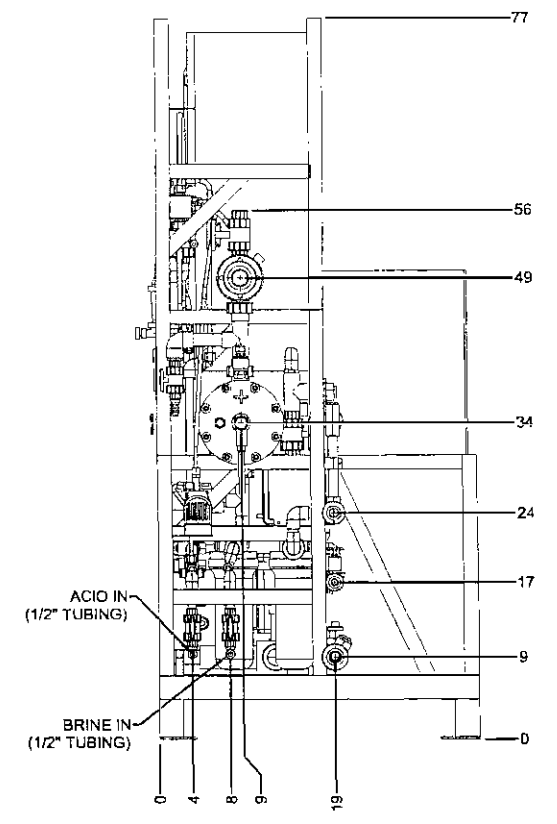
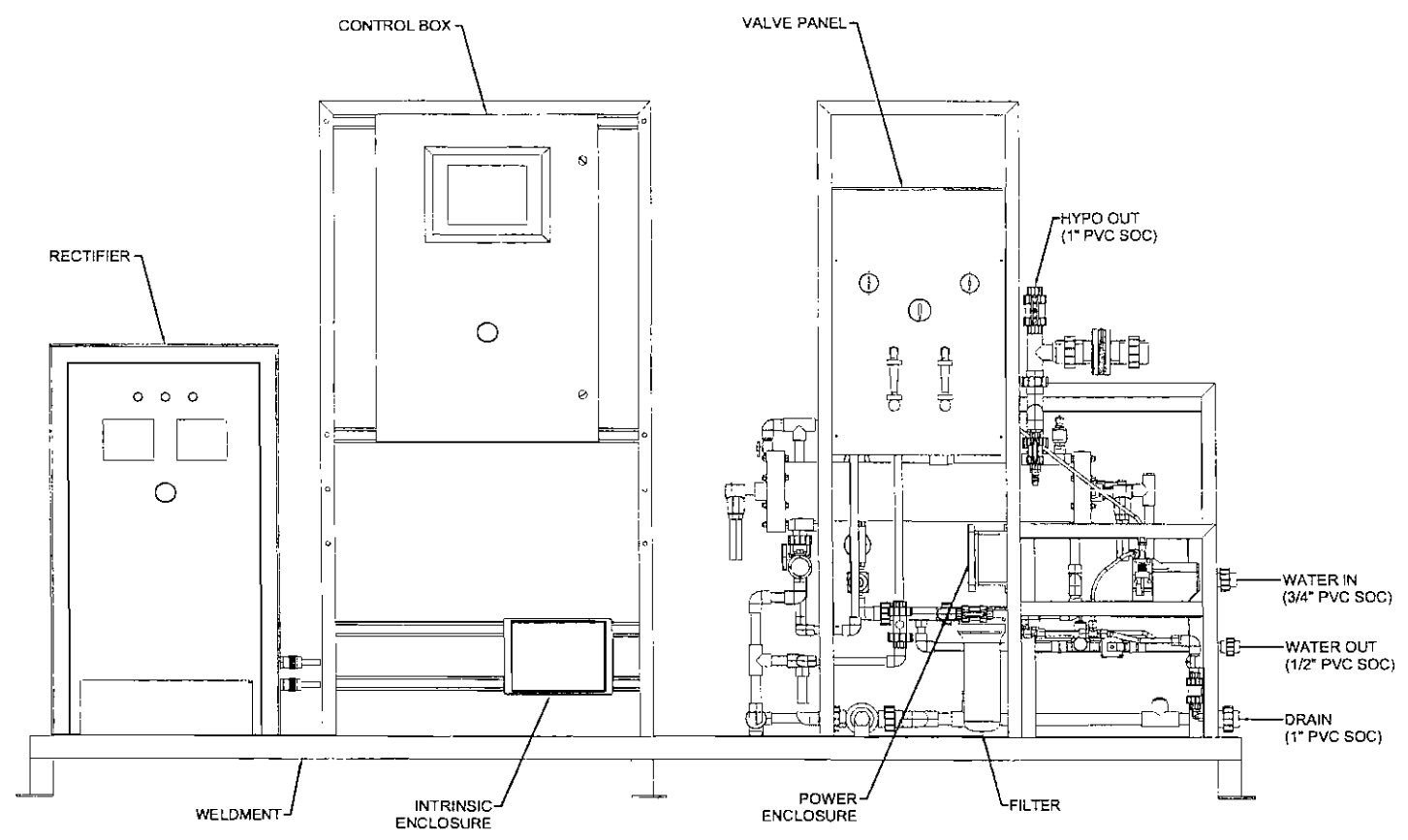
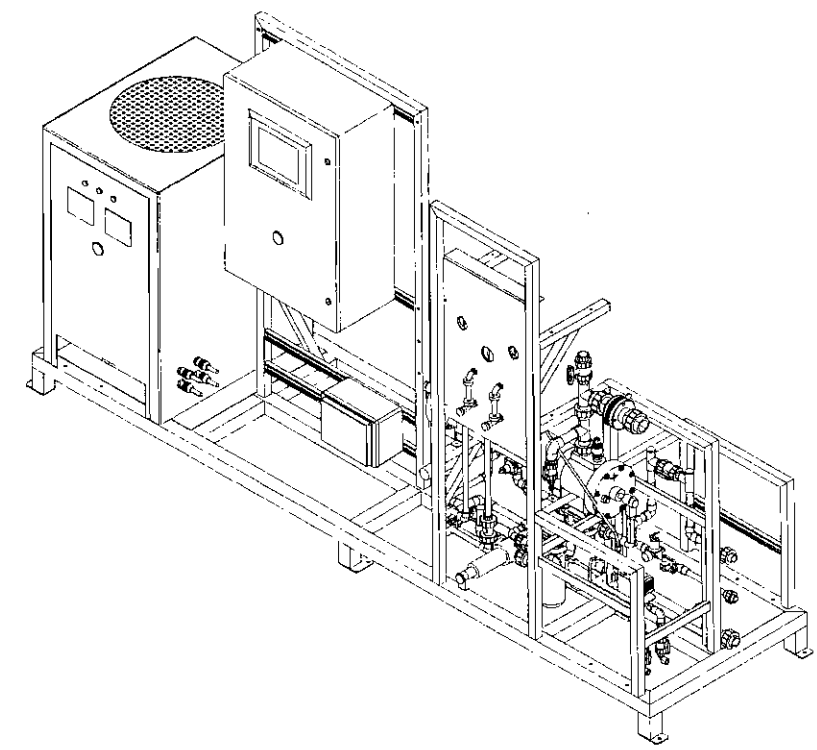
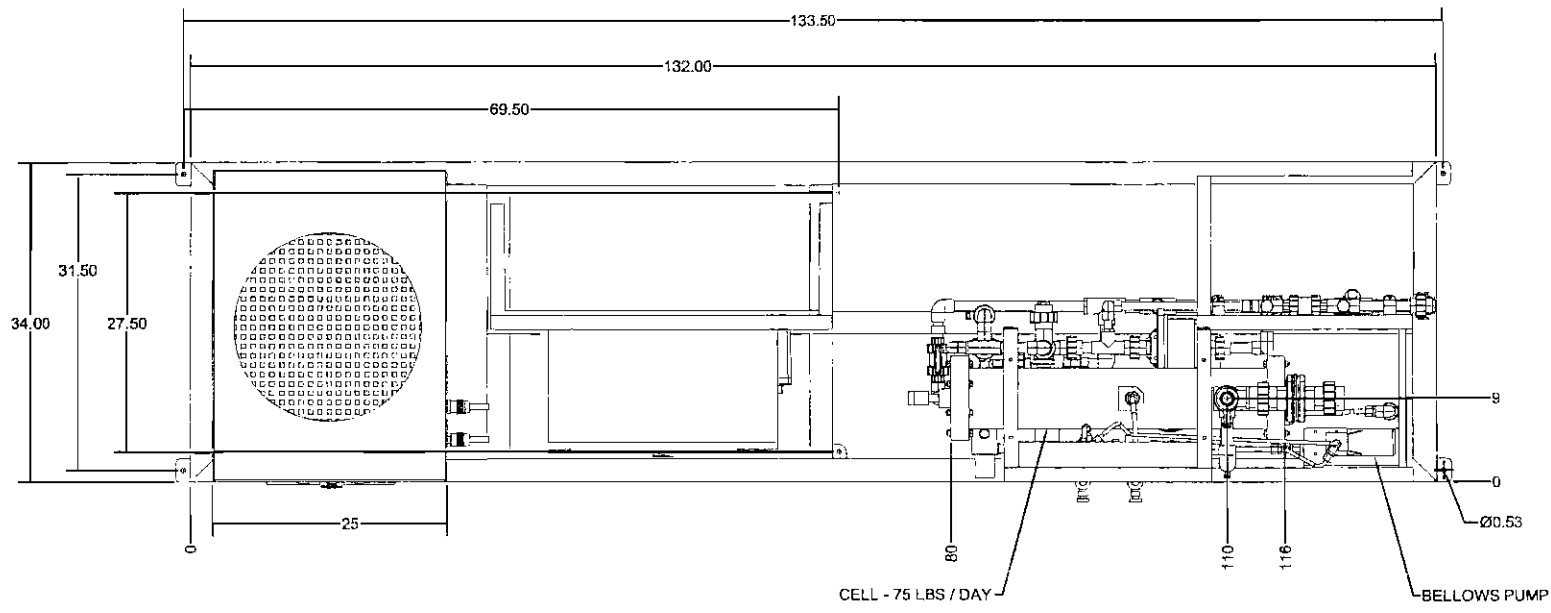


Model	Cell Configuration	Output		Flow		Water		Salt		Power DC/kWh/day	AC Amp 480 V 3 Ø Draw	Circuit Capacity
		lb/day	kg/day	gal/hr	L/hr	gal/day	L/day	lb/day	kg/day			
CT-75	1 x 75	75	34	47	177	1,125	4,258	225	102	150	15	20
CT-100	1 x 100	100	45	63	237	1,500	5,676	300	136	200	20	30
CT-150	2 x 75	150	68	94	355	2,250	8,516	450	204	300	30	40
CT-200	2 x 100	200	91	125	473	3,000	11,355	600	272	400	40	60
CT-225	3 x 75	225	102	141	532	3,375	12,774	675	306	450	45	70
CT-300	3 x 100	300	136	188	710	4,500	17,033	900	408	600	60	90

* Ready for use containerized packages available.

Use of the ETV Name or Logo does not imply approval or certification of this product nor does it make any explicit or implied warranties or guarantees as to product performance.

REV	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	APPROVED BY
01	1.13.06	ISSUED FOR APPROVAL	BCW	JPM	JPM



ITEM	QTY	DESCRIPTION	VENDOR
1	1	PANEL, VALVE, SS, CT75 -CT300	CLORTEC
2	2	BRACKET, FILTER ASSY	CLORTEC
3	1	BRACKET, BELLOWS PUMP	CLORTEC
4	2	SADDLE, CELL 100	EXCELTEC #CT3-0356
5	1	SOLENOID VALVE, 1/2"	BC VALVE #2108X-402CN-A210-DC
6	1	SOLENOID VALVE, 3/4"	BC VALVE #2108X-482CN-A210-DC
7	2	FLOWMETER, 0.1-1 GPM	BLUEWHITE #F-44375LKEA-B
8	1	SWITCH, FLOW, 150PSI, 1"	DWYER # FLOTEC V8
9	1	VALVE, BALL, TU, MTM, 1", PVC, SCH 80	G. FISCHER #800.016.011
10	2	FLOW SENSOR, PP, 1/2", 0-10VDC, 0.1-1	GEMS #170290
11	1	PUMP, BELLOWS, 45 rpm 115 v	GRI #16001-002 H8 F9 T7
12	1	GAUGE, PRESS, SS, 0-80, 2 1/2, 1/4 NPT, LBM	JENSEN INSTR #P552L-153104
13	1	RUPTURE DISK, 1 1/2", 35 PSI	OSECO
14	1	VALVE, PRESSURE RELIEF, 1"	PLAST-O-MATIC #RVD100V-PV
15	1	SWITCH, PRESSURE, 1/2"	PLAST-O-MATIC #SWT050T-3A-PV
16	2	GASKET, RUPTURE DISK, 1 1/2"	RYAN HERCO #3867-005
17	2	HOUSING, FILTER, CLR, 3/4" NPT, 10" LG	PENTAIR #150436
18	1	VALVE, LABCOCK, 1/4", KIT, PVC	SPEARS #1539-002
19	3	VALVE, CHECK, 1/2", PVC, SCH 80	SPEARS #2239-005
20	4	VALVE, BALL, TU, 1/2", PVC, SCH 80	SPEARS #3639-005
21	3	VALVE, BALL, TU, 3/4", PVC, SCH 80	SPEARS #3639-007
22	1	VALVE, BALL, TU, 1", PVC, SCH 80	SPEARS #3639-010
23	1	VALVE, PRESSURE REGULATOR, 3/4"	WATTS # N35BU
24	1	REGULATOR, PRESSURE, 1/2"	WATTS #263AB
25	1	GAUGE, PRESS, SS, 0-160, 1 5/8, 1/4 NPT, BM	WIKA #4233395

SEVERN TRENT SERVICES **CLORTEC**

3800 Chesapeake Blvd., Toronto, Ontario M9W 6L9 (416) 491-8100
 Fax: (416) 491-8238 www.severntrentservices.com

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DO NOT SCALE DRAWING

CT75 (75LBS/DAY) ON SITE HYPOCHLORITE GENERATOR
SKID ASSY, 132"Wx34"Dx77"H

Drawn by: DWorsley	Date: 1/13/2006	Checked by: []	Scale: []	Project: CTSA-75-01	Sheet: 01
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ClorTec®

CASE STUDY

“Exactly as Advertised”: On-site System Increases Safety, Reduces Costs

Sodium hypochlorite disinfection

The City of Gastonia, N.C., water treatment plant was constructed in 1922 near what is now the center of the city. Gastonia, a city of 70,000 residents, is located 20 miles west of Charlotte in the state’s southern Piedmont region. Its 25.2-mgd water treatment facility uses a traditional disinfection / coagulation / flocculation / sedimentation / filtration process to treat surface water drawn from Mountain Island Lake. The man-made lake is fed by the Catawba River and is the primary source of drinking water for residents of Gaston County.

Using gaseous chlorine for disinfection at the water treatment facility, the City had developed an efficient evacuation plan in the event of a large scale gas leak as required by its USEPA risk management plan. However, in the 1990s a three-story courthouse, a jail and a social services building were built near the plant, with the jail and courthouse adjacent to the chlorine storage building. With an evacuation plan now affecting thousands of residents — including inmates — rather than just hundreds, the City knew it was time to either move the plant or change disinfection methods.

For more information on ClorTec® on-site sodium hypochlorite generation systems visit www.severntrentservices.com



UNDERSTANDING
A VALUABLE RESOURCE



WE UNDERSTAND

SODIUM HYPOCHLORITE GENERATION

Considering the switch from gaseous chlorine

Even before the construction of the courthouse, jail and social services building, the City's public works and utilities department had been considering a switch to an alternative means of disinfection. And when the 9/11 terrorist attacks took place in 2001, increasing awareness of the potential hazard of transportation and storage of high-pressure chlorine cylinders, the City redoubled its efforts to secure funding for the disinfection switch over. With funding finally assured in 2007, the City began investigating two alternatives: bulk sodium hypochlorite and on-site sodium hypochlorite generation.

"Under the direction of our design engineer, CDM (Charlotte), we performed a fairly sophisticated analysis using different price points for the cost of bulk sodium hypochlorite," said Ed Cross, division manager, water supply and treatment for the City of Gastonia. "At the time of the analysis, the cost of bulk was relatively low — but now costs have risen again. The operational considerations were significant, too. With on-site generation, a shipment of salt would be delivered every six weeks affording uninterrupted service in between. However, with bulk, shipments would be received every few days. The frequency of shipments would have required a lot of extra labor to coordinate and physically handle the incoming material."

An additional benefit of on-site generation over the use of bulk sodium hypochlorite is that because the unit produces sodium hypochlorite on demand, the technology alleviates the problem of chlorate by-product generation that typically results from the storage of bulk material.

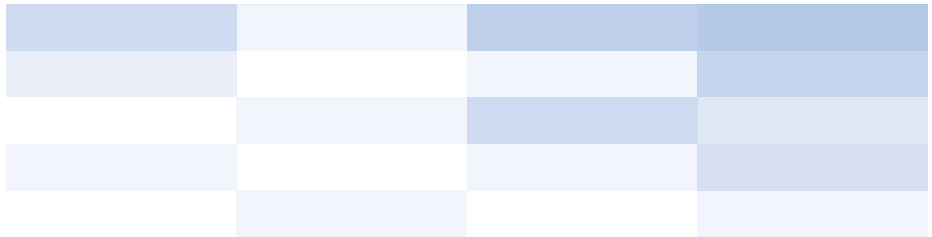
After analyzing the two disinfection methods, Laurin Kennedy PE, CDM's principal design engineer on the project, recommended the selection of the ClorTec® on-site sodium hypochlorite generating system from Severn Trent Services. Two 750-lb generating units were installed in January 2010 along with four 12,500-gallon storage tanks. The equipment was provided by Premier Water in Charlotte. Max Foster, the company's sales representative who worked with the City, also provided timely technical information and support.

The ClorTec technology came highly recommended by another local water utility. The City of Hickory, N.C., had installed the state's first ClorTec system in 2003, and the system has provided ongoing operational efficiencies with low, predictable maintenance, increased safety and demonstrable cost savings. "When we checked with other water utilities using various on-site systems, the ClorTec system had the best reputation and history of long-term performance," Cross said.

Advantages of on-site generation

The use of on-site sodium hypochlorite generation offers several advantages over gaseous chlorine for disinfection. The disinfectant is produced and stored in liquid form. Therefore, there is no danger of leaks from chlorine gas cylinders. It is also not necessary for facilities using on-site sodium hypochlorite generating systems to develop and maintain a risk management plan. HAZMAT training is not required for handling the disinfectant; nor is there any need for the use of self-contained breathing apparatuses. In addition, on-site sodium hypochlorite disinfection systems do not suppress finished water pH to the extent that gaseous chlorine disinfection does. Therefore, the amount of pH adjustment chemical (i.e., lime or caustic) necessary before distribution of finished water is reduced.

The on-site generation process is simple, as three common consumables are used in sodium hypochlorite generation: salt, water and electricity. The system operates by feeding softened water into a brine dissolver. The salt dissolves to form a brine solution, which is further diluted to the desired salt solution and then passed through electrolytic cells. The cells apply a low-voltage DC current to the brine to produce the sodium hypochlorite. The solution is then safely stored in two of the 12,500-gal storage tanks. When it reaches the low-level set point, the system automatically restarts to replenish its supply. The 0.8 percent sodium hypochlorite solution is non-hazardous; the only by-product is hydrogen gas, which is safely vented to the atmosphere.

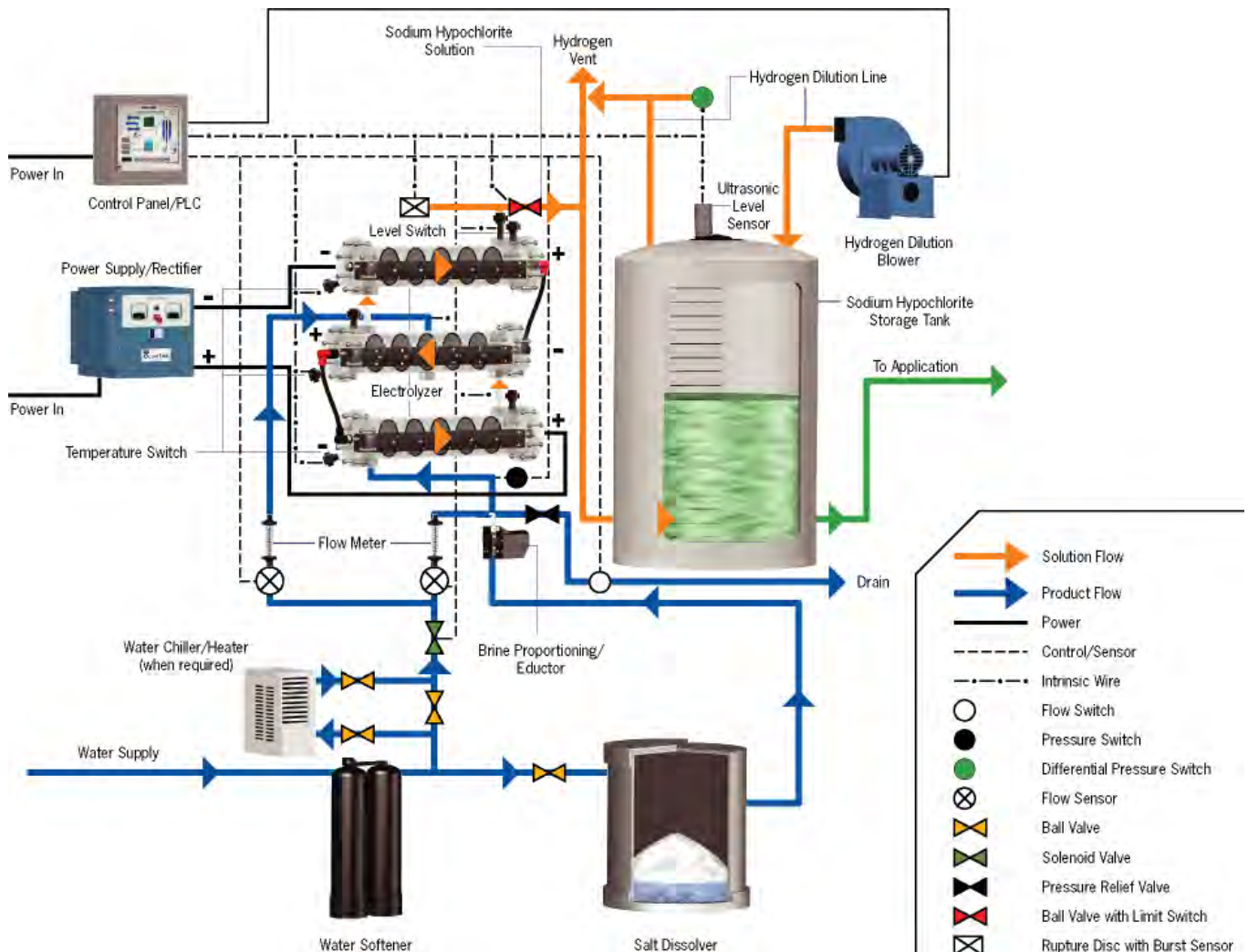


Safety of on-site generation

“From the beginning, safety was the driving force behind eliminating the use of gaseous chlorine at our facility” said Cross. “When the chlorine gas cylinders were being hauled away, we were jumping for joy. Choosing on-site generation for our disinfection needs was in line with our safety requirements and the switch provided us with cost savings, too. When we applied for deregistration from our risk management plan and no longer had to perform HAZMAT training, we realized how significant the savings were. We haven’t completed

a full cost analysis yet, but we are certain the ClorTec system is providing long-term savings. We have also been impressed with the intuitiveness of the system’s software package too. When there is an operational issue, the system tells you what’s wrong, and our staff has been able to handle every maintenance issue. The system has performed exactly as advertised, and that’s a testament to the technology and to the Severn Trent Services sales and technical team.”

ClorTec® PROCESS DIAGRAM



MICROCLOR

The Next Generation

It is well known that chlorine is a powerful disinfectant used in water treatment and plays a vital role in controlling bacteria and viruses that can cause human illness.

More stringent regulations for transportation and storage of bulk chlorine or pressurized chlorine gas have required many to search for alternative methods of disinfection.

Onsite generation of sodium hypochlorite alleviates the safety concerns associated with storing and using bulk sodium hypochlorite or chlorine gas.



300 PPD

Systems Capable of 20 to 3600 Pounds
per Day Chlorine Equivalent

The MicroClor vertical cell array (V-Ray) allows for the instantaneous passive removal of all hydrogen produced.

Making Bleach Made Easy

- Low Cost Hypochlorite
- Enhanced Performance
- Small Footprint
- 24 Hour Service
- Safe
- Vertical V-Ray Cell Design
- Immediate Hydrogen Removal
- Reduce Scaling
- Low Maintenance

V-Ray
Technology

MICROCLOR



40 PPD

The state of the art patent pending MicOclor onsite hypochlorite generation system is a brand new design built upon twenty years of dedicated research and development in the field of onsite hypochlorite generation.

The design incorporates all of the advantages of current industry standards while radically improving all safety aspects of the process. Specifically, the manner in which hydrogen is removed from the electrolytic cell is a huge improvement over more conventional horizontal tubular designs.

The MICROCLOR onsite hypochlorite generation system incorporates a multitude of unique features that are now patent pending. The most significant features are as follows:

1. Passive hydrogen removal.
2. Brine conductivity control.
3. Full wave D.C. rectification.
4. No cell electrode penetrations.
5. High velocity electrolyte flow.
6. Higher performance level.
7. Recirculating cell loop.
8. No internal cell baffles or gasketing.

There is no other onsite hypochlorite system in the marketplace today that possesses even one of the above advantages, no less all eight.

A brief discussion of each feature follows:

Passive Hydrogen Removal

The V-Ray cells are configured in a vertical format with a recirculation loop on each cell that allows for optimized brine utilization and passive release of the hydrogen gas from each cell. Hydrogen gas is not allowed to pass from cell to cell. This design radically increases operator safety and substantially reduces the possibility of hydrogen gas build-up in the cell and the potential of catastrophic failure. Immediate hydrogen removal at the top of each cell loop greatly reduces electrode blinding and associated heat buildup.

Brine Conductivity Control

Constant current is achieved via a current feedback loop where the brine pump speed is controlled by the system programmable logic controller. This feedback loop accounts for variations in temperature, conductivity and water flow. The titanium, Teflon impregnated gear pump is attached to a variable speed drive that continually provides a consistent blended electrolyte flow to the cells maximizing salt efficiency.

Full Wave D.C. Rectification

The DC Rectifier design consists of a fully isolated step-down transformer and bridge rectifier. DC voltage is fixed with primary taps for + 5, 10% voltage correction. DC ripple is less than 4.0% with a power factor of 99% or better. Switching rectifier or phase angle fired SCR voltage correction technology is not utilized as this twenty year old technology has an excessively high failure rate.

No Cell Electrode Penetrations

The V-Ray cells consist of thirteen internal bipolar electrodes while the cell outer plates serve as both terminating anode and cathode. All anodic surfaces are coated with DSA catalytic coating. The design of the cell precludes the need for wet D.C. cable connections or problematic O-ring seals.

High Velocity Electrolyte Flow

The passive hydrogen gas removal provides a hydraulic lift within the V-Ray cell loop which causes a high velocity flow through the recirculation loop and across the V-Ray cell plates. This high velocity flow results in a scouring action between the vertically mounted V-Ray cell plates. This novel self cleaning feature virtually eliminates the need for acid cleaning of the electrolytic cells and reduces heat build up.

Higher Performance Level

PSI's proprietary patent pending vertical V-Ray cell design provides for a far more efficient generation platform than the industry standard of 3.5 pounds salt and 2.5 KWH per pound chlorine equivalent.

The MICROCLOR vertical V-Ray cell produces hypochlorite at 0.8% while consuming less than 3 pounds of salt and 2.0 AC KWH per pound of equivalent chlorine.

There is no competitive open cell process available which is more efficient than the MICROCLOR System.

PSI welcomes a side by side comparison with any manufacturer claiming higher performance levels than MICROCLOR.

No Internal Cell Baffles or Gasketing

There are no internal cell baffles, gaskets or fasteners found inside the cell. The cells are built with clear acrylic guides that support the internal bi-polar plates that allows for direct visual inspection of the plates. Anode and Cathode mono-polar plates are surface mounted to the outside of the acrylic guides.

V-Ray Cell maintenance and replacement

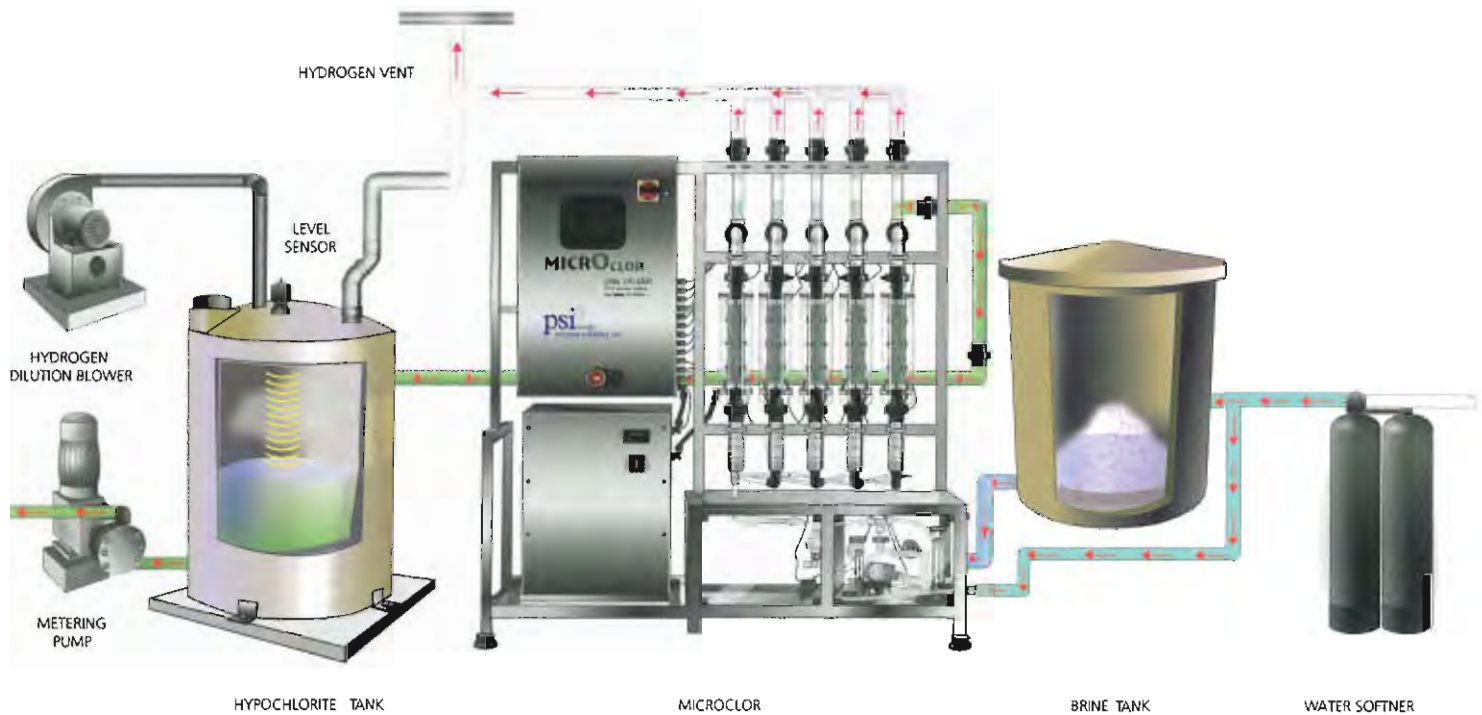
The MicOclor vertical V-Ray cell design allows for the cell to easily be removed from the cell carrier piping by simply breaking two unions. This makes for simple cell maintenance and or replacement.

The MicOclor design has taken into account every imaginable failure scenario including direct operator error in the handling of the process equipment.

Sequential operations logic is provided for all process variables where the change from standby to process is confirmed for all sensor locations at each start sequence. This auto diagnostic routine locks out generation in the event of sensor failure or electrical bypass.

MicOclor hypochlorite systems meet requirements for 20 to 3600 pounds per day chlorine equivalent.

The Next Generation Onsite Hypochlorite Generator



The MicroOclor is modular in design and based on standard components. These components may be customized to meet a wide range of requirements.

Standard components for the MicroOclor system include:

- Stainless Steel Skid Assembly
- Water Softener
- Brine Tank
- Brine Pump
- Electrolytic Cells
- Skid mounted PLC Control Panel
- D.C. Rectifier
- Hypochlorite Storage Tank
- Hypochlorite Metering Pump
- Hydrogen Dilution Blower

Model/Capacity	Cell Size W X H	# of Cells	H2O GPM	Brine GPM	DC Amps	KVA	FLA 208/240 1PH	FLA 480 3 PH
20	2 x 12	1	0.2	0.02	40	2.4	11.5/11	-
40	2 x 12	2	0.4	0.03	80	4.8	23/22	-
60	2 x 12	3	0.6	0.05	120	7.2	35/33.5	-
80	2 x 12	4	0.8	0.07	160	9.6	46/44	13
100	2 x 12	5	1	0.08	40	12	-	16
200	4 x 12	5	2	0.17	80	24	-	32
300	6 x 12	5	3	0.25	120	36	-	48
600	12 x 12	5	6	0.50	240	72	-	96
900	18 x 12	5	9	0.75	320	96	-	128
1200	24 x 12	5	12	1.00	480	144	-	192
1800	24 x 18	5	18	1.50	720	216	-	288

Note: Typical Nominal Operating Amperage is 75% of Full Load Amperage

Capacities: 20-3600 pounds per day free available chlorine.
 Control: Automatic, regulated by storage tank level.
 Percentage Sodium Hypochlorite: 0.8 ± 0.05
 Consumables per pound of chlorine produced:
 3lbs salt, 2KWH (AC), 15 gallons water.
 Water Input: Potable water, 30-80 PSI, 40°F-80°F (5°C-27°C)
 Salt: 99.7% pure dry weight Morton White Crystal or equivalent.

Power: 20-80ppd systems - 208V or 240V AC, 1PH, 60HZ
 80-1800ppd systems- 480V, 3PH, 60HZ
 Control Cabinet: 304 stainless steel NEMA 4X
 Operator Interface: 6" Color Touchscreen
 Programmable Logic Controller: Allen Bradley 1200
 Brine Tank & Hypochlorite Storage Tank shall be appropriately sized for each application.



MICROCLOR

The Next Generation

Comprehensive Warranty

It is our policy to provide every customer with a state of the art, fully tested system. Each MicroClor Hypochlorite Generation System carries a full three-year support agreement covering all parts and labor. In addition, the electrolytic cells and cell housings are warranted on a prorated basis for years 4-7.

Service & Support

PSI prides itself on our service and technical support. We offer complete support for your MicroClor Hypochlorite Generation System including all peripheral components. 24-7 phone support and next day parts are available for your MICROCLOR System. PSI guarantees next day field service, 7 days a week, with technicians located in all major markets plus an extensive factory trained representative network. If you need assistance, we're here to help.



1200 PPD

Represented by:



WATER AND WASTEWATER TREATMENT TECHNOLOGIES

1077 Dell Avenue, Suite A, Campbell, CA 95008

Toll Free: (888) 774 4536 (PSI Help)

Telephone: (408) 370-6540 Fax: (408) 866-4660

Email: mail@4psi.net www.4psi.net

with offices in Clearwater, FL, Mesa, AZ, and Temecula, CA.

Wallace & Tiernan® On-Site Hypochlorite Generation System

OSEC® B1-200 System

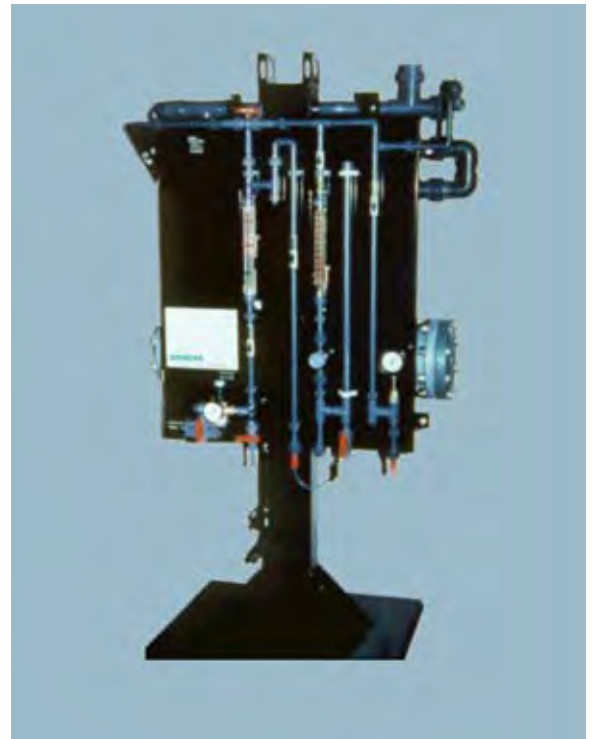
OSEC® Systems provide for on-site, on-demand production of sodium hypochlorite solution from salt, water, and electricity. This eliminates dependence on commercial chlorine suppliers and the problems inherent in the transport and handling of bulk hypochlorite. Additionally, OSEC® Systems can significantly lower operating costs, as well as disinfection by-products compared to the use of bulk hypochlorite. Operation is completely automatic, making the B1-200 system ideally suited for remote or unmanned locations.

System Components

The B1-200 OSEC® System can produce up to 113 kgs (250 lbs) per day of equivalent chlorine. The system includes all of the components to automatically generate sodium hypochlorite. This includes a salt saturator, water softener (if required), electrolyzer, transformer/rectifier, product storage tank and system control panel. To complete the disinfection process, Siemens Water Technologies offers a complete line of chemical metering pumps and packages to deliver the sodium hypochlorite to the point of application. Continuous, on-line residual analyzers for both free and total chlorine are available to measure chlorine levels in the treated water and compound-loop controllers to maintain the desired disinfectant level regardless of flow or water quality changes.

Key Benefits

- Economical, reliable, low maintenance operation
- Automatic, on demand production of sodium hypochlorite
- Major components mounted and pre-piped on a common pedestal
- Flexible installation configurations
- Positive Hydrogen gas dilution and removal



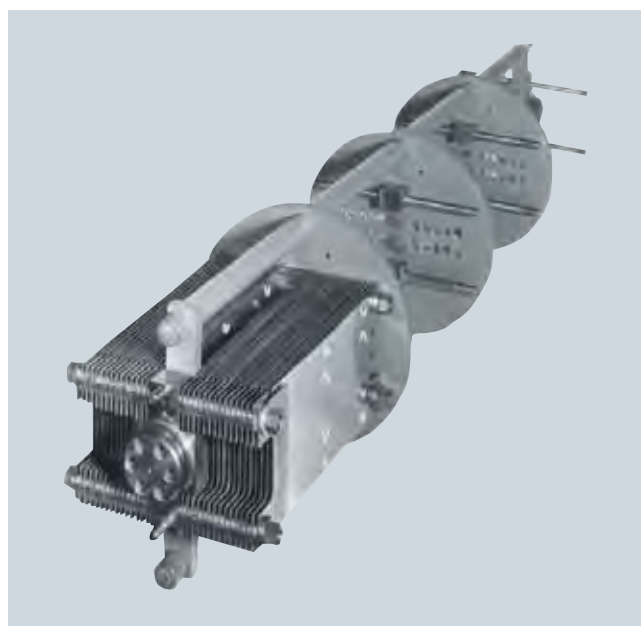
Product Sheet

Generator

The key component in any on-site electrochlorination system is the electrolyzer. This is where the salt or brine solution, water and power are combined to produce sodium hypochlorite. This critical function requires the latest anode technology and electrolyzer design to achieve consistent, reliable operation with efficient use of power and salt. As specialists in anode technology, Siemens Water Technologies maintains a complete "in-house" R & D facility for custom anode design, testing and evaluation of the optimum performance requirements for any application. In addition, a complete anode fabrication plant produces the OSEC® anodes in every configuration and size. Combined with the cell manufacturing and assembly expertise, Siemens offers complete system responsibility without the need to rely on sub-vendors for critical components.

The B1-200 OSEC® System consists of a single tubular electrolyzer casing, mounted on a sturdy, freestanding pedestal. This casing houses a titanium chassis to which the anodes and cathodes are fixed in a configuration that ensures maximum operational efficiency by providing simple, single-pass flow operation. The anodes are DSA-type and manufactured from a titanium substrate with a precious metal oxide coating. The cathodes are fitted with PVDF spacers that maintain a critical, uniform distance from the anode. The electrolyzer contains four cells electrically connected in series, containing sufficient anodes and cathodes to produce the desired quantity of chlorine 97 or 113 kgs/day (215 or 250 lbs/day.)

The internal electrolyzer design and vertical orientation of the anode and cathode plates provide for the quick removal of hydrogen from the inter electrode gap to ensure maximum efficiency. The partition discs have gas ports that pass the hydrogen through the compartments. Baffling effectively eliminates mixing between cells, thereby reducing competing electrochemical reactions. This design provides an efficient release of hydrogen, which results in electrical power and salt savings.



OSEC® Systems include a number of design features, which optimize operating efficiency, including:

Heat Exchanger

Reaction efficiency is greatly affected by the operating water temperature. Systems operating with incoming water temperatures below 7.2°C (45° F) often require electrically powered pre-heaters to elevate the water temperature to optimal conditions. OSEC® generators are offered with a heat exchanger, which is integrally mounted to the generator assembly. The optional heat exchanger uses the hypochlorite solution exiting the generator, which has been elevated in temperature due to the heat of reaction of the generation process, to heat the incoming cold water. When conditions dictate, the heat exchanger can be valved in service to allow the cold water to be heated in a counter-flow exchange manner with the warmer outlet solution. The use of the heat exchanger in typical installations results in a 2.8°C (5° F) increase in incoming water temperature, without any electric power consumption. With the piping manifold supplied, the heat exchanger can be bypassed during warm-season operation.

Split Flow Regime

OSEC® B-Series Generators employ a split-flow arrangement to further optimize overall process efficiency. The incoming dilution water is split into two streams before entering the electrolyzer. This provides a favorable brine concentration and enhanced operating temperature in the first cells allowing it to operate more efficiently. The rest of the cool dilution water is added to the downstream cells, which serve to maintain the operating temperature within the most efficient range, and achieves the final product concentration.

To maintain proper conditions for safe and efficient operation, OSEC® generators include sensors for brine flow, water flow, and electrolyzer level and inlet and outlet temperatures.

Control Panel

For supervision and monitoring of the safe generation of sodium hypochlorite, the entire OSEC® System is automatically operated by a central PLC-based control panel. The control panel includes an HMI (Human/Machine Interface) with an LCD screen to allow for immediate visual indication of complete system status and parameters. Status indications include rectifier on, water supply on, blower running, brine pump on, electrolyte inlet and hypochlorite outlet temperature, and storage tank level. There is a comprehensive list of alarms including storage tank overflow, high electrolyte temperature, improper voltage, and low brine flow. Any alarm condition that affects the consistent production of sodium hypochlorite shuts the system down. A last-200-event logger tracks all operating conditions and maintains a record for troubleshooting.

Transformer / Rectifier

Power for the electrolysis of brine is provided by a solid-state controlled, force-air-cooled transformer/rectifier. This unit takes the incoming AC power and converts it to the 32-volt DC power required for the electrolysis process. The rectifier is self-monitoring for cell voltage, thermal overload and internal faults. An alarm contact interfaces with the OSEC® System control panel to maintain proper system operation.

Product Tank

The freshly produced sodium hypochlorite solution is stored in a totally enclosed FRP tank. Storage is generally provided for 24 hours of operation, although this can be increased or decreased depending on site conditions. Level probes or transducers in the tank provide start/stop control of the OSEC® System to maintain a continuous supply of hypochlorite. A primary air dilution blower and a complete redundant standby blower is provided to force ventilate the product storage tank to reduce the concentration of hydrogen gas in the tank and the gas discharged from the system vent to 25% of the LEL, which is 1% in air. A differential pressure switch monitors the operation of the blower. If a decrease in air flow is detected, the standby blower is activated. Unless airflow is maintained, the OSEC® System is shutdown to prevent the accumulation of hydrogen above the LEL.

Salt Saturator

The salt saturator creates the brine solution that feeds the OSEC® electrolyzer. The saturated brine tank is constructed from FRP and features an automatic level control system to maintain a constant liquid brine level. The brine solution is made by passing the make-up water through the salt bed forming a saturated brine solution, which is then fed by a brine dosing pump to the electrolyzer. The saturator is typically sized for 30 or more days production to ensure sufficient salt quantity to provide production continuity and economical refill cycles.

Softener

The make-up water used for the salt saturator and the feed water used for the dilution of the brine must have less than 17 mg/l of calcium hardness, otherwise operating efficiency and maintenance-free operation will be compromised. For water supplies exceeding this hardness limit, a water softener is required. The softener is a twin tank design with automatic changeover for regeneration. One tank is in service while the other is regenerating or in standby-mode to assure a continuous, uninterrupted supply of softened water.

Anode Warranty

The anodes are warranted for seven years (two full years and five years prorated). This warranty is based on installation and start-up provided that the correct operating conditions of the OSEC® System are maintained.

Technical Specifications

Capacity:

Two sizes available:
97 kgs/day (215 lbs/day) of chlorine equivalent
113 kg/day (250 lbs/day) of chlorine equivalent

Housing: Single 152.4 mm (6") casing, nominal diameter tube with PVC end flanges

Anodes: DSA type with precious metal oxide coating

Cathode Spacers: Surface-mounted PVDF bushings

Chassis: Titanium construction

Dilution Water Flowmeter: Variable-area flowmeter with integral, adjustable alarm proximity switch

Brine Water Flowmeter: Variable-area flowmeter with integral, adjustable alarm proximity switch

Salt Requirements: Common solar grade salt. Salt usage is approx. 3 kgs per kg (3 lbs per lb).

Supply Water Requirements: Max. water hardness not to exceed 17 mg/l of CaCO₃ at the electrolyzer inlet

Water Pressure: 1.9 bar (29 psi) min.; 4.96 bar (72 psi) max.

Electrolyzer Inlet Temperature: Min. 7.2°C (45°F); max. 26.7° C (80°F)

Electrical Requirements: Main Control Panel 120/230 V 1 phase or 230/460 V 3 phase; Transformer Rectifier 230/460 V 3 phase

Electrical Power Consumption: 2.0 kWh AC per lb. of Cl₂ per day

Hypochlorite Strength: 0.7% to 0.85% concentration by weight

Pipe Connections: Inlet Water ¾", Inlet Brine ½", Outlet Product 1½"

Brine Pump: Premia® 75 ME 38 (See WT.460.150.003.UA.PS)

Generator Dimensions: 1.5m x 0.7m x 2.0m (3'9" x 2'4" x 6'6")

Weight: 91 kgs (200 lbs)

Optional Equipment: Hydrogen Detector, Titrator, Acid Cleaning Kit, Integral Heat Exchanger

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TM 7 – Reuse System Improvements including UV

PREPARED FOR: Jim Wodrich, P.E./City of Bend

PREPARED BY: Gregg Thompson, P.E./CH2M HILL

REVIEWED BY: Dave Green, P.E./CH2M HILL
Brady Fuller, P.E./CH2M HILL
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DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum details the schematic design for the reuse system improvements including ultraviolet (UV) disinfection.

The Bend Water Reclamation Facility (WRF) currently uses gaseous chlorine and a chlorine contact basin to achieve disinfection for plant effluent and for Class A reuse water.

The Project Definition Report documents the following decisions:

- Primary disinfection of the Class A reuse water will be provided by in-vessel UV disinfection.
- Secondary disinfection (and maintenance of a chlorine residual) will be provided by sodium hypochlorite.

Design Criteria

Table 1 lists the design criteria for the disinfection and plant water (PW) systems.

The UV system will be at-grade and under a roof with no walls. The electrical room will be a block building with heating and ventilation. The design of the UV chamber and piping will accommodate draining of the pipelines during the winter or other idle periods. To control scaling, fouling, and algae growth, a chemical cleaning system will be integrated into the design of the UV system.

TABLE 1
 Disinfection and Plant Water System Design Criteria
City of Bend Water Reclamation Facility

Criterion	Unit	AAF
Ultraviolet (UV) disinfection		
Design flow	mgd	2.5
Peak flow	mgd	5.0
Water quality		
Chlorine dose for disinfection	mg/L as Cl ₂	
Chlorine residual for disinfection	mg/L as Cl ₂	2
Chlorine dose for reuse	mg/L as Cl ₂	4
Chlorine residual for reuse	mg/L as Cl ₂	2

AAF = Average Annual Flow.
 Cl₂ = chlorine.
 mg/L = milligrams per liter.
 MMF = Maximum Month Flow.
 psi = pounds per square inch.

Evaluations

The type of UV equipment was evaluated during Schematic Design. The evaluation is documented in *Fact Sheet 1 – Ultraviolet Disinfection: Low Pressure vs. Medium Pressure* (provided in Attachment C to this technical memorandum).

UV disinfection for reuse and plant effluent can be impacted by water quality characteristics. Potential fouling of UV systems was evaluated and documented in *Fact Sheet 2 – Fouling of Ultraviolet Disinfection* (also provided in Attachment C).

Ultraviolet Disinfection: Low Pressure High Output versus Medium Pressure High Output

Two UV system types were considered for the primary disinfection system for the Class A reuse:

- Low pressure high output in-vessel UV systems
- Medium pressure high output (MPHO) in-vessel UV systems

A medium pressure in-vessel UV system was determined to be the best equipment for this application based on present worth analysis and the compact size and fewer components of MPHO systems.

Fouling of Ultraviolet Disinfection

UV disinfection for reuse and plant effluent can be impacted by water quality characteristics. Ferric, alum, hardness, and polymers were reviewed for impact on the Bend WRF. Water hardness (due to the addition of the lime in the primary clarifier) will impact

UV disinfection. A chemical cleaning system should be included in the design to address concerns related to hardness fouling.

Process Description

The facility secondary expansion will include the addition of a UV disinfection system downstream of the reuse filters. The UV disinfection will provide primary disinfection for the Class A reuse system. Sodium hypochlorite will be added as a secondary disinfectant to provide a residual when the water is delivered to the reuse customer (currently Pronghorn golf course).

The primary measurements required for proper UV disinfection are the flow rate and the UV transmittance. Flow rate will be measured using the existing magnetic flow meters installed downstream of the low head reuse pumps in the reuse facility. Transmittance will be measured with a flow through UV transmittance element sampled between the reuse pumps and the UV chambers.

National Water Research Institute (NWRI) standards are commonly used to define testing and treatment requirements for reuse water. For this project, those standards will generally serve as a guideline for design and specification of the UV system.

Design Data

Table 2 contains the design data for reuse disinfection.

TABLE 2
Disinfection, Chemical Building, and Plant Water System Design Data
City of Bend Water Reclamation Facility

Process	Unit	Existing Facilities	Secondary Expansion (11.9 mgd)
UV Disinfection			
Type		Not applicable	MPHO
Trains	each		Two
Chambers per train	each		Two
Design flow	mgd		2.5
Peak flow	mgd		5.0
Hypochlorite metering pumps – reuse residual			
Units	each	Not applicable	Two
Type			Diaphragm
Capacity per unit	gph		2
Pressure at capacity	psi		30

gph = gallons per hour.
mgd = million gallons per day.

Reliability/Redundancy

The U.S. Environmental Protection Agency (EPA) classifies wastewater treatment plants into three levels of system reliability. EPA standards do not apply to the reuse system at the Bend WRF since the system can be taken offline during power failures and mechanical failures. All flow would then be routed through the plant effluent disinfection system, which is designed to meet the EPA standards for reliability.

The reuse disinfection system is sized to disinfect the design flow with a single chamber out of service. No backup power will be provided for the reuse systems because the current power reliability meets the service standard. No installed redundancy will be provided for the master UV controller. An uninterrupted power supply will be provided for the programmable logic controller.

For hypochlorite metering pumps, a swing pump will be provided to dose chlorine to either the plant effluent or W4 reuse water. The metering pumps will be sized to meet the peak flow requirement with two pumps.

Instrumentation and Control Strategy

W3 Reuse Water Disinfection (UV)

Disinfection of the reuse water will be provided by a medium pressure high output UV system installed in two in-line trains. Each train is sized to handle the design flow rate for delivery to Pronghorn (2.5 mgd), so there is currently no need to run both trains simultaneously. Influent and effluent valves are provided at each UV train for isolation. A UV train will only operate when the low head reuse pumps are running.

The UV system will be operated by a package control system based on flow rate and transmittance feedback signals. The UV system flow rate is measured at the existing low head reuse flow meter (FIT-52-040 in the low head reuse pump header located at the reuse facility).

W3 Reuse Water UV System Chemical Cleaning

Operators will manually start and stop the chemical cleaning system on an as-needed basis. When operating, the chemical tank mixer and the feed pump will run continuously. A hardwired interlock is provided to stop the feed pump when a low chemical level is detected in the tank.

Outstanding Issues

The in-vessel UV equipment can be procured through several different mechanisms. The procurement method selected will impact the approach to procurement of the UV equipment. Common approaches for procuring unique equipment are as follows:

1. Design Bid Build
2. Owner Procured (Pre-Selection)
3. Owner Procured and Assigned to Construction Contractor

Attachments

Attachment A—Equipment Data Sheets

- In-Vessel Medium Pressure High Output Ultraviolet

Attachment B—Vendor Catalog Cuts

- Medium Pressure High Output Ultraviolet - Aquionics Inline W 16000plus

Attachment C—Schematic Design Fact Sheets

- Fact Sheet 1 – Ultraviolet Disinfection: Low Pressure High Output versus Medium Pressure High Output
- Fact Sheet 2 – Fouling of Ultraviolet Disinfection

Attachment A—Equipment Data Sheets

**Bend Water Reclamation Facility Secondary Expansion
EQUIPMENT DATA SHEET**

SPEC SECTION: _____

LEAD ENGINEER: Thompson

FACILITY NAME: 44 - Reuse Disinfection Facility

EQUIPMENT NAME: In-Vessel Medium Pressure High Output UV **QUANTITY:** 4

IDENTIFICATION NO.: _____

MATERIAL HANDLED: W3 - Reuse Water (Level 4/Class A)

CAPACITY: 2.5 mgd

LOCATION: x dry wet exterior hazardous

POWER REQUIRED: hp 480 volts 3 phase 108 kW

DRIVE: _____
(Constant speed, 2 speed, variable speed)

ENCLOSURE TYPE: **MOTOR:** na **CONTROL PANEL:** _____

SYNCHRONOUS SPEED (rpm): _____

MOUNTING TYPE: _____
(Horizontal or Vertical):

SUPPORT UTILITIES REQUIRED: _____

EQUIPMENT DESCRIPTION: _____
(Size, configuration)

MANUFACTURERS: **NO. 1:** Aquionics **NO. 2:** _____

MODEL: InLine W 16000+ **MODEL:** _____

EQUIPMENT WEIGHT: 530 lbs

EQUIPMENT COST: **QUOTE:** \$371,404 **DELIVERY TIME:** 12-18 weeks

VENDOR: Treatment Equipment Company - Dean Wood

MISCELLANEOUS COMMENTS, DATA, AND INFORMATION: _____

LOCATION OF EQUIPMENT: P&ID Sheet No. _____ Construction Sheet No. _____

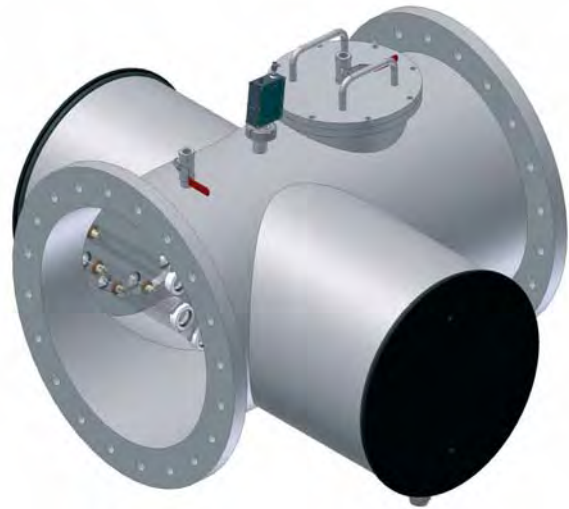
REVISION	DATE	NO.	BY

Attachment B—Vendor Catalog Cuts

Specifications UV unit

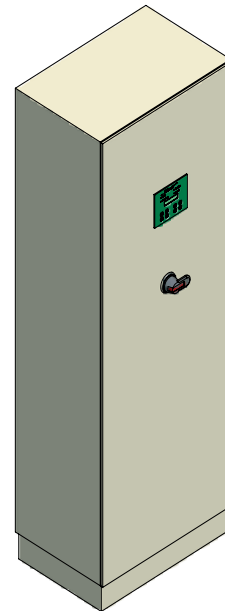
• Material	Stainless Steel, 316L
• Internal finish	Ra _{max} 0.8 μm
• Degree of protection	NEMA 12 (IP 54)
• Flange connections	20" ANSI 150 lbs
• Dimensions	See drawing next page
• Weight dry	530 lbs (260 kg)
• Weight wet	990 lbs (450 kg)
• Lamp type	B5050H
• Number of lamps	12
• Temperature sensor	PT 100
• UV sensor	UVector MPI
• Nominal pressure	102 psi (7 bar)*
• Test pressure	160 psi (11 bar)
• Maximum hydraulic flow	11.4 MGD (1800 m ³ /h)

* Higher pressures on request



Specifications

	<u>Control Cabinet</u>	<u>Power Cabinet</u>
• Cabinet type / QTY	Floor standing / 1	Floor standing / 2
• Dimensions	74.8x23.6x15.75 inch 1900x600x400 mm	74.8x47.25x15.75 inch 1900x1200x400 mm
• Weight	330 lbs (150 kg)	1015 lbs (460 kg)
• Material	Painted steel	Painted steel
• Color	RAL 7035	RAL 7035
• Degree of protection	NEMA 12 (IP54)	NEMA 12 (IP54)
• Ambient temperature	40-95 F (5-35 °C)	40-95 F (5-35 °C)
• Ambient humidity	15-90 % rel.	15-90 % rel.
• Maximum cable length	160 ft (50 m)	160 ft (50 m)



Electrical Specifications (Build according IEC 60204-1)

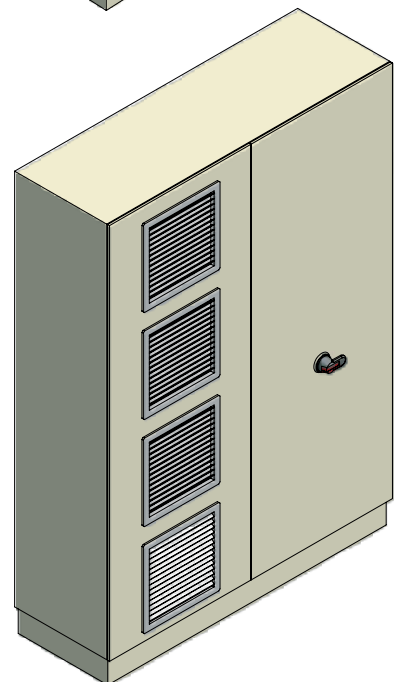
• Input Voltage	120 V, 60 Hz, 1L+N	480 V, 60 Hz, 3L
• Average power consumption	1.0 kW (±5%)	2x22.0 kW (±5%)
• Total connected power	1.0 kW (±5%)	2x30 kW (±5%)
• Size of customers breaker (D type tripping characteristic)	> 10A (120V)	>2x63A (480V)

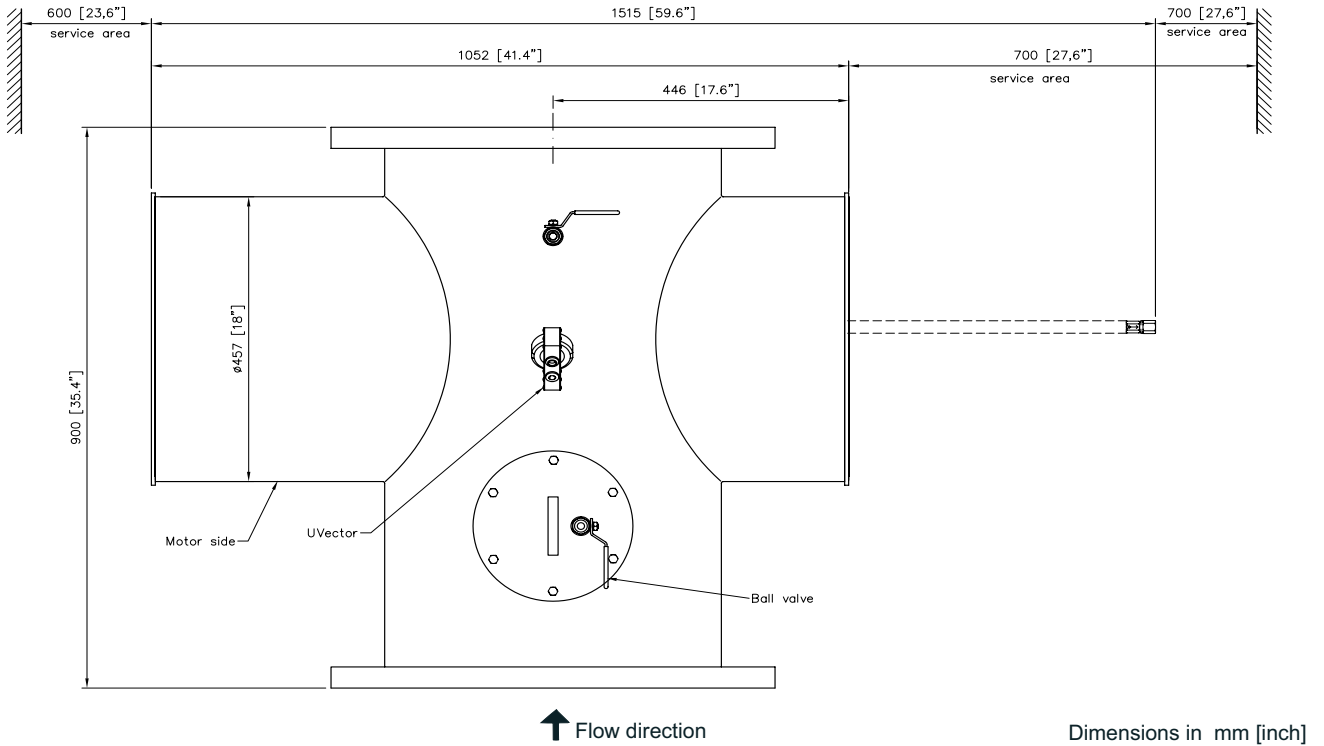
Standard features

ECtronic+ controller
 Automatic cleaning system
 Energy control, 3 power levels
 Drain tap (BSP or NPT)
 Air release valve
 Access hatch
 Door safety switch

Optional features

Allen Bradley Compact Logix PLC / HMI
 Ultrawipe™ (chemical assisted) cleaning system
 NEMA 4x cabinet with cooler
 Stainless Steel AISI 304 cabinet
 Bleed valve control
 Dose output signal (4-20mA)





Aquionics InLine® W series

InLine W 36000+

InLine W 33000+

InLine W 30000+

InLine W 18000+

InLine W 17000+

InLine W 16000+

InLine W 15000+

InLine W 7500+

InLine W 5000+

InLine W 4750+

InLine W 4500+

InLine W 4250 +

InLine W 1250+

InLine W 1000+

InLine W 400+

InLine W 250+

InLine W 100+

InLine W 40+

Notes

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Erlanger, KY 41018
USA

Fax (889) 341-0350
Phone (800) 925-0440
E-mail sales@aquionics.com
www.aquionics.com

**Attachment C—Schematic Design Fact
Sheets**

Ultraviolet Disinfection for Reuse Water

ATTACHMENT C TO: TM 7 – Reuse System Improvements Including Ultraviolet
 PROJECT: Schematic Design Report
 Bend Water Reclamation Facility Secondary Expansion

Objective

Ultraviolet (UV) radiation (using in-vessel equipment) will be used for primary disinfection of the Class A reuse water. Select the appropriate UV type, evaluating both Medium Pressure and Low Pressure UV systems.

Background

The Bend Water Reclamation Facility (facility) currently uses gaseous chlorine and a chlorine contact basin to achieve disinfection for Class A reuse.

Design Criteria

Table 1 lists the design criteria specific to addressing the selection of medium- versus low-pressure UV disinfection of the Class A reuse water.

TABLE 1
 Class A Reuse Disinfection Design Criteria
City of Bend Water Reclamation Facility

Criterion	Unit	AAF	MMF	Peak Hour
Class A Reuse flow	mgd	2.5	5	5
Chlorine Residual	mg/L as Cl ₂	.5	2	2
Total Coliform per 100 ml	mpn	2.2	2.2	23
UV Transmittance	/cm	65%	65%	65%
UV dose	mJ/cm ²	80	80	80

AAF = Average Annual Flow.
 Cl₂ = chlorine.
 mgd = million gallons per day.
 mg/L = milligrams per liter.
 ml = milliliter.
 MMF = Maximum Month Flow.
 mpn = most probable number

Evaluation of Alternatives

Two in-vessel alternatives were considered for UV disinfection of the reuse flow stream. Other UV arrangements that required an open water surface were not considered because additional pump stations would be required given the current arrangement of the plant.

Alternative 1—Low-Pressure Ultraviolet Disinfection

Advantages

- Lower power consumption (more efficient)
- Lower bulb temperature
- Auto wiper system

Disadvantages

- More expensive initial cost
- More bulbs to maintain
- Larger building footprint

Alternative 2 – Medium-Pressure Ultraviolet Disinfection

Advantages

- Less expensive initial cost
- Fewer bulbs to maintain
- Smaller building footprint
- Auto wiper system

Disadvantages

- Higher power consumption
- Higher bulb temperature
- Visible light from bulbs promotes algae growth

Present Worth Analysis

Table 2 provides the relevant project factors used in the present worth analysis. Table 3 summarizes the present worth analysis used in the UV equipment evaluation. Table 3 shows that a medium pressure system has a smaller present worth cost than the low pressure system. In analyses at other facilities, low pressure systems may have a lower cost because of the low power consumption of a low pressure system. The power cost is not a deciding factor in the analysis because the system is operated for part of a day and for less than half of the year and because the cost of power is very low compared to other plants in the United States.

TABLE 2
Present Worth Analysis Approach
City of Bend Water Reclamation Facility

Factors	Unit	Value
Power Cost	\$/kWh	\$0.041
Labor Cost	\$/hour	50
Inflation	Annual %	Not used
Discount Rate	Annual %	1%
Time Length	Years	20

kWh = kilowatt-hour.

TABLE 3
Ultraviolet Equipment Evaluation Present Worth Analysis Cost Estimates
City of Bend Water Reclamation Facility

Type of Cost	Alternative 1 Low-Pressure Ultraviolet Disinfection (\$ millions)	Alternative 2 Medium-Pressure Ultraviolet Disinfection (\$ millions)
Capital Cost	\$2.4	\$1.5
Annual Maintenance Costs	\$0.03	\$0.01
Annual Operations Cost	\$0.23	\$0.23
Net Present Worth	\$7.0	\$5.9

Recommendations

The present worth analysis indicates an economic advantage to medium-pressure UV. The small footprint of medium-pressure systems is an added advantage in the expected location of the UV building. The smaller size and fewer bulbs will be an advantage to operations staff.

There are a limited number of vendors for in-vessel medium pressure systems. Aquionics has a good track record with owners. Trojan also has a good reputation for its UV products.

The facility secondary expansion will include a medium-pressure UV disinfection system for the Class A reuse system.

Appendix A—Vendor Catalog Cuts

- Low Pressure Ultraviolet Disinfection (WEDECO)

Appendix A—Vendor Catalog Cuts



ITT

WATER & WASTEWATER

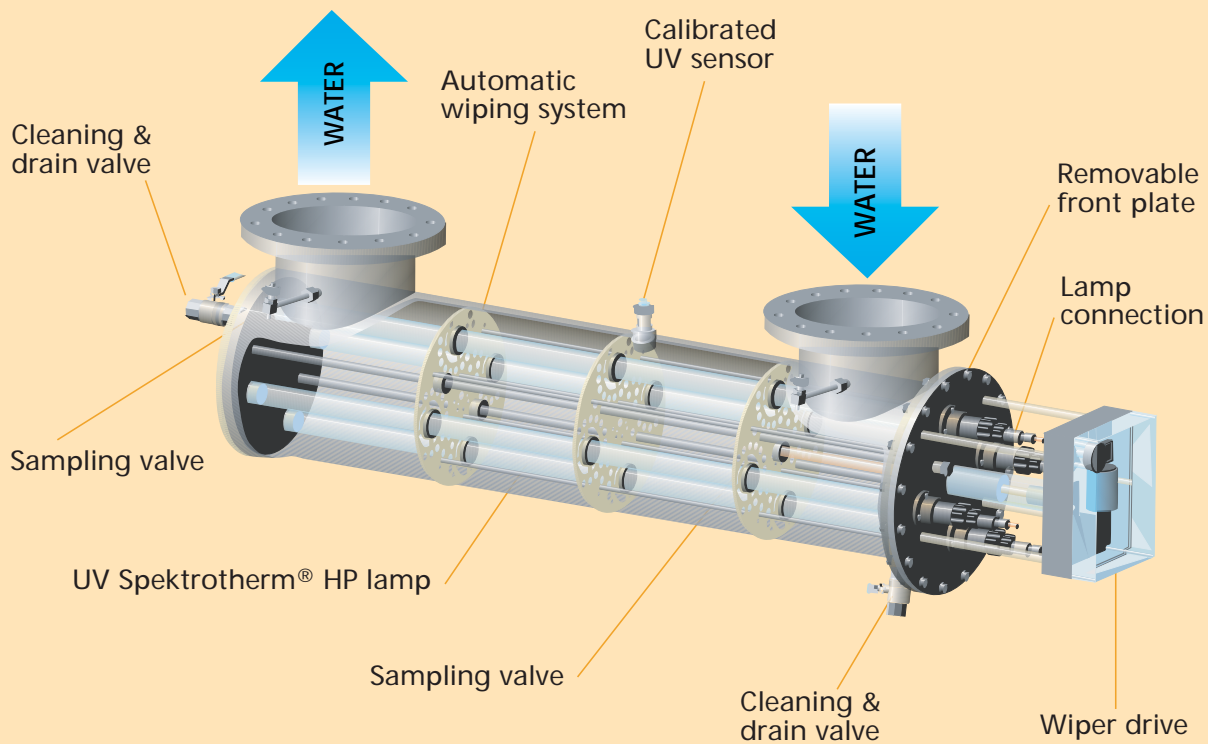
WEDECO LBX Series Closed Vessel UV Reactors

For wastewater and reuse applications



**NWRI
Certified**

Engineered for life



DESIGN: The reactors of the UV disinfection series LBX are equipped with low pressure / high intensity UV lamps, which are arranged parallel to the water flow inside the reaction chamber. The most powerful Spektrotherm® HP lamps are applied. A special baffle plate design creates turbulence which allows the system to achieve high disinfection levels. These UV systems can either be mounted horizontally or vertically into existing pipe lines and are equipped with a separate electrical cabinet.

ADVANTAGES

- Excellent and reliable disinfection capacity with low energy consumption
- High UV-C output of the lamps allows for a small number of lamps relative to the overall flow capacity
- Spektrotherm® low pressure / high intensity UV lamps have excellent temperature stability
- Long lamp life expectancy
- UV monitoring and control by a highly selective, calibrated UV sensor
- Optional automatic dose control system (Vario)
- Optional automatic quartz sleeve wiping system available
- Simple operation and easy maintenance



Electronic ballasts ensure that the Spektrotherm® HP UV lamps operate cost-effectively



UCA sensor



The new spectrum emission controller (SEC) handles all control and monitoring functions

All specifications are subject to change without notice.

(Hg) UV lamps contain mercury · Do not put in trash · Recycle or dispose as hazardous waste
www.lamprecycle.org · 1-866-457-6697 · **WARNING:** This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

To find ITT Water & Wastewater products near you please visit: www.us.ittwww.com



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 Zellenople, PA 16063
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 Fax 724-452-1377



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Fouling of Ultraviolet Disinfection

ATTACHMENT C TO: TM 7 – Reuse System Improvements Including Ultraviolet
PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Objective

Ultraviolet (UV) light will be used for primary disinfection of the Class A reuse water and for plant effluent. The purpose of this fact sheet is to evaluate the impact of the addition of ferric chloride, alum, lime, and polymer on UV disinfection.

Design Criteria

Table 1 (provided at the end of this fact sheet) lists the chemical additions at the Bend Water Reclamation Facility (WRF).

Evaluation

Iron addition is being considered at the WRF to reduce struvite formation after the degassing beds. The degassing beds receive filtrate from the belt filter press (dewatering). After the secondary expansion is complete, the secondary treatment process (e.g., integrated fixed-film activated sludge [IFAS]) will be capable of treating the flow without the use of the degassing beds. After completion, iron addition may no longer be required.

The use of alum at the filters reduces the total suspended solids (TSS). TSS has a much more significant impact on UV disinfection than aluminum. Used sparingly, the addition of alum can have a positive impact on UV disinfection by improving solids capture. If the same effluent TSS could be achieved with low doses of polymers, there would be even less impact on UV disinfection.

High doses of lime increase the total hardness. Total hardness is an indicator of the potential of lamp fouling. The hot quartz sleeves increase metal precipitation. Wiper systems and routine acid washing, if required, can aid in minimizing sleeve fouling. Measurements by WRF staff indicate the hardness ranges between 150 and 250 milligrams per liter (mg/L) as CaCO_3 . This is hard water and will require management of scale using mechanical and acid washing system.

At small controlled doses, polymers should not be a significant impact on UV disinfection.

Recommendations

Iron: Stop the usage of ferric chloride before the start up of the UV system. If continued use of ferric is required, the ferric dosing system should be tightly controlled to minimize the impacts of iron on the UV system.

Alum: Optimize the use of alum in the reuse filters to reduce the metals in the reuse water. Clean sleeves using an automated cleaning system

Lime: Clean sleeves using an automated cleaning system. Provide a system for regularly cleaning the UV system with an acid (e.g. citric acid or LimeAway). Plan to rotate UV trains to allow time to clean units.

Polymers: Use of a polymer is not likely to impact UV disinfection.

A test plan will be developed to evaluate UV transmittance and to monitor other constituents of concern.

Based on the review of chemical additions prior to testing, UV disinfection appears to be appropriate for this facility. Some of the chemicals being added to this facility (e.g., lime, ferric chloride, and alum) have impacted UV disinfection at other facilities. Fouling should be expected at this facility and management of fouling should be implemented into the design and operations. For example:

- Prudent use of chemicals
- Automated quartz sleeve wiper systems
- In-pipe acid wash for UV unit
- Allow access to quartz sleeves to allow easy inspection and cleaning

TABLE 1
 Class A Reuse Disinfection Design Criteria
 City of Bend Water Reclamation Facility

Wastewater Component	Addition Form	Addition Location	Purpose	Dose (ppd)	Flow Equivalent Concentration at Application Point (mg/L)	Estimated Concentration at UV (mg/L)	Impact on Disinfection
Iron	Ferric Chloride	Dewatering Filtrate	Future Struvite Control				UV systems are sensitive to iron concentrations. Iron interferes with UV disinfection by absorbing UV radiation and by increasing the scaling potential of quartz sleeves.
Aluminum	Alum	Reuse Filters	Filter Aid	200	10	5	Alum interferes with UV disinfection primarily through gravitational settling on the quartz sleeves. Aluminum can participate with other metals to form a scale deposit. However, the impact of aluminum on UV disinfection is not expected to be significant.
Hardness	Lime	Primary Effluent	Nitrification	1,500	150-250 as CaCO ₃	150-250 as CaCO ₃	The addition of lime increases hardness and increases the opportunity for scale/fouling of the quartz sleeve. High Hardness at this facility indicates that management of scale will be required.
Polymer	Polymer	Reuse Filter	Filter Aid	40	2	1	Currently used for thickening and dewatering. With automatic wiping systems provided on in-vessel UV systems, polymer is not expected to significantly foul the quartz sleeve or interfere with UV disinfection

mgd = million gallons per day.
 mg/L = milligrams per liter.
 ppd = pounds per day
 CaCO₃ = Calcium Carbonate

TM 8 – Solids Treatment Improvements

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DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum details the options that were evaluated for solids treatment improvements.

The Bend Water Reclamation Facility (WRF) solids building contains a gravity belt thickener (GBT) to thicken waste activated sludge (WAS) and a belt filter press (BFP) to dewater digested sludge. A centrifuge acts as a back up the BFP. A dry polymer system provides polymer to both the BFP and the GBT.

The previous Project Definition Report documented the following decisions:

- Continue thickening WAS using the existing GBT.
- Continue dewatering of digested sludge by parallel operation of the existing BFP and a new BFP.
- Remove the existing dewatering centrifuge and replace with a new BFP to provide additional dewatering capacity.
- Add new cake pump directly below the new BFP discharge to convey cake to the existing cake hopper.
- Add odorous air curtains and exhaust hoods around the BFPs to improve ventilation and solids building corrosion problems.
- Provide filtrate line upgrades to mitigate struvite accumulation by rerouting the dewatering filtrate from the degas beds to the primary splitter box

Design Criteria

Table 1 lists the design criteria for the solids building.

TABLE 1
 Solids Building Design Criteria
City of Bend Water Reclamation Facility

Criterion	Unit
Thickening	
WAS Feed Pumping	
Mass flow rate	19,438 lb/d (design); 8,166 lb/d (minimum)
Solids concentration	0.7%–1.1% total solids
WAS flow rate per day	246,376 gpd (design); 132,069 gpd (minimum)
WAS flow rate per minute	171 gpm (design); 46 gpm (minimum)
Gravity Belt Thickener	
Number of units	One
Belt size	2 meter
Solids Capture efficiency	90%
Mass capacity	660 lb/hr/m
Volume capacity	100 gpm/m
Thickened WAS Sludge Pumping (to digesters)	
Dewatering	
Digested Sludge/Dewatering Feed	
Mass flow rate	30,335 lb/d (design); 12,708 lb/d (minimum)
Solids concentration	3.4% total solids
Digested sludge flow rate per day	108,042 gpd (design); 46,211 gpd (minimum)
Digested sludge flow rate per minute	252 gpm (design); 135 gpm (minimum)
Belt Filter Press	
Number of units	Two
Belt size	2 meter
Solids capture efficiency	95%
Mass capacity	1,050 lb/hr/m
Volume capacity	75 gpm/m
Dewatered Sludge Pumping	
Cake pump quantity	Two
Mass flow rate	4,060 lb/hr (design); 2,153 lb/hr (minimum)
Solids concentration	17%
TDS flow rate, gpm/pump	30 gpm (design); 8 gpm (minimum)

TABLE 1
Solids Building Design Criteria
City of Bend Water Reclamation Facility

Criterion	Unit
Polymer System	
GBT polymer dose	13 lb/dt
BFP polymer dose	12 lb/dt
Total dry polymer usage	2,173 lb/week (design); 912 lb/week (minimum)
Maximum total operating polymer usage	31 lb/hr (design); 15.7 lb/hr (minimum)
Dry polymer storage size	4,950 lb
Polymer make up concentration	0.4%
Polymer mix tank volume	600 gallons
Polymer feed tank volume	900 gallons
Polymer feed rate	23 gpm (design), 2 gpm (minimum)

gpd = gallons per day; gpm = gallons per minute; lb = pounds; lb/d = pounds per day; lb/dt = pounds per dry ton; lb/hr = pounds per hour;

Existing Process Description

The existing solids treatment system at the Bend WRF consists of the following unit processes:

- Waste activated sludge (WAS) gravity belt thickening,
- Anaerobic digestion of primary sludge and thickened waste activated sludge
- Belt filter press dewatering of digested sludge
- Onsite asphalt air drying beds and storage
- Seasonal (early spring) land application of Class B biosolids

Near-term solids treatment improvements have been identified for the existing solids building, which houses the WAS thickening, digested sludge dewatering and polymer support facilities. Existing anaerobic digestion capacity and projected improvements are discussed in *Fact Sheet 2 – Existing Digester Volume, Capacity, and Projected Life* (provided in Attachment C – Schematic Design Fact Sheets of this memorandum).

The remainder of this section discusses the existing solids building unit processes.

A 2 meter GBT is located on the main floor of the solids building. WAS is fed from the secondary clarifiers to the GBT. The GBT produces thickened waste activated sludge (TWAS) up to 8 percent solids. TWAS is collected at the end of the GBT into a hopper and fed into a progressive cavity TWAS pump. The TWAS pump is controlled from a pressure transmitter located at the base of the TWAS hopper. The TWAS pump pumps the thickened WAS to the digester feed tank or can be directly pumped into the lead Digester 3.

Digested sludge from the last digester in series (Digester 2) is pumped to an existing BFP. The BFP is located in the mezzanine of the solids building. The BFP dewateres the sludge and the dewatered cake is discharged off the end of the BFP into a cross conveyor. The cross conveyor transports the dewatered cake to a cake pump located below the end of the conveyor. Cake is then pumped into the cake storage hopper. The cake hopper discharge is located directly above a truck load-out area. Dewatered cake is trucked to the drying beds located onsite.

An existing dewatering centrifuge, also located on the solids building mezzanine, provides infrequent back up to the existing BFP. The centrifuge does not have an associated cake pump. Instead it discharges alongside the cake hopper to the truck load-out area below.

A dry polymer system provides thickening and dewatering polymer to the GBT, BFP, centrifuge, and to the discharge of the cake pump. Dry polymer is fed into the system using 1,650 pound dry polymer sacks into the dry polymer storage hopper. The inlet to the dry polymer hopper is accessed from the mezzanine area by an inlet pipe through the floor. This dry polymer loading station is close to the existing BFP cake discharge area. The dry polymer storage bin is located in the polymer room directly below the mezzanine floor of the solids building.

Dry polymer is conveyed to the polymer mix tank by a gravimetric feeder and pneumatic conveyance system. Dry polymer is mixed with potable well water (W2) as it enters the top of the polymer mix tank through a wetting head. Batches are typically mixed in a concentration range of 0.2–0.5 percent. The polymer mix tank also has a center-mounted mixer to provide mixing to the tank. The top of the polymer mix tank, wetting head, and mixer are located above the polymer room at mezzanine slab level.

After polymer has mixed and aged, a valve located at the bottom of the polymer mix tank opens and the prepared polymer flows by gravity into the polymer feed tank. Polymer solution is then metered from the polymer feed tank to the points of use via two progressing cavity polymer feed pumps. The polymer feed pumps maintain a pressure in the discharge piping. Polymer flow is then metered to the individual points of use by individual flow meters and flow control valves. Excess polymer is recirculated to the polymer feed tank.

Polymer solution to the points of use is then in-line post-diluted with chlorinated plant effluent (plant water [W4]) to a concentration of approximately 0.1 percent. This post-dilution W4 water flow is currently controlled with isolation valves and pressure control valves.

Gravity Belt Thickening Improvements

The existing 2-meter GBT located on the ground floor of the solids building has adequate capacity to process the planning period solids production, based on an operational schedule of 7 days a week, 24 hours a day. Therefore, no thickening improvements are planned, other than the change to a dedicated GBT polymer feed pump, as discussed in the subsequent section. Reliability and redundancy issues will be addressed by the City via acquisition of critical GBT on-hand spares inventory.

The GBT capacity is currently limited by the filtrate drain capacity. Changes to the drain will be required before the GBT can be fully utilized under future conditions. If the filtrate drain (gravity belt and BFP) is returned to the primary influent, the primary clarifiers can provide additional treatment (specifically, settling of suspended solids and particulate-associated chemical oxygen demand [COD]) before the aeration basin. However, the relatively low elevation of the GBT results in limited freeboard within the GBT filtrate system. Draining GBT filtrate to the secondary influent provides additional hydraulic capacity for the GBT filtrate drain, and if this line is in place, it is reasonable to also route BFP filtrate to the primary effluent piping. Design issues of equal flow-split to aeration basins, filtrate within the primary effluent system, and hydraulic capacity will be evaluated in the design development phase.

From a treatment perspective, the new IFAS process will be able to accommodate the loads generated from the filtrate streams (both GBT and BFP) if these are returned to either the primary influent or primary effluent. However, these process streams do need to remain free of rags or trash that could impact the IFAS system (i.e., blind plastic carrier retention screens, etc.). Before incorporation of the IFAS system, additional evaluations should be completed to determine the impacts of this on the existing MLE secondary treatment process. The initial evaluations of the adjustment of the filtrate streams can be refined and impacts quantified during the initial phases of the design development project.

Polymer System Evaluations and Improvements

The following elements of the existing polymer system were evaluated to determine its ability to support the GBT and two BFPs simultaneously:

- Dry polymer storage capacity
- Dry polymer feed system
- Polymer batching time and age time
- Polymer feed pump capacity

Those evaluations are documented in *Fact Sheet 1 – Polymer System Evaluation* (provided in Attachment C of this technical memorandum).

The existing polymer system, with modifications, was determined to have capacity for the planning period solids quantities to support gravity belt WAS thickening and digested sludge dewatering with two parallel BFPs operating in parallel. Modifications to the existing polymer system include the the following:

- Increase the polymer mix tank concentration from 0.25 to 0.50 percent.

- Add a rapid-fill water line to the polymer mix tank with a capacity of 125 gallons per minute (gpm).
- Modify polymer feed pump configuration to use dedicated polymer feed pumps for each point of use. The two existing polymer feed pump configurations will be modified to provide a dedicated feed pump to each BFP. A new third polymer feed pump will be sized to provide dedicated polymer feed for the GBT operation.

Filtrate Return Improvements

The filtrate return line evaluation is documented in *Fact Sheet 3 – Filtrate Return Process Evaluation* (provided in Attachment C of this technical memorandum).

In order to mitigate struvite formation at the degas bed return pump station, the filtrate lines from the BFPs will be rerouted to the primary influent distribution structure ahead of the primary clarifiers. The City of Bend is proceeding with this design and the construction associated with this work.

Belt Filter Press Dewatering Improvements and Options

Two belt filter presses will be required to be operational to process the planning period solids production, based on a preferred operational schedule of one 8 hour shift per day. One new BFP will replace the existing unreliable dewatering centrifuge located on the mezzanine of the solids building.

Two options exist for the second BFP. The first option is continued operation of the existing BFP, also located on the mezzanine of the solids building. The second option consists of replacing the existing BFP with a new press, identical to the one that will replace the old dewatering centrifuge

The benefits of replacing the existing BFP are presented in *Fact Sheet 4 – Benefits of Replacing Existing Belt Filter Press* (provided in Attachment C of this technical memorandum).

If the operation and maintenance (O&M) benefits associated with providing two new BFPs are determined to be important, and if the overall project cost constraints can accommodate the additional initial capital costs, the recommendation is to replace the existing BFP with a new BFP identical to the unit being installed to replace the existing centrifuge.

Reliability/Redundancy

The U.S. Environmental Protection Agency (EPA) classifies wastewater treatment plants into three levels of system reliability. Based on discussions with Oregon Department of Environmental Quality (DEQ), confirmed as part of this predesign effort, the Bend WRF must meet the reliability and redundancy requirements of a Class II facility. No specific requirements apply to solids processing, so redundancy and reliability requirements are determined by City of Bend preferences and the inherent flexibility associated with solids processing.

Gravity Belt Thickening

The single existing 2-meter GBT system will be sufficient to meet critical reliability and redundancy requirements if sufficient spare parts (belt, bearings, and drives) are on hand to limit downtime due to maintenance of the GBT and associated TWAS pump. During GBT maintenance, solids can be stored in the secondary treatment for 2 days. Solids can also be temporarily stored in the existing primary clarifiers in an emergency. An existing dissolved air flotation treatment (DAFT) unit will be modified soon and will no longer be available for emergency backup thickening of WAS.

Belt Filter Press Dewatering

The BFP system will meet critical reliability and redundancy requirements by stocking spare parts on hand to limit downtime due to maintenance of the BFPs and associated cake pumps. During a BFP maintenance interruption, the other BFP can be operated for longer durations and at maximum loading rates. In addition, digested sludge can be stored in the degasification basins or pumped directly to the drying beds.

Polymer System

The polymer system will meet critical reliability and redundancy requirements by stocking spare parts on hand to limit downtime due to maintenance of the polymer system. Spare parts for the following major equipment should be stocked onsite: polymer feed pumps, dry polymer conveyor, and dry polymer gravimetric feeder. The use of a portable temporary polymer system is also an option for long duration polymer system outages.

Instrumentation and Control Strategy

Summary control narratives for new equipment are identified below.

Gravity Belt Thickening

No control changes will be made to the existing GBTs, with the exception of changing to a dedicated GBT polymer feed pump.

Belt Filter Press Dewatering

Two belt filter presses, operating in parallel, will be required to dewater the planning period digested sludge production, based on a preferred operational schedule of one 8 hour shift per day. The two BFPs will be set up to run individually or in parallel, depending on the operator's determination of digested sludge feed and the duration (hours per day) of operation.

Each BFP will be provided with a packaged control panel that provides control for belt tensioning, belt tracking, belt spray water, and protective machine interlocks. The plant's supervisory control and data acquisition (SCADA) system will provide controls for sludge feed, polymer feed, washwater pumps, and dewatered cake conveyance.

The digested sludge feed flow rates to each BFP will be based on an operator-entered flow rate set point. Automated flow control valves will meter the sludge feed set point flow to each of the operating presses. The BFP sludge feed will automatically shut down after the

volume of digested sludge (minimum level in Digester 2) has been processed or when the BFP fails, loss of polymer occurs, loss of wash water occurs, or loss of cake conveyance occurs.

Interlocks: The belt presses will automatically stop when any of the following conditions are detected:

- High cake storage hopper level
- High cake pump weight
- Cake pump failure
- Belt tensioning failure or belt misalignment
- Emergency safety pull stop

Alarms:

- BFP failure
- Loss of sludge feed
- Loss of polymer feed
- Loss of cake pump
- High cake storage hopper level alarm

Dewatered Cake Pumping

Both the cake pump and close coupled feed cake hopper are equipped with a weigh element to determine the feed cake inventory. A cake pump will run when its associated BFP is operating. Cake pump speed will be based on maintaining a selected feed cake hopper weight or cake inventory. If necessary, operators can manually start polymer solution feed to the discharge piping of the cake pump to assist in pumping very dry cake, should discharge pressure head losses prove excessive.

Interlocks: The cake pump will automatically stop when any of the following conditions are detected:

- Low cake feed hopper/pump weight
- High cake storage hopper level
- High discharge pressure

Alarm:

- High feed cake hopper inventory (weight) level alarm
- High discharge pressure
- Cake Pump Fail

Polymer Feed System

The polymer feed system is recommended to operate with dedicated feed pumps.

Each polymer pump will be piped to a dedicated feed point (GBT, each BFP, or cake pump discharge line). Each pump will run based on operation of the feed equipment. For example, if the pump is piped to feed a BFP, the pump will not run unless the associated BFP is operating. When running, the speed of each pump will be automatically adjusted by a

dedicated flow control loop in the programmable logic controller (PLC) (separate flow loop for each pump). The speed and flow rate for the individual polymer feed pumps serving the GBT and each BFP will normally be automatically adjusted based on the respective sludge feed rates and polymer dosing requirements entered by operators via the human-machine interface (HMI).

The flow rate set point for polymer pumps feeding cake pump discharge lines will be manually adjusted by operators via the HMI graphics.

The polymer post-dilution water flow valves will be automatically adjusted by the PLC to provide the polymer concentration chosen by operators at the HMI.

Design Development Issues

The following actions or issues need to be performed or addressed in the Design Development phase:

- Decide whether to utilize the existing BFP and replace the existing dewatering centrifuge with one new BFP, or replace the existing BFP and existing centrifuge with two new BFPs
- Provide piping features for potential future addition of ferric chloride to BFP filtrate lines for struvite control.
- BFP foul air exhaust hood and containment curtain design details.
- Crane access or lifting device design details for BFP drives, belt and roller removal and replacement.
- Solids building interior re-coating design details, construction schedule constraints, and potential temporary dewatering needs versus temporary use of existing drying beds for liquid digested sludge deposition.
- The belt press filter equipment can be procured through several different mechanisms. Common approaches for procuring unique equipment are as follows:
 1. Design Bid Build
 2. Owner Procured (Pre-Selection)
 3. Owner Procured and Assigned to Construction Contractor

Attachments

Attachment A—Equipment Data Sheets

- Belt Filter Presses
- Cake Pump 2
- Polymer Feed Pump 3
- Wash Water Pump 3

Attachment B—Vendor Catalog Cuts

- Belt Filter Press – Andritz
- Belt Filter Press – Ashbrook

Attachment C—Schematic Design Fact Sheets

- Fact Sheet 1 – Polymer System Evaluation
- Fact Sheet 2 – Existing Digester Volume, Capacity, and Projected Life
- Fact Sheet 3 – Filtrate Return Process Evaluation
- Fact Sheet 4 – Benefits of Replacing Existing Belt Filter Press

Attachment A—Equipment Data Sheets

**Bend Water Reclamation Facility Secondary Expansion
EQUIPMENT DATA SHEET**

SPEC SECTION: _____

LEAD ENGINEER: Krumsick

FACILITY NAME: 67 - Dewatering

EQUIPMENT NAME: Belt Filter Press 1 & 2 **QUANTITY:** 2

IDENTIFICATION NO.: _____

MATERIAL HANDLED: DS - Digested Sludge

CAPACITY: 2 meter machine, 1050 lb/hr/m, 75 gpm/m

LOCATION: X dry wet exterior hazardous

POWER REQUIRED: 6 hp 480 volts 3 phase

DRIVE: variable speed
(Constant speed, 2 speed, variable speed)

ENCLOSURE TYPE: MOTOR: _____ CONTROL PANEL: N/A

SYNCHRONOUS SPEED (rpm): _____

MOUNTING TYPE: Horizontal
(Horizontal or Vertical):

SUPPORT UTILITIES REQUIRED: AHP- tensioning- Andritz,

EQUIPMENT DESCRIPTION: 2.0 meter Belt Filter Press, low profile gravity and wedge sections, control panel
(Size, configuration)

MANUFACTURERS: **NO. 1:** Andritz **NO. 2:** Ashbrook

MODEL: 2.0 Meter, SMX-S8 low profile **MODEL:** KP "Z", 2.0 meter

EQUIPMENT WEIGHT: 24,000 lbs

EQUIPMENT COST: **QUOTE:** \$275,000 per unit **DELIVERY TIME:** 10-12 weeks

VENDOR: APSCO - Shawn Clark
Ashbrook - WH Reilly

MISCELLANEOUS COMMENTS, DATA, AND INFORMATION: _____
Pneumatic tensioning - Andritz, Hydraulic tensioning - Ashbrook

LOCATION OF EQUIPMENT: P&ID Sheet No. 08-I-024 Construction Sheet No. _____

REVISION	DATE	NO.	BY
Andritz quote	3/28/2011		j. krumsick

**Bend Water Reclamation Facility Secondary Expansion
EQUIPMENT DATA SHEET**

SPEC SECTION: 44 42 56.13

LEAD ENGINEER: Krumsick

FACILITY NAME: 67 - Dewatering

EQUIPMENT NAME: Cake Pump 1 & 2 **QUANTITY:** 2

IDENTIFICATION NO.: _____

MATERIAL HANDLED: TDS - Thickened Digested Sludge

CAPACITY: 30 gpm

LOCATION: X dry wet exterior hazardous

POWER REQUIRED: 10.5 hp 480 volts 3 phase

DRIVE: Variable Speed
(Constant speed, 2 speed, variable speed)

ENCLOSURE TYPE: MOTOR: TEFC CONTROL PANEL: _____

SYNCHRONOUS SPEED (rpm): 1,750

MOUNTING TYPE: Horizontal In-line, with bridge breaker and 2-meter hopper
(Horizontal or Vertical):

SUPPORT UTILITIES REQUIRED: Seal water

EQUIPMENT DESCRIPTION: two stage
(Size, configuration)

MANUFACTURERS: NO. 1: Moyno NO. 2: Seepex

MODEL: 2000 G3 **MODEL:** _____

EQUIPMENT WEIGHT: _____ lbs

EQUIPMENT COST: QUOTE: _____ DELIVERY TIME: _____

VENDOR: APSCO - Shawn Clark

MISCELLANEOUS COMMENTS, DATA, AND INFORMATION: _____
Pump Main drive motor 7.5 hp, Pump has a separate bridge breaker and associated motor 3.0 hp

LOCATION OF EQUIPMENT: P&ID Sheet No. 08-I-025 Construction Sheet No. _____

REVISION	DATE	NO.	BY

**Bend Water Reclamation Facility Secondary Expansion
EQUIPMENT DATA SHEET**

SPEC SECTION: _____

LEAD ENGINEER: Krumsick

FACILITY NAME: 68 - Polymer System

EQUIPMENT NAME: Polymer Feed Pump 3 **QUANTITY:** 1

IDENTIFICATION NO.: _____

MATERIAL HANDLED: PO - Polymer Solution

CAPACITY: 3.1 - 0.4 gpm

LOCATION: X dry wet exterior hazardous

POWER REQUIRED: 0.5 hp volts phase

DRIVE: variable speed
(Constant speed, 2 speed, variable speed)

ENCLOSURE TYPE: MOTOR: TEFC CONTROL PANEL: _____

SYNCHRONOUS SPEED (rpm): 1,750

MOUNTING TYPE: Vertical In-line
(Horizontal or Vertical):

SUPPORT UTILITIES REQUIRED: _____

EQUIPMENT DESCRIPTION: _____
(Size, configuration)

MANUFACTURERS: NO. 1: Moyno NO. 2: Sepex

MODEL: B1CSSF3APA **MODEL:** _____

EQUIPMENT WEIGHT: _____ lbs

EQUIPMENT COST: **QUOTE:** _____ **DELIVERY TIME:** _____

VENDOR: _____

MISCELLANEOUS COMMENTS, DATA, AND INFORMATION: _____

LOCATION OF EQUIPMENT: P&ID Sheet No. 08-I-019 Construction Sheet No. _____

REVISION	DATE	NO.	BY

**Bend Water Reclamation Facility Secondary Expansion
EQUIPMENT DATA SHEET**

SPEC SECTION: _____

LEAD ENGINEER: Krumsick

FACILITY NAME: 67 - Dewatering

EQUIPMENT NAME: Wash Water Pump 3 **QUANTITY:** 1

IDENTIFICATION NO.: _____

MATERIAL HANDLED: W4 - Chlorinated Effluent (Plant Water)

CAPACITY: 100 gpm @ 110 ft

LOCATION: X dry wet exterior hazardous

POWER REQUIRED: 7.5 hp volts phase

DRIVE: Constant Speed
(Constant speed, 2 speed, variable speed)

ENCLOSURE TYPE: MOTOR: TEFC CONTROL PANEL: _____

SYNCHRONOUS SPEED (rpm): 1,800

MOUNTING TYPE: Horizontal
(Horizontal or Vertical):

SUPPORT UTILITIES REQUIRED: _____

EQUIPMENT DESCRIPTION: horizontal, frame mounted
(Size, configuration)

MANUFACTURERS: NO. 1: _____ NO. 2: _____

MODEL: _____ MODEL: _____

EQUIPMENT WEIGHT: _____ lbs

EQUIPMENT COST: QUOTE: _____ DELIVERY TIME: _____

VENDOR: _____

MISCELLANEOUS COMMENTS, DATA, AND INFORMATION: _____

LOCATION OF EQUIPMENT: P&ID Sheet No. 08-I-017 Construction Sheet No. _____

REVISION	DATE	NO.	BY

Attachment B—Vendor Catalog Cuts



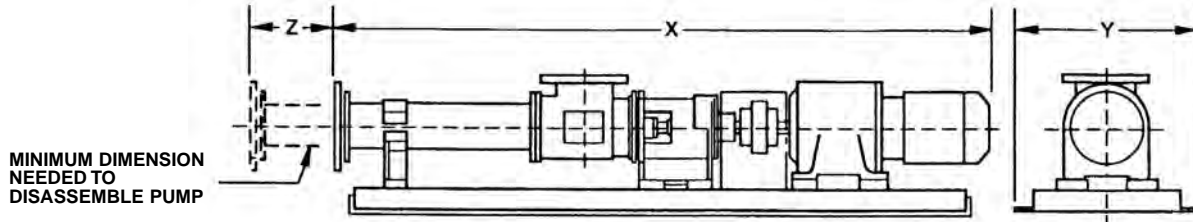
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IN-LINE GERMOTOR ARRANGEMENT



PUMP	X	Y	Z	MAX HP	MAX UNIT WT.	PUMP	X	Y	Z	MAX HP	MAX UNIT WT.
1E008G1	71	23	7	5	670	1G090G1	106	30	7	30	1,670
2E008G1	83	23	7	10	780	2G090G1	146	32	7	60	3,390
4E008G1	101	26	7	20	980	1G115G1	112	30	9	40	2,800
6E008G1	122	30	7	30	1,060	2G115G1	135	32	9	60	3,920
1E012G1, 1E018EG1	74	23	7	5	680	6H036G1	193	34	10	75	4,000
2E012G1, 2E018EG1	90	23	7	10	790	6H050G1	230	37	10	100	4,350
4E012G1	113	26	7	20	1,000	4H065G1	181	37	10	100	4,680
6E012G1	140	30	7	30	1,090	6H065G1	216	37	10	100	4,980
1E022G1, 1E033EG1	80	23	7	10	820	2H090G1	150	32	10	60	3,920
2E022G1, 2E033EG1	94	23	7	20	1,050	4H090G1	207	37	10	100	4,720
4E022G1	125	26	7	30	1,180	1H115G1	116	30	10	40	2,900
1E036G1	84	26	7	20	990	2H115G1	152	34	10	75	4,290
2E036G1	103	30	7	30	1,140	4H115G1	202	37	10	100	5,060
1E050G1	89	26	7	20	1,030	1H175G1	125	32	13	50	3,460
2E050G1	115	30	7	30	1,220	2H175G1	163	37	13	100	5,040
6F012G1	145	30	8	30	1,270	6J065G1	227	42	12	150	5,720
4F022G1	136	30	8	40	1,900	4J090G1	218	42	12	150	5,610
6F022G1	162	30	8	40	2,040	6J090G1	267	42	12	150	5,780
1F036G1, 1F054EG1	85	23	8	15	900	4J115G1	213	42	12	150	6,300
2F036G1, 2F054EG1	106	26	8	30	1,260	6J115G1	260	42	12	150	6,560
4F036G1	142	30	8	40	2,290	1J175G1	133	32	12	60	4,390
1F050G1, 1F075EG1	91	23	8	20	1,090	2J175G1	167	37	12	100	5,160
2F050G1, 2F075EG1	123	30	8	40	1,920	4J175G1	226	42	12	150	6,220
4F050G1	163	30	8	40	2,320	1J345G1	160	37	12	100	5,670
1F065G1	97	26	8	25	1,550	2J345G1	212	42	12	150	6,660
2F065G1	114	30	8	30	1,670	6K115G1	274	47	13	200	7,060
1F090G1	103	30	8	30	1,590	4K175G1	239	47	13	200	7,210
2F090G1	128	30	8	30	1,730	6K175G1	292	47	13	200	7,740
6G022G1	170	32	7	50	2,360	1K345G1	172	37	13	100	5,810
4G036G1	151	32	7	50	2,630	2K345G1	224	42	13	150	6,820
6G036G1	184	32	7	60	3,590	3K345G1	270	47	13	200	7,460
4G050G1	177	32	7	60	3,490	1K620G1	206	37	13	100	6,110
6G050G1	217	32	7	60	3,640	2K620G1	292	42	13	150	7,320
1G065G1, 1G098EG1	99	26	7	25	1,660	1K800G1	203	42	13	150	6,890
2G065G1, 2G098EG1	128	32	7	50	2,540	2K800G1	262	47	13	200	7,700
4G065G1	169	32	7	60	3,690	1K1500G1	262	47	26	200	8,000

All dimensions in inches.

Dimensions and weights are estimates only. Actual values may vary.



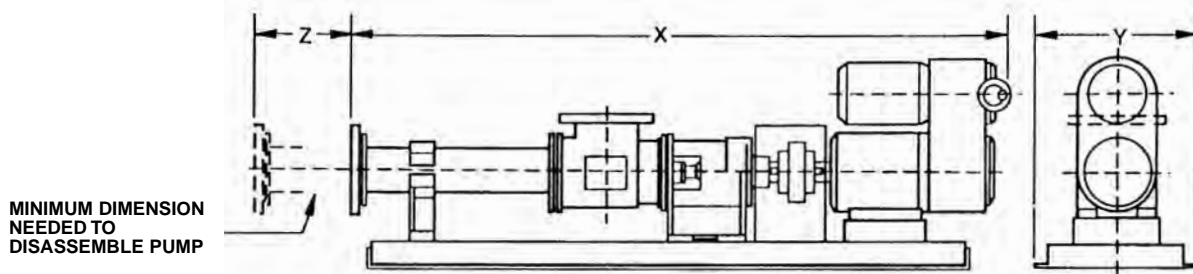
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IN-LINE MECHANICAL VARIABLE SPEED ARRANGEMENT



PUMP	X	Y	Z	MAX HP	MAX UNIT WT.	PUMP	X	Y	Z	MAX HP	MAX UNIT WT.
1E008G1	71	23	7	5	670	1G090G1	106	30	7	30	2,270
2E008G1	83	23	7	10	880	2G090G1	146	32	7	50	3,390
4E008G1	101	26	7	20	1,380	1G115G1	112	30	9	40	3,300
6E008G1	122	30	7	30	1,660	2G115G1	135	32	9	50	3,920
1E012G1, 1E018EG1	74	23	7	5	680	6H036G1	103	34	10	50	3,500
2E012G1, 2E018EG1	90	23	7	10	890	6H050G1	230	37	10	50	3,450
4E012G1	113	26	7	20	1,400	4H065G1	181	37	10	50	3,780
6E012G1	140	30	7	30	1,690	6H065G1	216	37	10	50	4,080
1E022G1, 1E033EG1	80	23	7	10	920	2H090G1	150	32	10	50	3,920
2E022G1, 2E033EG1	94	23	7	20	1,450	4H090G1	207	37	10	50	3,820
4E022G1	125	26	7	30	1,780	1H115G1	116	30	10	40	3,300
1E036G1	84	26	7	20	1,390	2H115G1	152	34	10	50	3,790
2E036G1	103	30	7	30	1,740	4H115G1	202	37	10	50	4,160
1E050G1	89	26	7	20	1,430	1H175G1	125	32	13	50	4,060
2E050G1	115	30	7	30	1,820	2H175G1	163	37	13	50	4,140
6F012G1	145	30	8	30	1,870	6J065G1	227	42	12	50	4,220
4F022G1	136	30	8	40	2,400	4J090G1	218	42	12	50	4,110
6F022G1	162	30	8	40	2,540	6J090G1	267	42	12	50	4,280
1F036G1, 1F054EG1	85	23	8	15	1,050	4J115G1	213	42	12	50	4,800
2F036G1, 2F054EG1	106	26	8	30	1,860	6J115G1	260	42	12	50	5,060
4F036G1	142	30	8	40	2,790	1J175G1	133	32	12	50	4,390
1F050G1, 1F075EG1	91	23	8	20	1,490	2J175G1	167	37	12	50	4,260
2F050G1, 2F075EG1	123	30	8	40	2,420	4J175G1	226	42	12	50	4,720
4F050G1	163	30	8	40	2,820	1J345G1	160	37	12	50	4,770
1F065G1	97	26	8	25	2,050	2J345G1	212	42	12	50	5,160
2F065G1	114	30	8	30	2,270	6K115G1	274	47	13	50	5,560
1F090G1	103	30	8	30	2,190	4K175G1	239	47	13	50	5,710
2F090G1	128	30	8	30	2,230	6K175G1	292	47	13	50	6,240
6G022G1	170	32	7	50	2,960	1K345G1	172	37	13	50	4,910
4G036G1	151	32	7	50	3,230	2K345G1	224	42	13	50	5,320
6G036G1	184	32	7	50	3,590	3K345G1	270	47	13	50	5,960
4G050G1	177	32	7	50	3,490	1K620G1	206	37	13	50	5,210
6G050G1	217	32	7	50	3,640	2K620G1	292	42	13	50	5,820
1G065G1, 1G098EG1	99	26	7	25	2,160	1K800G1	203	42	13	50	5,390
2G065G1, 2G098EG1	128	32	7	50	3,140	2K800G1	262	47	13	50	6,200
4G065G1	169	32	7	50	3,690	1K1500G1	262	47	26	50	6,500

All dimensions in inches.

Dimensions and weights are estimates only. Actual values may vary.



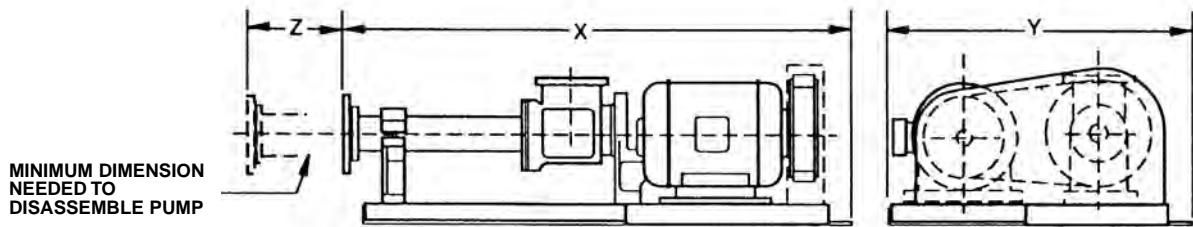
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BELT AND PULLEY ARRANGEMENT



PUMP	X	Y	Z	MAX HP	MAX UNIT WT.	PUMP	X	Y	Z	MAX HP	MAX UNIT WT.
1E008G1	43	42	7	5	670	1G090G1	68	44	7	30	1,670
2E008G1	51	42	7	10	780	2G090G1	92	50	7	60	3,390
4E008G1	68	42	7	20	980	1G115G1	67	44	9	40	2,800
6E008G1	84	42	7	30	1,060	2G115G1	90	50	9	60	3,920
1E012G1, 1E018EG1	46	42	7	5	680	6H036G1	135	60	10	75	4,000
2E012G1, 2E018EG1	58	42	7	10	790	6H050G1	168	60	10	100	4,350
4E012G1	80	42	7	20	1,000	4H065G1	120	60	10	100	4,680
6E012G1	102	42	7	30	1,090	6H065G1	155	60	10	100	4,980
1E022G1, 1E033EG1	48	42	7	10	820	2H090G1	96	50	10	60	3,920
2E022G1, 2E033EG1	61	42	7	20	1,050	4H090G1	146	60	10	100	4,720
4E022G1	87	42	7	30	1,180	1H115G1	71	50	10	40	2,900
1E036G1	51	44	7	20	990	2H115G1	94	60	10	75	4,290
2E036G1	65	44	7	30	1,140	4H115G1	141	60	10	100	5,060
1E050G1	56	44	7	20	1,030	1H175G1	76	60	13	50	3,460
2E050G1	76	44	7	30	1,220	2H175G1	102	60	13	100	5,040
6F012G1	107	42	8	30	1,270	6J065G1	160	80	12	150	5,720
4F022G1	91	42	8	40	1,900	4J090G1	151	80	12	150	5,610
6F022G1	117	44	8	40	2,040	6J090G1	200	80	12	150	5,780
1F036G1, 1F054EG1	53	44	8	15	900	4J115G1	146	80	12	150	6,300
2F036G1, 2F054EG1	68	44	8	30	1,260	6J115G1	193	80	12	150	6,560
4F036G1	97	44	8	40	2,290	1J175G1	79	60	12	60	4,390
1F050G1, 1F075EG1	58	44	8	20	1,090	2J175G1	106	60	12	100	5,160
2F050G1, 2F075EG1	78	44	8	40	1,920	4J175G1	161	80	12	150	6,220
4F050G1	118	44	8	40	2,320	1J345G1	99	60	12	100	5,670
1F065G1	59	44	8	25	1,550	2J345G1	145	80	12	150	6,660
2F065G1	76	44	8	30	1,670	6K115G1	207	80	13	200	7,060
1F090G1	65	44	8	30	1,590	4K175G1	172	80	13	200	7,210
2F090G1	90	44	8	30	1,730	6K175G1	225	80	13	200	7,740
6G022G1	121	50	7	50	2,360	1K345G1	111	60	13	100	5,810
4G036G1	102	50	7	50	2,630	2K345G1	157	80	13	150	6,820
6G036G1	130	44	7	60	3,590	3K345G1	203	80	13	200	7,460
4G050G1	123	44	7	60	3,490	1K620G1	145	60	13	100	6,110
6G050G1	163	44	7	60	3,640	2K620G1	225	80	13	150	7,320
1G065G1, 1G098EG1	61	44	7	25	1,660	1K800G1	136	80	13	150	6,890
2G065G1, 2G098EG1	79	50	7	50	2,540	2K800G1	195	80	13	200	7,700
4G065G1	115	50	7	60	3,690	1K1500G1	195	80	26	200	8,000

All dimensions in inches.

Dimensions and weights are estimates only. Actual values may vary.



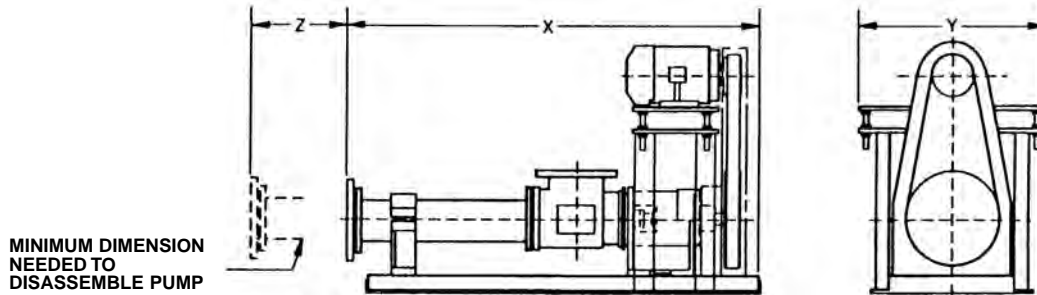
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PIGGYBACK BELT AND PULLEY ARRANGEMENT



PUMP	X	Y	Z	MAX HP	MAX UNIT WT.	PUMP	X	Y	Z	MAX HP	MAX UNIT WT.
1E008G1	43	23	7	5	670	1G090G1	68	30	7	30	1,670
2E008G1	51	23	7	10	780	2G090G1	92	32	7	60	3,390
4E008G1	68	26	7	20	980	1G115G1	67	30	9	40	2,800
6E008G1	84	30	7	30	1,060	2G115G1	90	32	9	60	3,920
1E012G1, 1E018EG1	46	23	7	5	680	6H036G1	135	34	10	75	4,000
2E012G1, 2E018EG1	58	23	7	10	790	6H050G1	168	37	10	100	4,350
4E012G1	80	26	7	20	1,000	4H065G1	120	37	10	100	4,680
6E012G1	102	30	7	30	1,090	6H065G1	155	37	10	100	4,980
1E022G1, 1E033EG1	48	23	7	10	820	2H090G1	96	32	10	60	3,920
2E022G1, 2E033EG1	61	23	7	20	1,050	4H090G1	146	37	10	100	4,720
4E022G1	87	26	7	30	1,180	1H115G1	71	30	10	40	2,900
1E036G1	51	26	7	20	990	2H115G1	94	34	10	75	4,290
2E036G1	65	30	7	30	1,140	4H115G1	141	37	10	100	5,060
1E050G1	56	26	7	20	1,030	1H175G1	76	32	13	50	3,460
2E050G1	76	30	7	30	1,220	2H175G1	102	37	13	100	5,040
6F012G1	107	30	8	30	1,270	6J065G1	160	42	12	150	5,720
4F022G1	91	30	8	40	1,900	4J090G1	151	42	12	150	5,610
6F022G1	117	30	8	40	2,040	6J090G1	200	42	12	150	5,780
1F036G1, 1F054EG1	53	23	8	15	900	4J115G1	146	42	12	150	6,300
2F036G1, 2F054EG1	68	26	8	30	1,260	6J115G1	193	42	12	150	6,560
4F036G1	97	30	8	40	2,290	1J175G1	79	32	12	60	4,390
1F050G1, 1F075EG1	58	23	8	20	1,090	2J175G1	106	37	12	100	5,160
2F050G1, 2F075EG1	78	30	8	40	1,920	4J175G1	161	42	12	150	6,220
4F050G1	118	30	8	40	2,320	1J345G1	99	37	12	100	5,670
1F065G1	59	26	8	25	1,550	2J345G1	145	42	12	150	6,660
2F065G1	76	30	8	30	1,670	6K115G1	207	47	13	200	7,060
1F090G1	65	30	8	30	1,590	4K175G1	172	47	13	200	7,210
2F090G1	90	30	8	30	1,730	6K175G1	225	47	13	200	7,740
6G022G1	121	32	7	50	2,360	1K345G1	111	37	13	100	5,810
4G036G1	102	32	7	50	2,630	2K345G1	157	42	13	150	6,820
6G036G1	130	32	7	60	3,590	3K345G1	203	47	13	200	7,460
4G050G1	123	32	7	60	3,490	1K620G1	145	37	13	100	6,110
6G050G1	163	32	7	60	3,640	2K620G1	225	42	13	150	7,320
1G065G1, 1G098EG1	61	26	7	25	1,660	1K800G1	136	42	13	150	6,890
2G065G1, 2G098EG1	79	32	7	50	2,540	2K800G1	195	47	13	200	7,700
4G065G1	115	32	7	60	3,690	1K1500G1	195	47	26	200	8,000

All dimensions in inches.

Dimensions and weights are estimates only. Actual values may vary.



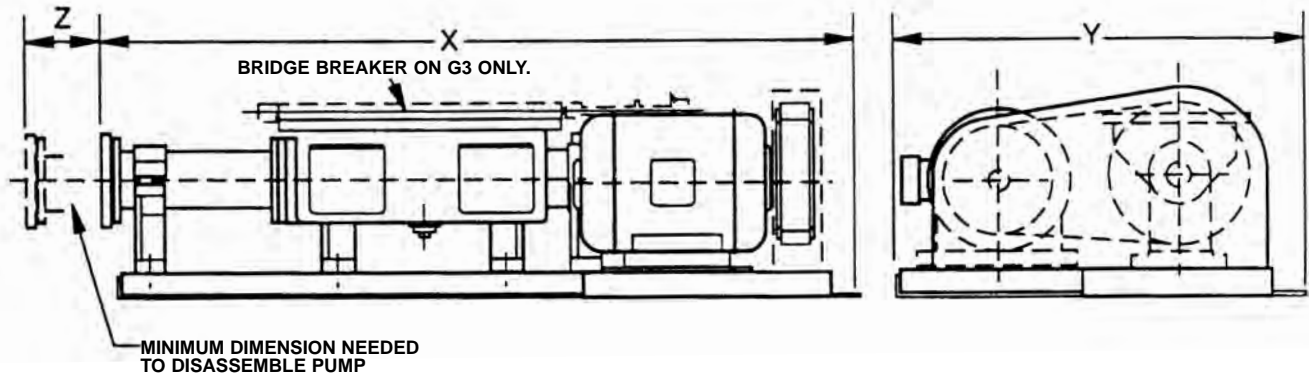
Always the Right Solution™

Section: Moyno® 2000
PUMP, DRIVE AND BASE DIMENSIONS

Page: 5 of 6

Date: October 15, 1998

BELT AND PULLEY ARRANGEMENT



BELT AND PULLEY ARRANGEMENT

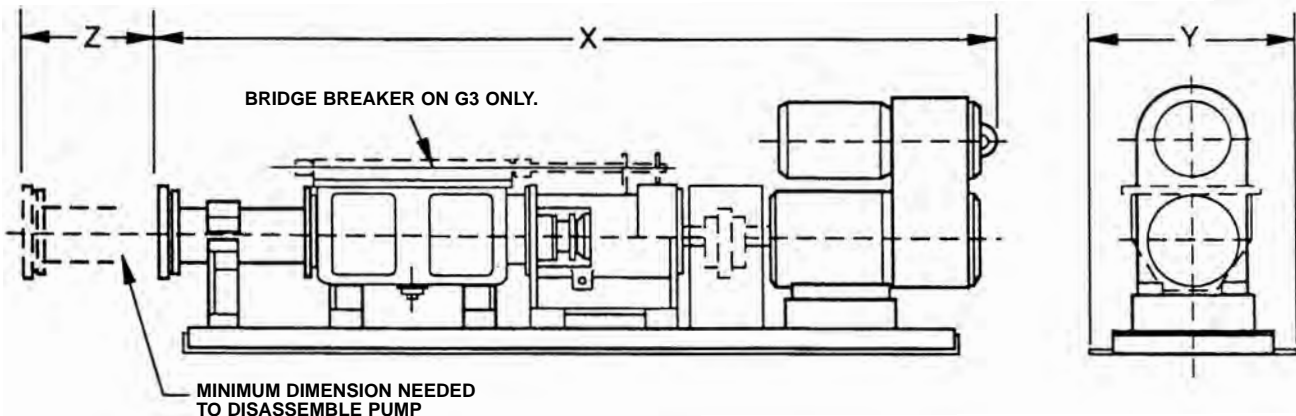
IN-LINE MECHANICAL VARIABLE SPEED ARRANGEMENT

PUMP	X	Y	Z	MAX HP	MAX UNIT WT.	PUMP	X	Y	Z	MAX HP	MAX UNIT WT.
2E008G2 & G3	71	44	7	20	820	2E008G2 & G3	113	26	7	20	1,000
4E008G2 & G3	82	44	7	25	970	4E008G2 & G3	129	30	7	25	1,250
2E012G2, G3 & 2E018EG2	74	44	7	15	820	2E012G2, G3 & 2E018EG2	110	26	7	15	1,010
4E012G2 & G3	97	44	7	15	990	4E012G2 & G3	134	30	7	15	1,210
2F022G2, G3 & 2F033EG2	92	57	8	20	1,490	2F022G2, G3 & 2F033EG2	130	30	8	20	1,480
4F022G2 & G3	123	64	8	20	1,820	4F022G2 & G3	156	32	8	20	1,780
2G036G2, G3 & 2G054EG2	90	57	7	30	2,250	2G036G2, G3 & 2G054EG2	144	32	7	30	2,415
4G036G2 & G3	123	64	7	40	2,830	4G036G2 & G3	175	32	7	40	2,950
2G050G2, G3 & 2G075EG2	103	44	7	30	2,350	2G050G2, G3 & 2G075EG2	155	32	7	30	2,550
4G050G2 & G3	147	65	7	40	3,050	4G050G2 & G3	195	32	7	40	3,100
2H065G2, G3 & 2H098EG2	106	60	10	50	2,700	2H065G2, G3 & 2H098EG2	158	32	10	50	2,790
4H065G2 & G3	147	65	10	60	3,300	4H065G2 & G3	195	32	10	50	3,230
2H090G2 & G3	123	64	10	50	3,000	2H090G2 & G3	172	32	10	50	3,000
4J090G2 & G3	180	65	12	100	3,400	4J090G2 & G3	232	37	12	50	3,400
2J115G2 & G3	129	64	12	100	3,470	2J115G2 & G3	181	32	12	50	2,590
4J115G2 & G3	176	65	12	100	4,130	4J115G2 & G3	228	32	12	50	4,100

All dimensions in inches.

Dimensions and weights are estimates only. Actual values may vary.

IN-LINE MECHANICAL VARIABLE SPEED ARRANGEMENT





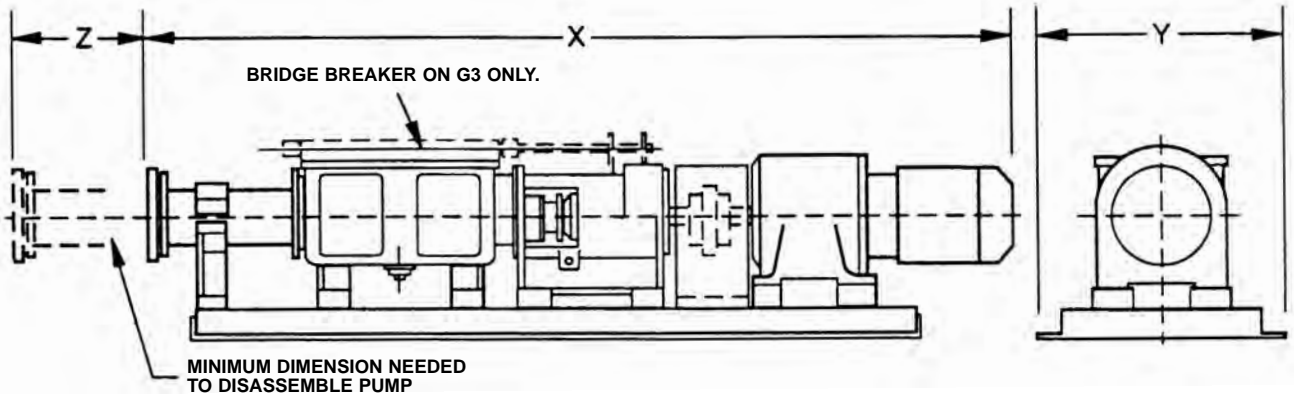
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Section: Moyno® 2000
PUMP, DRIVE AND BASE DIMENSIONS

Page: 6 of 6

Date: October 15, 1998

IN-LINE GEARMOTOR ARRANGEMENT



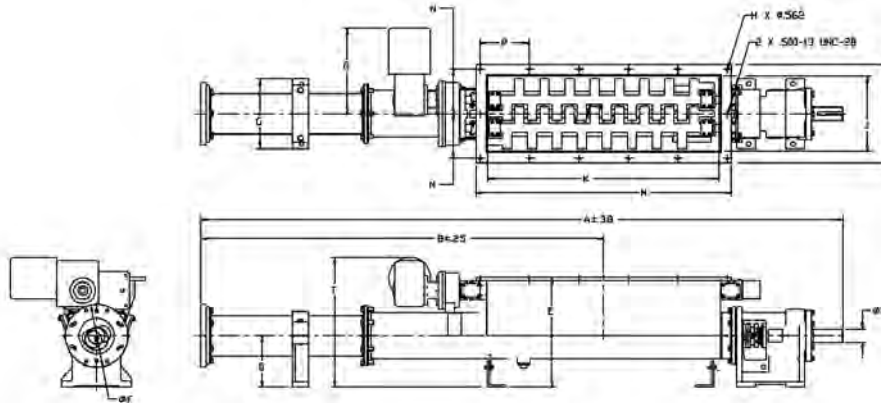
PUMP	X	Y	Z	MAX HP	MAX UNIT WT.
2E008G2 & G3	103	26	7	20	950
4E008G2 & G3	123	30	7	25	1,400
2E012G2, G3 & 2E018EG2	111	26	7	15	1,000
4E012G2 & G3	144	32	7	15	1,400
2F022G2, G3 & 2F033EG2	124	30	8	20	1,460
4F022G2 & G3	150	32	8	20	1,740
2G036G2, G3 & 2G054EG2	137	30	7	30	2,250
4G036G2 & G3	173	32	7	40	2,940
2G050G2, G3 & 2G075EG2	144	32	7	30	2,400
4G050G2 & G3	185	32	7	40	3,200
2H065G2, G3 & 2H098EG2	157	32	10	50	2,800
4H065G2 & G3	195	32	10	60	3,260
2H090G2 & G3	173	32	10	50	3,050
4J090G2 & G3	246	37	12	100	3,600
2J115G2 & G3	193	32	12	100	3,740
4J115G2 & G3	240	32	12	100	4,220

All dimensions in inches.

Dimensions and weights are estimates only. Actual values may vary.



Always the Right Solution™



* Consult factory for extended suction housing lengths. Bolt hole spacing may change in longer housings.

* R and T values are estimated and will vary per specific HP and gearmotor. Please consult factory for more specific information based upon application details.

G3 Bare Pump Dimensions									
Drive End	Suction ID			G3					
	J	K	L	M	N	P	H Qty	R	T
E	13.25	19.88	18.38	25.00	8.31	7.75	8	18.50	23.00
F	13.25	25.88	18.38	31.00	8.31	9.75	8	18.50	24.00
G	14.75	28.12	19.88	33.25	9.06	10.50	8	18.50	26.00
H	16.00	49.75	21.12	54.88	9.63	10.63	12	18.50	28.00
J	19.00	49.50	24.38	54.88	11.25	10.63	12	18.50	28.00
K	20.50	49.50	25.88	54.88	12.00	10.63	12	18.50	30.00

G3 Bare Pump Dimensions Open Throat Design with Bridge Breaker																
Frame Size	Standard Housing									Extended Length Suction Housings						
	A	B	D	E	G	U	Discharge Flange		Weight (Lbs)	1.0 Meter		1.5 Meter		2.0 Meter		
							Size	F		A	B	A	B	A	B	
1E008G3	73.88	42.01	6.00	15.75	8.00	1.875	4.00	9.00	722	103.75	56.95	123.25	66.70	142.88	76.51	
2E008G3	82.00	50.14	6.00	15.75	8.00	1.875	4.00	9.00	740	111.87	65.07	131.37	74.82	151.00	84.64	
4E008G3	98.50	66.64	6.00	15.75	8.00	1.875	4.00	10.00	822	128.37	81.57	147.87	91.32	167.50	101.14	
6E008G3	114.50	82.64	6.00	15.75	8.00	1.875	4.00	10.00	873	144.37	97.57	163.87	107.32	183.50	117.14	
1E012G3	76.94	45.08	6.00	15.75	8.00	1.875	4.00	9.00	727	106.81	60.01	126.31	69.76	145.94	79.58	
2E012G3	88.00	56.14	6.00	15.75	8.00	1.875	4.00	9.00	749	117.87	71.07	137.37	80.82	157.00	90.64	
4E012G3	110.50	78.64	6.00	15.75	8.00	1.875	4.00	10.00	866	140.37	93.57	159.87	103.32	179.50	113.14	
1F022G3	86.71	49.89	7.00	17.75	10.00	2.125	6.00	11.00	908	110.58	61.82	130.08	71.57	149.62	81.39	
2F022G3	99.52	62.70	7.00	17.75	10.00	2.125	6.00	11.00	950	123.40	74.64	142.90	84.39	162.52	94.20	
4F022G3	125.71	88.89	7.00	17.75	10.00	2.125	6.00	12.50	1,090	149.58	100.82	169.08	110.57	188.71	120.39	
6F012G3	141.40	104.58	7.00	17.75	10.00	2.125	4.00	10.75	1,074	165.28	116.52	184.78	126.27	204.40	136.08	
1G036G3	92.84	52.69	9.00	19.75	11.50	2.375	6.00	11.00	1,095	114.46	63.50	133.96	73.25	153.59	83.06	
2G036G3	107.34	67.19	9.00	19.75	11.50	2.375	6.00	11.00	1,157	128.96	78.00	148.46	87.75	168.09	97.56	
4G036G3	136.78	96.63	9.00	19.75	11.50	2.375	6.00	12.50	1,450	158.40	107.44	177.90	117.19	197.53	127.00	
1G050G3	98.27	58.12	9.00	19.75	11.50	2.375	6.00	11.00	1,133	119.90	68.94	139.40	78.69	159.02	88.50	
2G050G3	118.09	77.94	9.00	19.75	11.50	2.375	6.00	11.00	1,217	139.71	88.75	159.21	98.50	178.84	108.31	
4G050G3	158.40	118.25	9.00	19.75	11.50	2.375	6.00	12.50	1,499	180.03	129.07	199.53	138.82	219.15	148.63	
6G022G3	156.47	116.32	9.00	19.75	11.50	2.375	6.00	14.00	1,395	178.09	127.13	197.59	136.88	217.22	146.69	
1H065G3	121.36	68.01	11.00	23.50	15.00	2.875	8.00	13.50	1,696			140.86	77.76	160.49	87.58	
2H065G3	139.23	85.89	11.00	23.50	15.00	2.875	8.00	13.50	1,816	STD	STD	158.73	95.63	178.36	105.45	
4H065G3	175.48	122.13	11.00	23.50	15.00	2.875	8.00	15.00	2,140			194.98	131.88	214.61	141.70	
1H090G3	127.98	74.63	11.00	23.50	15.00	2.875	8.00	13.50	1,734			147.48	84.38	167.11	94.20	
2H090G3	152.48	99.13	11.00	23.50	15.00	2.875	8.00	13.50	1,957	STD	STD	171.98	108.88	191.61	118.70	
4H090G3	201.98	148.63	11.00	23.50	15.00	2.875	8.00	15.00	2,313			221.48	158.38	241.11	168.20	
6H036G3	191.36	138.01	11.00	23.50	15.00	2.875	6.00	14.00	2,026	STD	STD	210.86	147.76	230.49	157.58	
6H065G3	210.98	157.63	11.00	23.50	15.00	2.875	8.00	15.00	2,436			230.48	167.38	249.58	177.20	
1J115G3	131.51	73.62	11.00	25.00	15.00	3.375	8.00	13.50	2,232			151.01	83.37	170.63	93.18	
2J115G3	154.88	96.99	11.00	25.00	15.00	3.375	8.00	13.50	2,465	STD	STD	174.38	106.74	194.00	116.55	
4J115G3	202.13	144.24	11.00	25.00	15.00	3.375	8.00	15.00	2,820			221.63	153.99	241.25	163.80	
1J175G3	134.78	76.89	11.00	25.00	15.00	3.375	10.00	16.00	2,361			154.28	86.64	173.90	96.45	
2J175G3	161.40	103.51	11.00	25.00	15.00	3.375	10.00	16.00	2,683	STD	STD	180.90	113.26	200.52	123.07	
4J175G3	214.65	156.76	11.00	25.00	15.00	3.375	10.00	16.00	3,290			234.15	166.51	253.77	176.32	
6J090G3	256.21	198.32	11.00	25.00	15.00	3.375	8.00	16.50	3,236	STD	STD	275.71	208.07	295.33	217.88	
6J115G3	248.88	190.99	11.00	25.00	15.00	3.375	8.00	15.00	3,228			268.38	200.74	288.00	210.55	
6K175G3	277.48	213.13	13.00	28.50	17.00	3.875	10.00	17.00	4,679	STD	STD	296.98	222.88	316.60	232.69	

NOTE: All dimensions are in inches.

Moyno Pump Model: 2H065G3CDQ3AAA

File Reference:
Prepared For:
Prepared By:
Material:

Parameters

Rate of Flow:	30 GPM	Suction Pressure:	0 PSI
		Discharge Pressure:	50 PSI

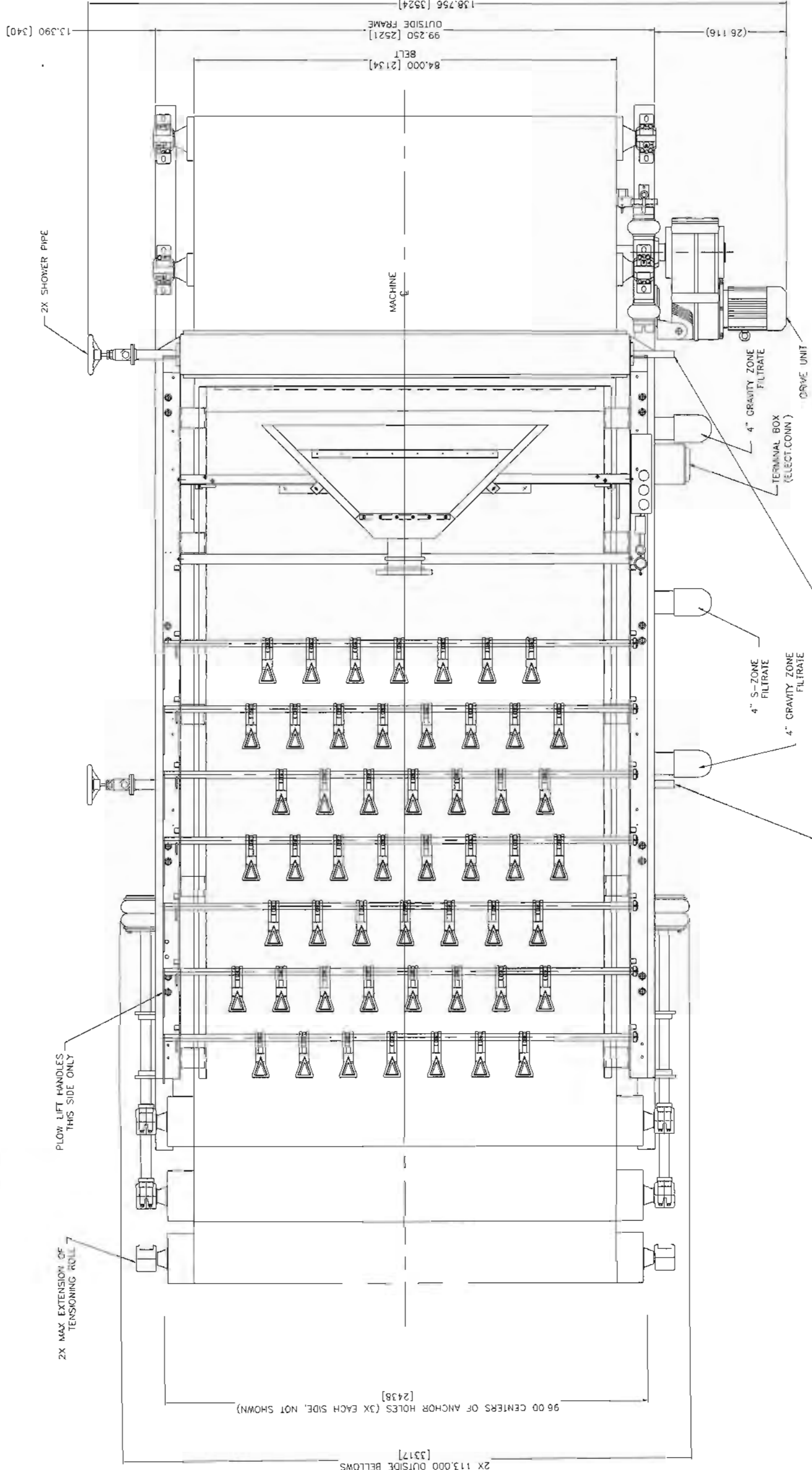
Fluid Character

Apparent Viscosity:	30,500 CP	Fluid Type:	Viscous
Specific Gravity:	1	% Solids:	17 %
Temperature:	70 F	Max Particle Size:	0.2 IN
Abrasion Level:	Medium	Average Particle Size:	0.1 IN

Performance (Calculated)

Diff Pressure:	50 PSI	Rate of Flow:	30 GPM
Slip:	0.00 GPM	Pump Speed:	66.81 RPM
Delta Temp:	0.10 F	Operating Torque:	3,579.72 In-Lbs
Internal Vel:	2.35 Ft/S	Starting Torque:	3,384.3 In-Lbs
Shear Rate:	38.66 Inv Secs	Required Power:	3.79 HP
NPSHR:		Intake Index	7.02

Notes: Use 7.5 HP Motor



13,390 [340]

99,250 [2521]

84,000 [2154]

138,756 [3524]

(26 116)

9600 CENTERS OF ANCHOR HOLES (3X EACH SIDE, NOT SHOWN) [2438]

2X 113,000 OUTSIDE BELLOWS [3317]

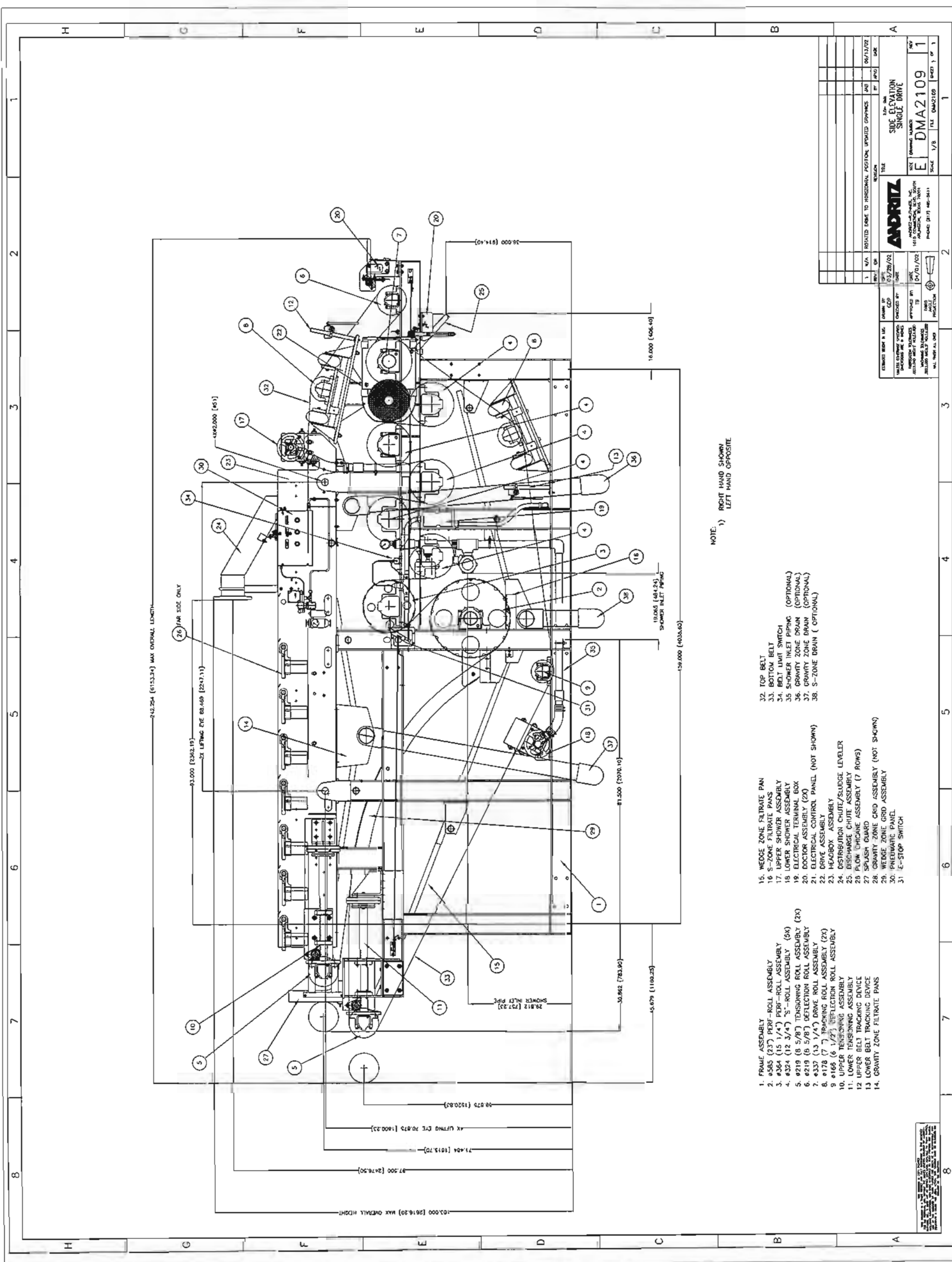
REV		DATE	BY	APVD	DATE
1	N/A				05/13/02
REVISION					
TITLE					
2.0m SUB					
PLAN VIEW SINGLE DRIVE					
SIZE	D	DRAWING NUMBER	DMA2110		
SCALE	1/10	FILE	DMA2110		
SHEET	1	OF	1		

ESTIMATED WEIGHT IN LBS:	DRAWN BY:	DATE:	REVISED BY:	DATE:
	GOF	03/28/02		
UNLESS OTHERWISE SPECIFIED:	CHECKED BY:	DATE:	APPROVED BY:	DATE:
DIMENSIONS ARE IN INCHES			TB	04/01/02
FABRICATION REQUIREMENTS:			THIRD	
XXXI.DWG FIRST "COLLECTED"			ANGLE	
MACHINE AUTOMATICALLY			PROTECTION	
XXXI.DWG REVISED 05/13/02				
WILL FINISH ALL OVER				

NOTES:

- RIGHT HAND MACHINE AS SHOWN
- LEFTHAND MACHINE OPPOSITE.

ANDRITZ-ROBINER, INC.
1016 COMMERCIAL BELT, SOUTH
WILMINGTON, TEXAS 75391
PHONE (817) 485-5811



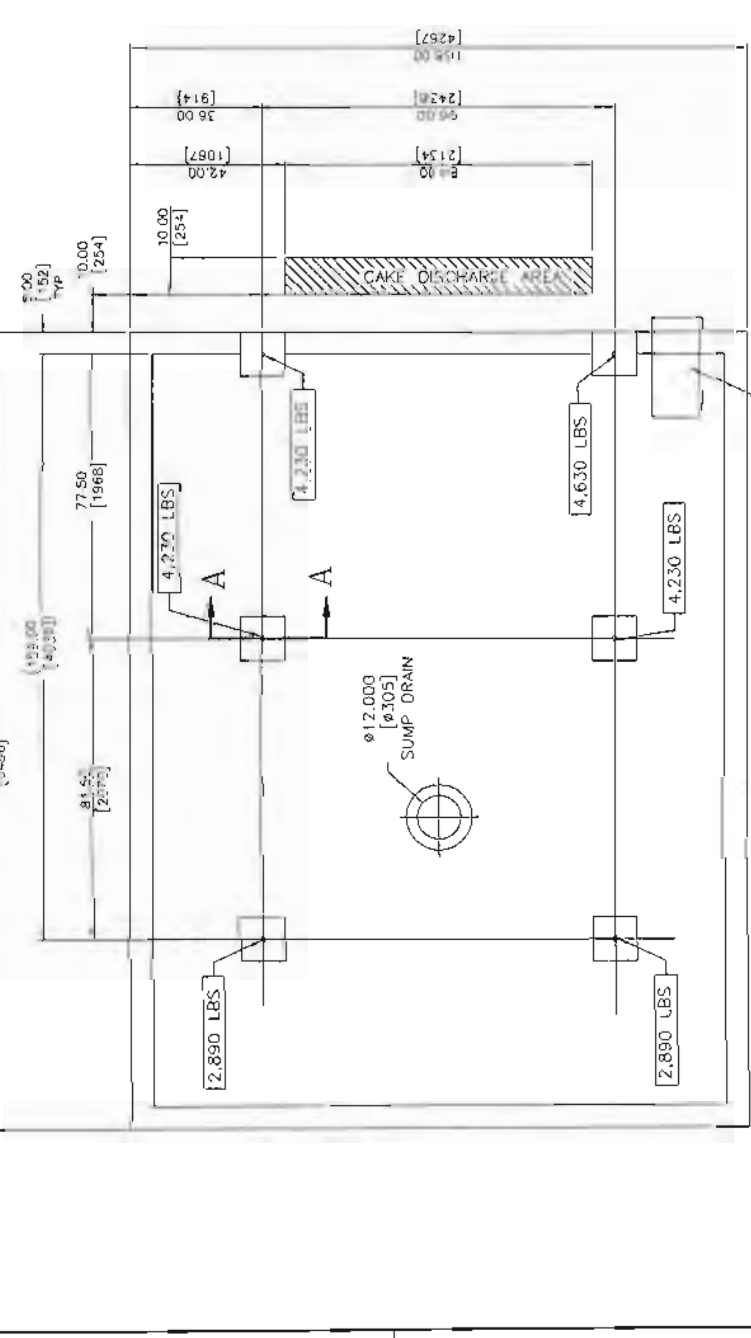
NOTE: 1) RIGHT HAND SHOWN
LEFT HAND OPPOSITE

- 1. FRAME ASSEMBLY
- 2. #585 (23) PERF-ROLL ASSEMBLY
- 3. #364 (15 1/4") PERF-ROLL ASSEMBLY
- 4. #324 (12 3/4") S"-ROLL ASSEMBLY (5X)
- 5. #219 (8 5/8") TENSIONING ROLL ASSEMBLY (2X)
- 6. #219 (8 5/8") DEFLECTION ROLL ASSEMBLY
- 7. #337 (13 1/4") DRIVE ROLL ASSEMBLY
- 8. #178 (7") TRACKING ROLL ASSEMBLY (2X)
- 9. #166 (6 1/2") REFLECTION ROLL ASSEMBLY
- 10. UPPER TENSIONING ASSEMBLY
- 11. LOWER TENSIONING ASSEMBLY
- 12. UPPER BELT TRACKING DEVICE
- 13. LOWER BELT TRACKING DEVICE
- 14. GRAVITY ZONE FILTRATE PANS
- 15. WEDGE ZONE FILTRATE PAN
- 16. S-ZONE FILTRATE PANS
- 17. UPPER SHOWER ASSEMBLY
- 18. LOWER SHOWER ASSEMBLY
- 19. ELECTRICAL TERMINAL BOX
- 20. DOCTOR ASSEMBLY (2X)
- 21. ELECTRICAL CONTROL PANEL (NOT SHOWN)
- 22. DRIVE ASSEMBLY
- 23. HEADBOX ASSEMBLY
- 24. DISTRIBUTION CHUTE/SLUDGE LEVELER
- 25. DISCHARGE CHUTE ASSEMBLY
- 26. FLOW CHICANE ASSEMBLY (7 ROWS)
- 27. SPLASH GUARD
- 28. GRAVITY ZONE CRID ASSEMBLY (NOT SHOWN)
- 29. WEDGE ZONE CRID ASSEMBLY
- 30. PNEUMATIC PANEL
- 31. E-STOP SWITCH
- 32. TOP BELT
- 33. BOTTOM BELT
- 34. BELT LIMIT SWITCH
- 35. SHOWER INLET PIPING (OPTIONAL)
- 36. GRAVITY ZONE DRAIN (OPTIONAL)
- 37. GRAVITY ZONE DRAIN (OPTIONAL)
- 38. S-ZONE DRAIN (OPTIONAL)

DESIGNED BY	DATE	SCALE	SHEET
CHKD BY	DATE		
APPROVED BY	DATE		
PROJECT NO.			
REV. NO.	DESCRIPTION	DATE	BY
1	REVISED DRAWING TO HORIZONTAL POSITION, UPDATED DIMENSIONS	06/13/02	JAB
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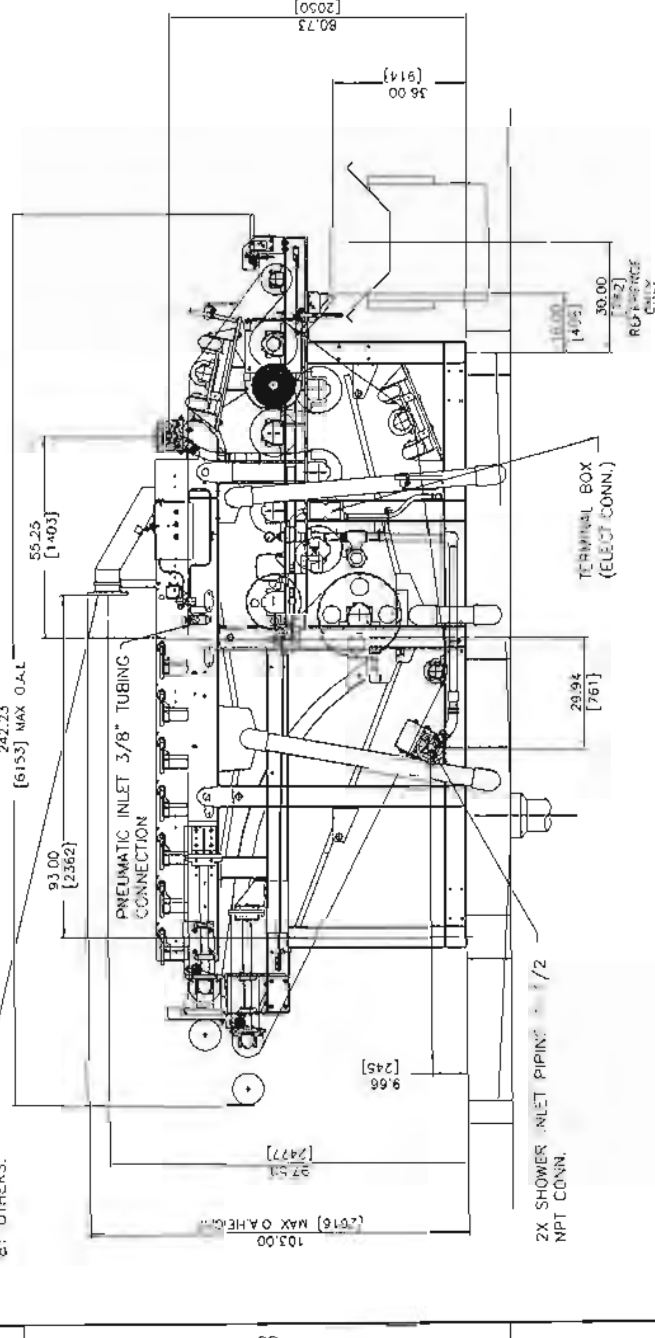
ANDRITZ
ANDRITZ-FAHNELE, INC.
1615 COMMERCIAL BLVD., SUITE 200
MADISON, MISSISSIPPI 39101
PHONE: (601) 462-1811

TITLE: SIDE ELEVATION SINGLE DRIVE
JOB NO: DMA2109
SCALE: 1/8" = 1'-0"
SHEET: 1 OF 1

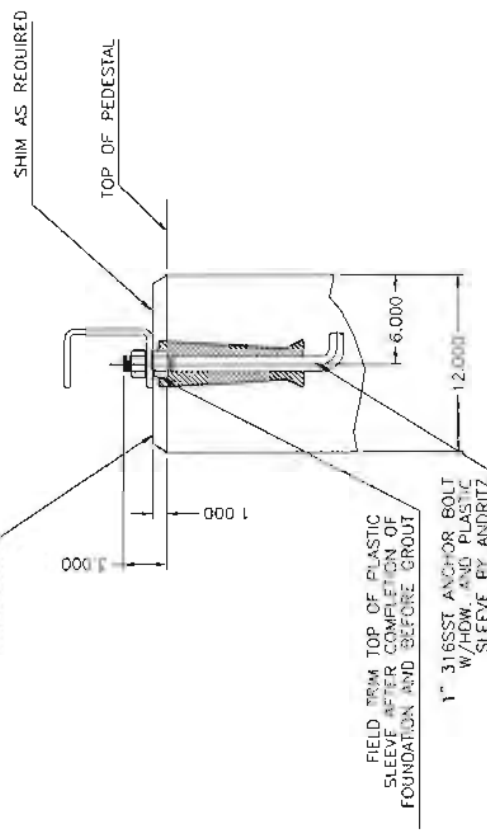


FOUNDATION PLAN

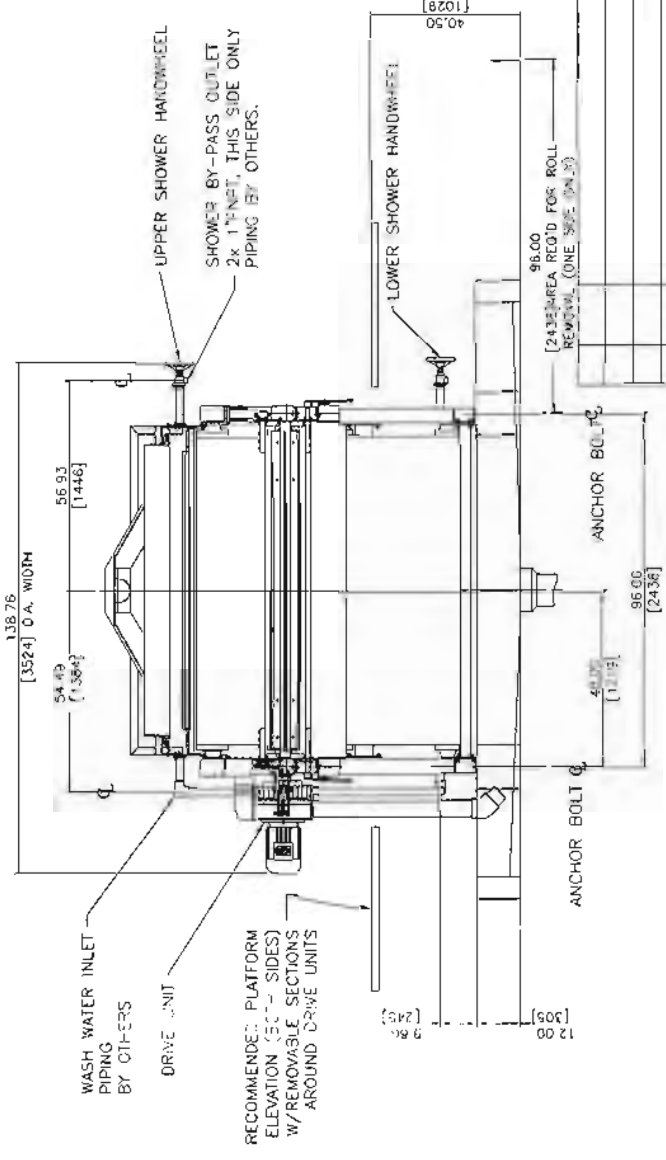
FEED INLET 6" 150#
PLG CONN PIPE
SUPPORTS &
EXPANSION JOINT
BY OTHERS.



SIDE ELEVATION



SECTION A-A
(SCALE: 1/8)



END ELEVATION

GENERAL NOTES AND INFORMATION

1. THE LOADINGS INDICATED INCLUDE VIBRATION EFFECTS.
2. THE FOUNDATION DESIGN SHOWN INDICATES MINIMUM REQUIREMENTS FOR CLEARANCE AND DRAINAGE. ACTUAL FOUNDATION DESIGN AND CONSTRUCTION TO BE FURNISHED BY OTHERS.
3. MINIMUM UTILITIES REQUIRED TO BE FURNISHED BY THE OWNER. THE FIGURES BELOW ARE FOR THE MACHINE ONLY. ANY ANCILLARY EQUIPMENT WILL REQUIRE ADDITIONAL UTILITIES.
 - A. AIR - FOUR (4) CUBIC FEET PER MINUTE OF CLEAN AIR @ 90 PSIG.
 - B. WATER - 90 GALLONS PER MINUTE AT AMBIENT TEMPERATURE AND 120 PSIG. MIN.
 - C. DRY WEIGHT OF MACHINE: 20,100 LBS
WET WEIGHT: 23,100 LBS
 - D. RIGHT HAND MACHINE - AS SHOWN

ESTIMATED WEIGHT IN LBS	DRAWN BY	DATE	REVISION	TITLE
FIELD CHECKED DIMENSIONS AS SHOWN	GDZ	03/28/12	1 N/A	FOUNDATION PLAN RH
FABRICATION TOLERANCES: ±0.005 (±0.0005) UNLESS OTHERWISE SPECIFIED	CHECKED BY	DATE	BY	DATE
MACHINING TOLERANCES: ±0.002 (±0.0002) UNLESS OTHERWISE SPECIFIED	TD	04/01/12	DMF	06/13/02
WELDING TOLERANCES: ±0.005 (±0.0005) UNLESS OTHERWISE SPECIFIED	THIRD ANGLE PROJECTION			
WELL FINISH ALL SURFACES				

ANDRITZ
ANDRITZ-ROTHER, INC.
10110 COMMERCIAL BLVD. SUITE 200
ARLINGTON, TEXAS 76017
PHONE: (817) 465-5611

SIZE	DRIVING NUMBER	REV
D	DMF1381	1
SCALE	FILE	SHEET
1/2"=1'	DMF1381	1 OF 1





Andritz Information Package 1002252-1

March 22, 2011

To

CH2M Hill

Mr. Jason Krumsick

Jason.krumsick@ch2m.com

In Response to

Bend, Oregon WWTP Solid Dewatering Project

Andritz Local Representative

Shawn Clark-APSCO

PH: (541) 754-7292

Email: sclark@apsco-inc.com

This proposal is the confidential and proprietary information of Andritz Separation Inc. Any party accepting receipt of this proposal does so on the express understanding and agreement that they will neither copy, reproduce, disclose to third parties or use this proposal for any purpose other than those expressly agreed to by Andritz Separation Inc. in writing. Such party also agrees to indemnify Andritz Separation Inc. against any losses or damages suffered by Andritz Separation Inc. as a result of such party's improper reproduction, disclosure or use of this proposal.

March 22, 2011

Ch2M Hill

Mr. Jason Krumsick

REFERENCE: Bend, OR WWTP - Solid Dewatering Project

Mr. Krumsick

As requested by the local Andritz equipment representative for your area I am providing you this information package that details the Andritz Low Profile belt filter press. Andritz is pleased to provide you with this package that not only provides budgetary pricing but also defines the Andritz Low Profile belt press features.

I would like to point out that all of Andritz products are engineered for quality and value. Andritz designs their belt presses too compete in a market that desires equipment with the reliable life cycle time, ease of operation and lowest maintenance costs. The following outline of the features and benefits of the Andritz Low Profile belt filter press technology will help to define why Andritz competes in this market area.

Please review the following information. Should you have further questions regarding our equipment or company, please contact our local equipment representative Shawn Clark of APSCO at (541) 754-7292 or myself at (817) 419-1730.

Sincerely,



Bruce SoRelle
Western
Regional Sales Manager
Andritz Separation Inc.

Attachments:

2.0 meter, Low Profile, SMX-S8 Specifications/Drawings

ANDRITZ

Belt Filter Press Features & Benefits

Several equipment manufacturers actively market belt filter press technology. As a result, different levels of manufacturing become distinct, **quality competitive** and **price competitive**. Price competitive features include; lower effective filtration areas, channel frames, and un-machined rolls to name a few. Quality competitive features include; high effective filtration areas, wide flange beam frames, 316L stainless steel wetted areas, and machined rolls. Andritz offers both or a combination of quality levels in their equipment to cater to specific applications and needs. Andritz has developed and maintains a reputation for manufacturing quality equipment. While bottom dollar price is initially attractive, it ultimately costs the owner considerably throughout the life of the equipment with high O&M costs and unscheduled downtime. The owner's interests are clearly protected by quality-engineered designs. For this reason Andritz offers designs that provide both quality and value. To detail several quality features of the SMX-S8, Low Profile belt press technology, please review the following:

2.0-Meter, Low Profile SMX-S8, Effective Filtration Area

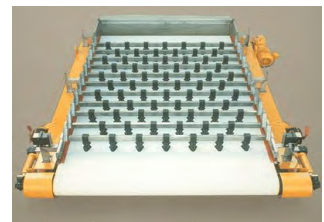
Effective filtration area relates directly to throughput and performance.

	Andritz S8
	(Based on 2.0m)
Gravity zone area	90 ft ²
Wedge zone area	83.4 ft ²
Pressure zone area	122 ft ²
Total	295.4 ft²



Plow Assembly

Andritz utilizes a plow design that not only distributes the feed across the width of the belt, but also allows for a gentle rolling action which releases additional free water. The entire assembly is manufactured of 316L stainless steel as a standard. The use of stainless steel and our chicane design minimizes cost of ownership in terms of polymer consumption and replacement due to corrosion and abrasion.



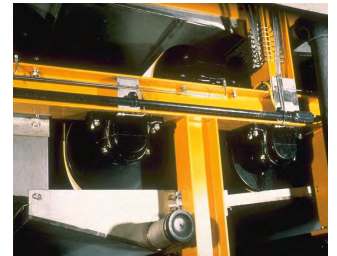
Cambered Wedge

This innovative design allows a self-adjusting, constant pressure to be applied to the sludge cake regardless of belt speed and solids loading fluctuations. Case studies have proven that a 2 to 4 percent increase in cake solids is achieved from the cambered wedge design. The self-adjusting feature is key to maximum wedge zone efficiency.



High Pressure Zone

The Andritz low profile unit incorporates a 24" perforated drum followed by seven (7) rolls that sequentially decrease in diameter. This configuration increases surface tension, and allows for a gradual increasing pressure on the sludge cake, thus increasing cake dryness.



Rollers

All Andritz presses utilize a three step machining process on our rollers. This insures precision centering in the journal and concentricity. Approximated journals increase the probability of oval journal rotation that deform the bearing seal and permits moisture intrusion into the bearing housing. Unmachined roller surfaces allow for hills and valleys on the roller face. This promotes wear at varying rates as well as accelerates belt wear. The Andritz double shaft construction has a minimum roll wall thickness of 1/2" and minimum rubber coating thickness of 1/4". All rollers are machined to a concentricity of 0.020".



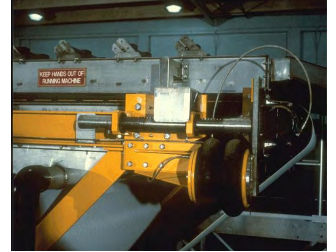
Belt Tracking

Tracking a traveling belt has been developed to a fine art in the pulp and paper industry. Few belt press manufacturers are aware and understand the technology. You may be aware paper machines travel up to 4,000 ft/min. Andritz incorporates this same **proportional** tracking with continuous monitoring into our belt press design.



Belt Tensioning

Andritz – rack & pinion assemblies are manufactured of 316L stainless steel. Rack and pinion belt tensioning insures parallel movement of the tensioning roll. Andritz tensioning design eliminates the need for O-rings, which decreases O&M and downtime.



Service After The Sale

Of utmost importance is Andritz support after the sale. Andritz has earned a strong reputation in the marketplace by providing quality service with emphasis on customer satisfaction. We continuously support our customers with prompt availability and fair spare parts pricing. Andritz also has a laboratory-staffed full time to evaluate and assist customers with process upset conditions. This service is available to all Andritz customers free of charge. Andritz also can provide bench testing and on site pilot testing during project development stages. These services establish specific performance capabilities that assist with performance specification development. It is highly recommended that these services be utilized.

Summary

In summary, we recognize that we need to go the extra mile for our customers. Our services for belt filter press technology have been in the U.S. market since 1978. **We want to earn your business.** Should Andritz be purchased for this project, the customer can rest assured that their dewatering equipment needs will be met with total satisfaction.

Features & Benefits Quick Reference Guide

<u>FEATURE</u>	<u>BENEFIT</u>
A) Precision Machined rollers	Longer roller life Longer belt life Reduced O&M expenses
B) Interconnected belt tensioning thrust arms	Tensioning arms must remain parallel thus insuring accurate belt tracking
C) Paper machine quality belt tracking mechanism	Automatic belt travel correction which increases belt life and roller surface life
D) Replaceable UHMW wear bars that do not require frame disassembly	Lowers O&M cost by \$10K/5 years of ownership
E) Plows that invert sludge upon passing	Exposes wear to filter media
F) All stainless steel UHMW wear bar support grid	Lowers O&M cost
G) Split pillow block bearing housing	Can replace bearing without roller removal off the shelf items
H) Solid bearing exterior housing	Prevents moisture intrusion
I) Double end stub journal design with minimum .5" wall thickness	Roller deflection of .05mm" or less per meter, lower O&M cost
J) 24" diameter perforated drum roller	Higher throughput
K) 8 sequentially decreasing diameter high pressure rollers	Higher dryness at discharge
L) Pneumatic operation	No mess; no routine maintenance
M) Total effective filtration area of 295.4 sq. ft.	High performance in both throughout or dryness

Andritz

Information Package 1127362-1

For

Bend, Oregon WWTP

Belt Filter Application Project

March 22,2011

A. Design Criteria

1. Type of Sludge: 66% Primary/ 33% WAS Anaerobically Digested
2. Design Throughput: 2100 lbs/hr TS
3. Hydraulic Loading: 150 gpm
4. Inlet Solids Consistency: 3.5% TS
5. Operating Cycle: 40 hours a week

B. Equipment Recommended and Anticipated Performance

1. Number of Units: Two (2)
2. Type of Press: 2.0 meter SMX-S8, Low Profile Belt Filter Press
3. Anticipated Cake Consistency: 17 -19 % TS
4. Solids Capture Efficiency: 95% TSS
5. Polymer Consumption: 20 ± 2 lbs/ton Active Solids Content

NOTE:

All performance values listed previously are obtained from Andritz experience from similar installations and laboratory testing. Laboratory analysis and or on site pilot testing of specific sludge is required to determine actual performance capabilities for specific installations. Andritz offers laboratory bench and on site pilot testing.

C. Budgetary Pricing:

Standard, 2.0 meter SMX-S8 Low Profile Belt Press: **\$275,000 per unit**

D. Scope of Supply Included in Andritz Pricing:

ITEM #	QTY	DESCRIPTION
1.	One	<p>The Andritz 2.0 Meter, SMX[®]-S8, Low Profile Belt Filter Press comes standard with a “Hot Dipped” galvanized carbon steel frame, and all wetted parts 316L stainless steel including:</p> <ul style="list-style-type: none"> • Pneumatic tracking and belt tensioning system • Triple-sealed split pillow block bearings • One (1) set of seamed dewatering fabrics • Buna N rubber and Rilsan covered rolls • Upper & lower stainless steel showers with internal brush and hand wheel for cleaning • Upper & lower automatic dewatering fabric tracking and tensioning device • Eurodrive reducer complete with motor mounting bracket, high speed coupling, and guards with motor and VFD • Wiring of emergency stop and belt runoff limit switches • Gravity zone plows with stainless steel assembly and fixtures • Nema 4X 304L stainless steel electric/pneumatic control panel <p>316L SS assemblies included</p> <ul style="list-style-type: none"> - Headbox - Venturi Mixer - Distribution plate - Gravity zone sidewalls - Grid brackets in gravity and wedge sections - Thrust rod guides - Upper and lower shower boxes - Filtrate pans in all areas - All nuts, bolts, and associated hardware - Plow assemblies

2. 1 Lot Basic Engineering and Documentation:
(Typically includes the following)
- Six sets arrangement drawings and dimensions for the Andritz scope
 - Six sets foundation drawings showing details needed for building work
 - Motor list
 - Written sequence of operation including all interlocks
 - Control panel layout
 - Electrical and pneumatic schematics
 - Terminal box details
 - Erection, operating and maintenance manuals
 - Six sets operation/part manuals

E. Scope Not Included in Andritz Price:

(To be provided by others or Andritz at an additional cost)

	Estimated Cost
v Access platforms (if required)	\$25,000.00 ea.
v Sludge feed pumps	\$15,000.00 ea.
v Polymer systems	\$15,000.00 (liquid) ea.
v Sludge discharge conveyors	\$1,400.00 per Linear Foot
v Flow meters and related field instruments	\$5,000.00 ea.
v Wash water booster pumps	\$1,000.00 ea.
v Air compressors	\$3,000.00 ea.
v Civil and structural engineering work including preparation of foundations, platforms, and channels	
v Static calculations of foundations, building and building plans (Andritz will furnish load data)	
v Building modifications	
v All utilities required for operation and erection	
v Cranes or other lifting devices	
v Unloading and unpacking at site	
v Flush water connections	
v Oil and grease	
v Freight to job site	
v On site start up services	
v Electrical wiring or pneumatic connections to main control panel	
v Local pressure gauges and other instruments not specified in our scope of supply	
v Equipment Installation	

ANDRITZ SEPARATION INC.

STANDARD TERMS AND CONDITIONS OF SALE

1. TERMS APPLICABLE

The Terms and Conditions of Sale listed below are the exclusive terms and conditions applicable to quotations made and orders acknowledged by Andritz Separation Inc. ("Seller") for the sales of products, equipment and parts relating thereto ("Products"). This quotation or acknowledgment is expressly made conditional upon Buyer's assent to such terms and conditions. Any of Buyer's terms and conditions which are in addition to or different from those contained herein, which are not separately agreed to by Seller in writing, are hereby objected to and shall be of no effect. Objections to any terms and conditions contained herein shall be deemed waived if Seller does not receive written notice thereof within 20 days of the date of this quotation or acknowledgment. Buyer in any event will be deemed to have assented to the terms and conditions contained herein if delivery of any Product is accepted. The term "this Agreement" as used herein means this quotation or acknowledgment or purchase order, together with any attachment hereto, any documents expressly incorporated by reference and these Standard Terms and Conditions of Sale.

2. DELIVERY

Delivery dates are good faith estimates and do not mean that "time is of the essence". Buyer's failure to promptly make advance or interim payments, supply technical information, drawings and approvals will result in a commensurate delay in delivery. Upon and after delivery, title and risk of loss or damage to the Products shall be Buyer's. Unless otherwise agreed in writing by Seller, delivery of the Products hereunder will be made F.O.B. Seller's plant (or F.O.B. point of manufacture for any Product shipped direct to Buyer from any location other than Seller's plant).

3. WARRANTY

(a) Seller warrants to Buyer that the Products manufactured by it will be delivered free from defects in material and workmanship. This warranty shall commence upon delivery of the Products and shall expire on the earlier to occur of 12 months from initial operation of the Products and 18 months from delivery thereof (the "Warranty Period"). If during the Warranty Period Buyer discovers a defect in material or workmanship and gives Seller written notice thereof within 10 days of such discovery, Seller will either deliver to Buyer, a replacement part or repair the defect in place. Seller will have no warranty obligations under this paragraph 3(a): (i) if the Products have not been operated and maintained in accordance with generally approved industry practice and with Seller's specific written instructions; (ii) if the Products are used in connection with any mixture or substance or operating condition other than that for which they were designed; (iii) if Buyer fails to give Seller such written 10 day notice; (iv) if the Products are repaired by someone other than Seller or have been intentionally or accidentally damaged, or (v) for corrosion, erosion, ordinary wear and tear or in respect of any parts which by their nature are exposed to severe wear and tear or are considered expendable.

(b) Seller further warrants to Buyer that at delivery, the Products manufactured by it will be free of any liens or encumbrances. If there are any such liens or encumbrances, Seller will cause them to be discharged promptly after notification from Buyer of their existence.

(c) THE EXPRESS WARRANTIES SELLER MAKES IN THIS PARAGRAPH 3 ARE THE ONLY WARRANTIES IT WILL MAKE. THERE ARE NO OTHER WARRANTIES, WHETHER STATUTORY, ORAL, EXPRESS OR IMPLIED. IN PARTICULAR, THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

(d) The remedies provided in paragraphs 3(a) and 3(b) are Buyer's exclusive remedy for breach of warranty.

(e) With respect to any Product or part thereof not manufactured by Seller, Seller shall pass on to Buyer only those warranties made to Seller by the manufacturer of such Product or part which are capable of being so passed on.

4. LIMITATION OF LIABILITY

Notwithstanding any other provision in this Agreement, the following limitations of liability shall apply:

(a) In no event, whether based on contract, tort (including negligence), strict liability or otherwise, shall Seller, its officers, directors, employees, subcontractors, suppliers or affiliated companies be liable to Buyer or any third party for loss of profits, revenue or business opportunity, loss by reason of shutdown of facilities or inability to operate any facility at full capacity, or cost of obtaining other means for performing the functions performed by the Products, loss of future contracts, claims of customers, cost of money or loss of use of capital, in each case whether or not foreseeable, or for any indirect, special, incidental or consequential damages of any nature.

(b) The aggregate liability of Seller, its officers, directors, employees, subcontractors, suppliers or affiliated companies, for all claims of any kind for any loss, damage, or expense resulting from, arising out of or connected with the Products or this Agreement or from the performance or breach thereof, together with the cost of performing make good obligations to pass performance tests, if applicable, shall in no event exceed the contract price. The foregoing notwithstanding, if applicable, any claims for (a) delay in delivery shall not exceed 5% and (b) breach of performance guarantees shall not exceed 20% of the order price.

(c) The limitations and exclusions of liability set forth in this paragraph 4 shall take precedence over any other provision of this Agreement and shall apply whether the claim of liability is based on contract, warranty, tort (including negligence), strict liability, indemnity, or otherwise. The remedies provided in this Agreement are Buyer's exclusive remedies.

(d) All liability of Seller, its officers, directors, employees, subcontractors, suppliers or affiliated companies, resulting from, arising out of or connected with the Products or this Agreement or from the performance or breach thereof shall terminate on the third anniversary of the date of this Agreement.

5. TAXES

Seller's prices do not include any sales, use, excise or other taxes. In addition to the price specified herein, the amount of any present or future sales, use, excise or other tax applicable to the sale or use of the Products shall be billed to and paid by Buyer unless Buyer provides to Seller a tax-exemption certificate acceptable to the relevant taxing authorities.

6. SECURITY INTEREST

Seller shall retain a purchase money security interest and Buyer hereby grants Seller a lien upon and security interest in the Products until all payments hereunder have been made in full. Buyer acknowledges that Seller may file a Form UCC-1 financing statement and may take all other action it deems reasonably necessary to perfect and maintain such security interest in Seller and to protect Seller's interest in the Products.

7. SET OFF

Neither Buyer nor any of its affiliates shall have any right to set off claims against Seller or any of its affiliates for amounts owed under this Agreement or otherwise.

8. PATENTS

Unless the Products or any part thereof are designed to Buyer's specifications and provided the Product or any part thereof is not used in any manner other than as specified or approved by Seller in writing, (i) Seller shall defend against any suit or proceeding brought against Buyer to the extent based on a claim that any Product, or any part thereof, infringes any United States patent; provided Seller is notified promptly in writing and given the necessary authority, information and assistance for the defense of such suit or proceeding; (ii) Seller shall satisfy any judgment for damages entered against Buyer in such suit; and (iii) if such judgment enjoins Buyer from using any product or a part thereof, then Seller shall, at its option: (a) obtain for Buyer the right to continue using such Product or part; (b) eliminate the infringement by replacing or modifying all or part of the Products; or (c) take back such Product or part and refund to Buyer all payments on the purchase price which Seller has received, in which case neither Buyer nor Seller will have any claim against the other under this Agreement or arising out of the subject matter of this Agreement. The foregoing states Seller's entire liability for patent infringement by any Product or part thereof.

9. TERMINATION

Buyer may only terminate its order upon written notice to Seller and upon payment to Seller of Seller's termination charges, which shall be specified to Buyer and shall take into account among other things expenses (direct and indirect) incurred and commitments already made by Seller and an appropriate profit; provided, that in no event shall Seller's termination charges be less than 25% of the contract price. In the event of the bankruptcy or insolvency of Buyer or in the event of any bankruptcy or insolvency proceeding brought by or against Buyer, Seller shall be entitled to terminate any order outstanding at any time during the period allowed for filing claims against the estate and shall receive reimbursement for its cancellation charges.

10. CHANGES

Seller will not make changes in the Products unless Buyer and Seller have executed a written Change Order for such change. Such Change Order will include an appropriate adjustment to price and delivery terms. If the change impairs Seller's ability to satisfy any of its obligations to Buyer, the Change Order will include appropriate modifications to this Agreement. If, after the date of this quotation or acknowledgment, new or revised governmental requirements should require a change in the Products, the change will be subject to this paragraph 10.

11. CONFIDENTIALITY

Buyer acknowledges that the information which Seller submits to Buyer in connection with this quotation or acknowledgment includes Seller's confidential and proprietary information, both of a technical and commercial nature. Buyer agrees not to disclose such information to third parties without Seller's prior written consent. Seller grants to Buyer a non-exclusive, royalty-free, perpetual license to use Seller's confidential and proprietary information for purposes of this specific order and the Products that are the subject hereof only. Buyer further agrees not to permit any third party to fabricate the Products or any parts thereof from Seller's drawings or to use the drawings other than in connection with this specific order. Buyer will defend and indemnify Seller from any claim, suit or liability based on personal injury (including death) or property damage related to any Product or part thereof which is fabricated by a third party without Seller's prior written consent and from and against related costs, charges and expenses (including attorney's fees). All copies of Seller's drawings shall remain Seller's property and may be reclaimed by Seller at any time.

12. END USER

If Buyer is not the end user of the Products sold hereunder (the "End User"), then Buyer will use its best efforts to obtain the End User's written consent to be bound to Seller by the provisions of paragraphs 3, 4, 5 and 11 hereof. If Buyer does not obtain such End User's consent, Buyer shall defend and indemnify Seller and Seller's agents, employees, subcontractors and suppliers from any action, liability, cost, loss, or expense for which Seller would not have been liable or from which Seller would have been indemnified if Buyer had obtained such End User's consent.

13. FORCE MAJEURE

(a) Force Majeure Defined. For the purpose of this Agreement "Force Majeure" will mean all unforeseeable events, beyond the reasonable control of either party which affect the performance of this Agreement, including, without limitation, acts of God, acts or advisories of governmental or quasi-governmental authorities, laws or regulations, strikes, lockouts or other industrial disturbances, acts of public enemy, wars, insurrections, riots, epidemics, pandemics, outbreaks of infectious disease or other threats to public health, lightning, earthquakes, fires, storms, severe weather, floods, sabotage, delays in transportation, rejection of main forgings and castings, lack of available shipping by land, sea or air, lack of dock lighterage or loading or unloading facilities, inability to obtain labor or materials from usual sources, serious accidents involving the work of suppliers or sub-suppliers, thefts and explosions.

(b) Suspension of Obligations. If either Buyer or Seller is unable to carry out its obligations under this Agreement due to Force Majeure, other than the obligation to make payments due hereunder, and the party affected promptly notifies the other of such delay, then all obligations that are affected by Force Majeure will be suspended or reduced for the period of Force Majeure and for such additional time as is required to resume the performance of its obligations, and the delivery schedule will be adjusted to account for the delay.

(c) Option to Terminate. If the period of suspension or reduction of operations will extend for more than four (4) consecutive months or periods of suspension or reduction total more than six (6) months in any twelve (12) month period, then either Buyer or Seller may terminate this Agreement.

14. INDEMNIFICATION AND INSURANCE

(a) Indemnification. Seller agrees to defend and indemnify Buyer from and against any third-party claim for bodily injury or physical property damage ("Loss") arising in connection with the goods provided by Seller hereunder or the Work performed by Seller hereunder, but only to the extent such Loss has been caused by the negligence, willful misconduct or other legal fault ("Fault") of Seller. Buyer shall promptly tender the defense of any such third-party claim to Seller. Seller shall be entitled to control the defense and resolution of such claim, provided that Buyer shall be entitled to be represented in the matter by counsel of its choosing at Buyer's sole expense. Where such Loss results from the Fault of both Seller and Buyer or a third party, then Seller's defense and indemnity obligation shall be limited to the proportion of the Loss that Seller's Fault bears to the total Fault.

(b) Insurance. Seller shall maintain commercial general liability insurance with limits of not less than \$2,000,000 per occurrence and in the aggregate covering claims for bodily injury (including death) and physical property damage arising out of the Work. Seller shall also provide workers' compensation insurance or the like as required by the laws of the jurisdiction where the Work will be performed, and owned and non-owned auto liability insurance with limits of not less than \$1,000,000 combined single limit. Buyer shall be designated as an additional insured under Seller's commercial general liability insurance and auto liability insurance coverages, and Seller will provide a Certificate of Insurance certifying the existence of such coverages upon request.

15. GENERAL

(a) Seller represents that any Products or parts thereof manufactured by Seller will be produced in compliance with all applicable Federal, State and local laws applicable to their manufacture and in accordance with Seller's engineering standards. Seller shall not be liable for failure of the Products to comply with any other specifications, standards, laws or regulations.

(b) This Agreement shall inure only to the benefit of Buyer and Seller and their respective successors and assigns. Any assignment of this Agreement or any of the rights or obligations hereunder, by either party without the written consent of the other party shall be void.

(c) This Agreement contains the entire and only agreement between the parties with respect to the subject matter hereof and supersedes all prior oral and written understandings between Buyer and Seller concerning the Products, and any prior course of dealings or usage of the trade not expressly incorporated herein.

(d) This Agreement (including these standard terms and conditions of sale) may be modified, supplemented or amended only by a writing signed by an authorized representative of Seller. Seller's waiver of any breach by Buyer of any terms of this Agreement must also be in writing and any waiver by Seller or failure by Seller to enforce any of the terms and conditions of this Agreement at any time, shall not affect, limit or waive Seller's right thereafter to enforce and compel strict compliance with every term and condition thereof.

(e) This Agreement and the performance thereof will be governed by and construed according to the laws of the State of Texas. The parties hereto irrevocably submit to the jurisdiction of the Federal and State courts sitting in Tarrant County, Texas and waive any claims as to inconvenient forum. In the event this Agreement pertains to the sale of any goods outside the United States, the parties agree that the United Nations Convention for the International Sale of Goods shall not apply to this Agreement.

September 30, 2011

To: Jason Krumsick, PE*
CH2M Hill
2020 SW Fourth Ave, Suite 300
Portland OR 97201



Ref: Bend Belt Press Budget Quote

Jason,

On behalf of WH Reilly & Associates and Ashbrook Simon-Hartley, we both thank you for the opportunity to offer our budget proposal for your consideration on this project.

The equipment we propose to furnish is as follows:

<u>QUANTITY</u>	<u>DESCRIPTION</u>
(1)	Ashbrook Simon-Hartley KP “Z”[®] , 2.0-meter Belt Filter Press with low profile gravity and wedge sections and is complete with Hydraulic System for belt tensioning. Speed control for the press is via a VFD at the press.
(1)	Control Panel. The Belt Filter Press (BFP) Control Panel will be designed, based on Ashbrook’s standard BFP specifications (NO contract drawings). It will be powered from a 480 VAC power source, supplied by others. IEC style motor starters will be supplied for the washwater pump and hydraulic pump, with an Allen Bradley PowerFlex 400 style VFD’s provided for the belt drives. All other starters / controllers, and 120 VAC power for the polymer system will be supplied by others. The BFP Control Panel will be a NEMA 4X-Stainless Steel enclosure. The controls for the BFP and ancillary equipment will be either manually or automatically controlled. START/STOP pushbuttons with RUNNING status lights will be provided for control of the washwater pump/valve, the hydraulic pump, the belt drive, the conveyor, the sludge pump and the polymer pump. Speed control and speed/flow indication will be provided for the belt drive, the sludge pump and the polymer pump. Operator interface will be accomplished using Allen Bradley, Type 800H pilot devices. All logic will be performed via an Allen Bradley MicroLogix 1200 programmable logic controller (PLC), with NO network communication capabilities.
(1)	Wash Water Pump. Belt wash pump which requires a minimum supply of 15 psi at 80 gpm will boost water pressure to 85 psi.
(1)	Inline, non-clog, variable orifice mixer, complete with injection manifold system and a four port vortex polymer injection ring.

- (1) **Spares**, one set of standard spares including a set of belts, seals and scrapper blades.
- (1) **Service** to start up and train plant staff. One trip (4) days on site
- (Lot) **Freight** to job site.

Budget Price: \$288,500.00 each

With freight allowed to job site. The off loading by others.

Rental Unit

Ashbrook can provide and coordinate the use of a 2.0-meter rental skid while old press is removed and new Klampress is installed. We charge \$12,000/month for rental plus freight. Unit is skid mounted and excludes conveyor.

Clarifications

Further, interconnecting piping and wiring between Ashbrook equipment and other ancillary equipment shall be by others.

Unless otherwise specified in this proposal, installation of all equipment supplied by Ashbrook shall be by others.

Taxes:

The budget price does not include any local, state or federal taxes, permits or other fees. Any taxes or fees that may apply must be added to the quoted price and paid by the buyer.

Shipment:

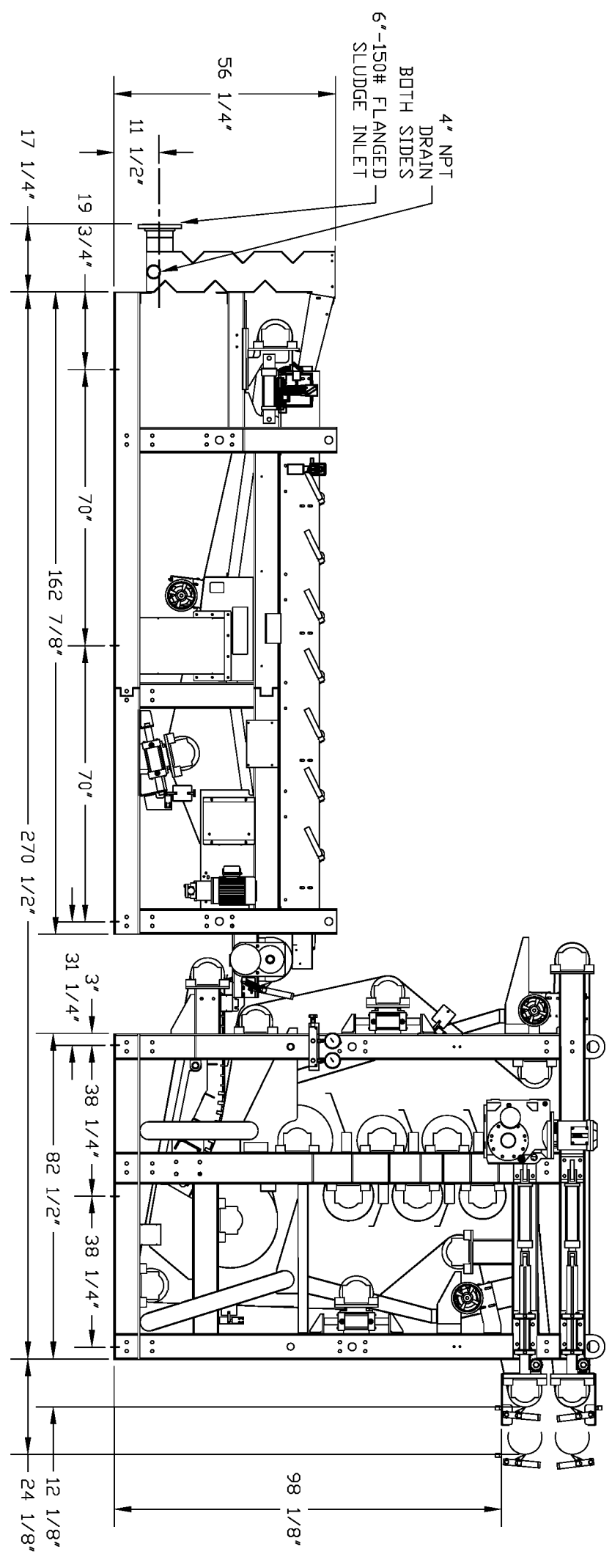
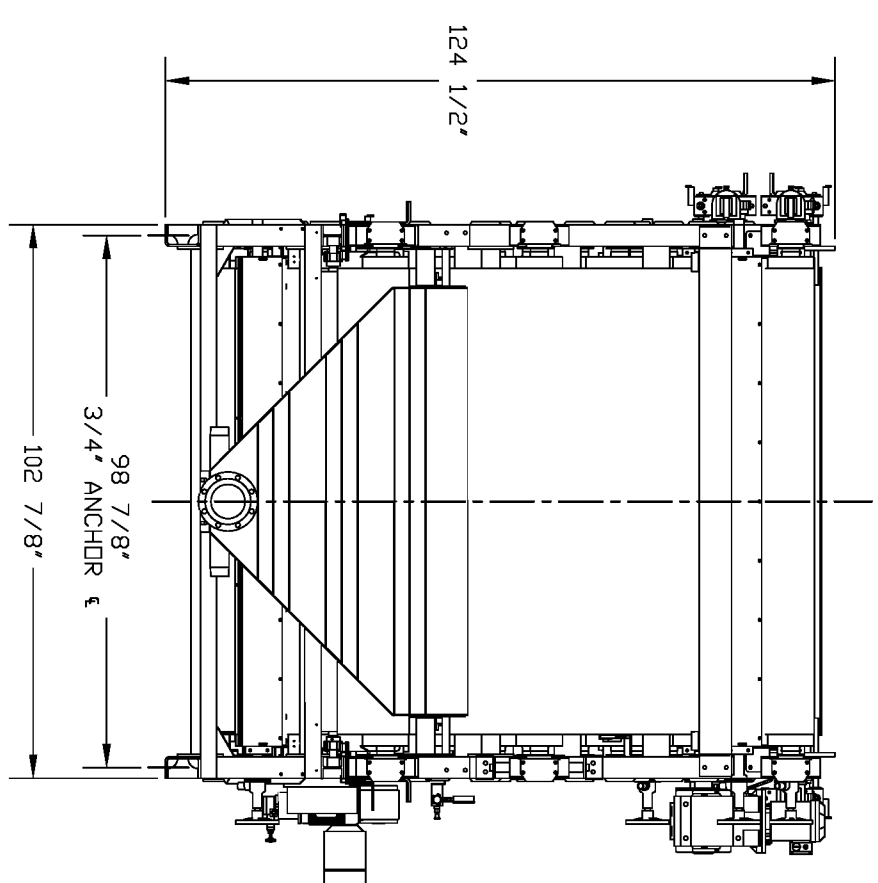
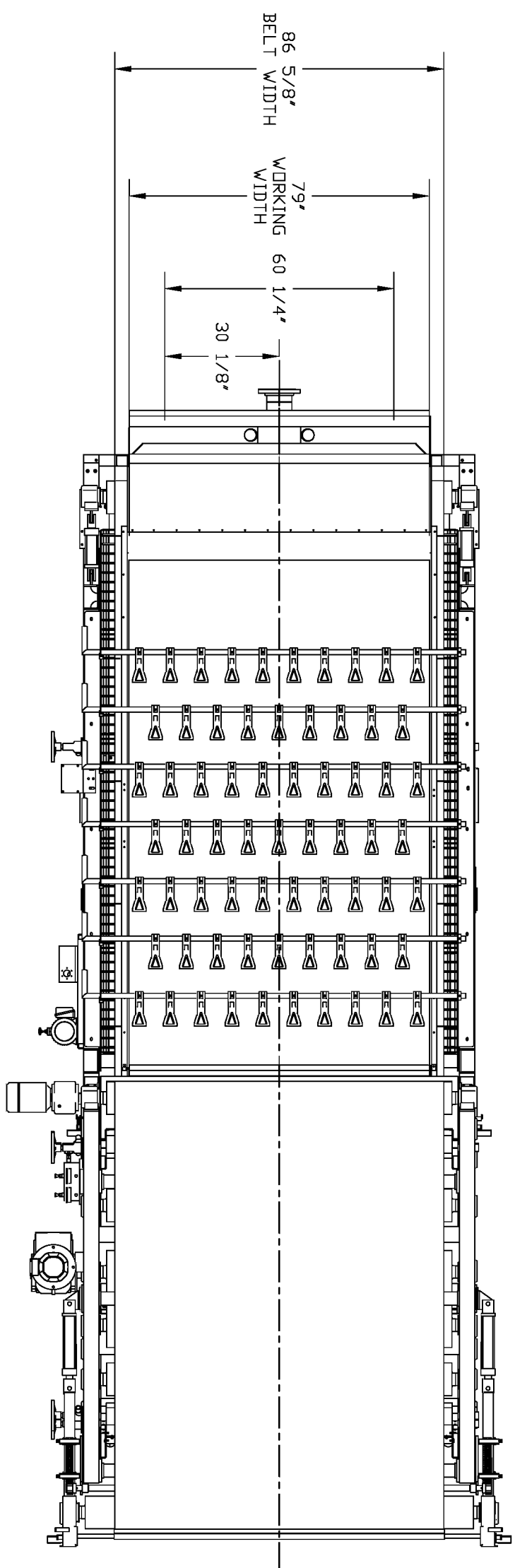
10-12 weeks after receipt of approved shop drawings. Allow 3 weeks to receive shop drawings after executed purchase order.

September 30, 2011
Bend WWTP
Page 3

Again, we thank you for the opportunity to offer this proposal. Should you have any questions, please feel free to contact us. .

Sincerely,
Bill Noxon
Bill Noxon
Regional Manager
281-380-0261

CC: Bill Reilly
Wm. H. Reilly & Co.
503-223-6197 Office |



TOLERANCE, UNLESS NOTED		REV		DATE		SUMMARY DESCRIPTION OF CHANGES		BY	APP	REV	DATE	SUMMARY DESCRIPTION OF CHANGES		BY	APP
FRACTION	INCH	MILLIMETER						MCA	MCA						
X	+/- 1/32"	N/A	1	9/10	ADDED ANCHOR DIMS, UPDATED APPEARANCE			MCA	MCA	7					
X	+/- 0.000	N/A	2	2/11	UPDATED COMPONENTS / APPEARANCE			MCA	MCA	8					
XX	+/- 0.030	+/- 1.0	3							9					
XXX	+/- 0.015	+/- 0.5	4							10					
XXXX	+/- 0.005	+/- 0.1	5							11					
			6							12					

NOTICE: THIS DRAWING HAS NOT BEEN REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF ASHBROOK SIMON-HARTLEY OPERATIONS LP. ANY UNAUTHORIZED REPRODUCTION OR TRANSMISSION IS STRICTLY PROHIBITED. ANY UNAUTHORIZED REPRODUCTION OR TRANSMISSION IS STRICTLY PROHIBITED. ANY UNAUTHORIZED REPRODUCTION OR TRANSMISSION IS STRICTLY PROHIBITED.

Ashtbrook Simon-Hartley

DATE: 3/27/09
 PRICE: 24,000.00
 WEIGHT: 24,000.00

NOTE: DEBUR ALL SHARP EDGES. MARK FINISHED PARTS WITH PART NUMBER PER WORK ORDER OR PURCHASE ORDER.

Ashtbrook Simon-Hartley Operations LP
 11500 East Hardy Rd
 Houston, Texas 77093
 Phone: 281-449-1324
 Fax: 281-449-1324

SCALE: 1:36
 CUSTOMER: GENERAL USE

REV: 2
 SK003750

Static Radial Wedge Belt Press



BUDGET PROPOSAL FOR

Bend, OR

PREPARED FOR

CH2M HILL

PREPARED BY

SIEMENS

Siemens Water Technologies Corp.
2155 112th Avenue, Holland, MI 49424
PH: 616-772-9011, FX: 616-772-4516
www.siemens.com/water

Proposal Number: 1104014R0

April 11, 2011

SECTION 1 Application Summary

Siemens Water Technologies Corp. is pleased to present this proposal to CH2M HILL for Bend, OR. This proposal includes two (2) Static Radial Wedge Belt Presses model BPS2000-8C and ancillary equipment as described in Section 3 of this proposal.

We understand the system design requirements to be as follows:

Sludge type:	Not specified
Sludge % solids:	5%
Sludge volume:	150 gallons/minute*
Throughput rate:	2,200 dry solids/hour*
Desired cake solids:	17%

*Whichever capacity is lower.

The presses are designed for a throughput rate of 88 gpm at 5% solids, 2,200 pounds/hour dry solids basis. The press model included in this proposal has eight (8) high pressure dewatering rolls for maximum performance on difficult to dewater sludges.

In order to meet the requested performance requirements the ancillary equipment (supplied by others) must meet the following minimum requirements:

Feed pump type:	Progressive cavity, VFD motor
Feed pump rate:	150 gpm
Polymer feed rate:	12 pounds active/ton dry solids

Siemens believes that the stated performance is achievable based upon the information provided and our experience with similar applications. Since preliminary testing has not been performed and since performance is directly dependant upon the nature of the sludge being processed, there is the potential for reduced performance or a higher chemical conditioning requirement. Siemens will make every reasonable effort to adjust the equipment in order to meet the stated goals. If it is shown that the stated goals cannot be achieved due to the physical or chemical nature of the sludge, performance will be deemed achieved and acceptance granted.

SECTION 2 General Description

The Static Radial Wedge Belt Press (SRW) is a double belt dewatering machine designed to dewater biological sludge by means of progressive pressure between two permeable synthetic belts. The drainage and pressure application areas are generously designed for dilute, high volatile and unstable sludge.

2.1 Conditioning

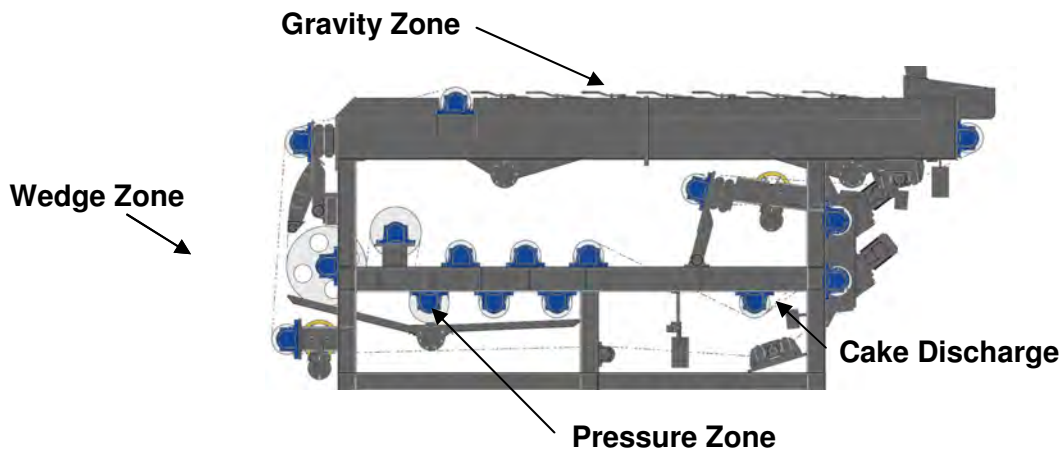
The feed sludge is conditioned by adding polymers to agglomerate the solids (flocculation). This operation is performed with a venturi type mixer.

A. Venturi Mixer

The venturi type mixer is located in the feed pipe upstream of the belt press. It is constructed of 304 stainless steel and can be adjusted for a wide range of conditioning energies. Control of mixing energy is accomplished by adjustment of a counterweighted lever, which controls the orifice size.

2.2 Dewatering Zones

The Static Radial Wedge Belt Press is comprised of three dewatering zones: gravity, wedge, and high pressure. A discussion of each dewatering zone is presented below.



A. Gravity Zone

Once flocculated, the sludge passes through a feed box and is distributed onto a gravity belt (Gravity Zone). On the gravity belt, free water is allowed to drain from the sludge and migrate through the belt where it is collected on stainless steel drainage pans. The gravity belt is supported by UHMW-PE strips, which serves to break the surface tension on the bottom of the belt and assists in releasing the water from the belt. Rows of plows mounted over the gravity belt continuously turn the sludge further assisting in the release of free water. The plows are constructed of HDPE and are mounted on transverse bars that are also used to lift and lock the assembly into place for cleaning.

B. Static Radial Wedge Zone

The upper and lower belts converge, encapsulate the sludge, and then traverse over a large radius perforated UHMW-PE sheet with stainless steel support structure. This creates a static radial wedge zone, which gently applies both shear and pressure to the sludge. Low pressure, combined with shear, gently removes water from the sludge before small particles have a chance to blind the belts.

C. High Pressure Zone

After the radial wedge zone, the belts are routed around a series of rollers. The high-pressure zone begins with a series of four (4) decreasing diameter pressure rollers, which steadily increases the pressure on the sludge between the belts. This is followed by a series of small, equal diameter rollers, which exert the highest pressure on the sludge. Additional rollers provide additional dewatering time, increasing cake solids.

2.3 Effective Filtration Area

The filtration area is an important consideration in belt press performance and operation. Larger filtration areas result in greater throughput and better dewatering performance. The SRW has been designed with large filtration areas for excellent dewatering performance. The filtration areas for the belt press in this proposal are provided in the data sheet found in Section 5.

2.4 Supporting Structure (Frame)

The frame is composed of ASTM A36 structure channel members, hot dip galvanized to ASTM 123 for corrosion resistance. The frames are dipped in multiple sections and then bolted together. This minimizes distortion during the galvanizing process. The frame is designed by finite element analysis in order to attain the lowest possible deflection and stress values. The maximum induced stresses are calculated using a belt tension of 50 PLI and a belt speed of 15 feet per minute.

The frame is designed for easy accessibility, visibility, and maintenance of all internal components. The frame provided with integral lifting eyes for handling by a crane. All the fasteners are made of high strength stainless steel.

2.5 Rollers and Bearings

The first roller of the high pressure zone is perforated for rapid draining. This roller is composed of 0.18" (5 mm) plate, with 1.375" (35mm) holes that provide an open area of 40%. Material of construction for the perforated roller shell, shaft and internal supports is 304 stainless steel.

All other rollers are made of carbon steel tubes ASTM-A519. Drive and tracking rolls are covered with 0.25" thick Buna N rubber, hardness 85±5 shore A. Remaining rolls are covered with Buna N rubber. All journals are made of 1045 carbon steel with double stub shaft end plates, which are thermally interference fit to eliminate weld stresses. Rollers are sized for continuous operation at 50 PLI linear tension on the belts. The number and sizes of the rollers are shown in the following tables:

Drive, Tensioning and Tracking Rolls		
Roller	No. of Rollers	Diameter of Roller
Drive	2	250 mm
Tensioning	2	250 mm
Guide	2	250 mm
Centering Device/Idler	3	130 mm

High Pressure Rolls		
Roller	No. of Rollers	Diameter of Roller
Pressure roll #1 (Perforated roll)	1	660 mm
Pressure roll #2	1	423 mm
Pressure roll #3	1	330 mm
Remaining pressure rolls	5	250 mm
Total number of Pressure Rolls	8	

All bearings are double row, self-aligning spherical type with two-piece split cast iron housing and double labyrinth seals. The bearing housings are coated with impact resistant nylon for maximum corrosion resistance. The L¹⁰ bearing life, shown on the attached data sheet, is calculated considering all static and dynamic loads, including those induced by belt drive torque, with 50 PLI belt tension and 15 fpm belt speed.

2.6 Belt Tensioning

The tension of the belts is maintained and controlled pneumatically with tension on both upper and lower belts independently adjustable. Pneumatically operated air bellows provide an axial thrust to a cross-linked torsion tube which is connected to the tensioning roll bearings. This configuration ensures fail-safe parallel movement of the tension rollers. The belt tension may be varied up to a maximum of 50 PLI and may be adjusted without stopping the machine.

2.7 Belt Tracking

The belt tracking system is pneumatic for simple and economic operation. A transverse rubber covered roll, fixed at one end, performs centering of each belt. The opposite end is mounted on a pneumatically operated centering slide. A sensor paddle rides in contact with the belt and continuously controls the lateral movement of the belt to maintain a centered position. Corrections are proportional to the amount of deviation from center. Proximity style over-travel switches are supplied on both sides of the machine to detect excessive misalignment as a backup system.

2.8 Pneumatic Controls

Pneumatic controls are mounted on the press frame and include all pneumatic devices necessary for operation of the machine. This including inlet pressure reducer with inlet air filter, pressure gauges, minimum pressure switch for each circuit, and individual adjustable pressure reducing valves for belt tension and tracking.

2.9 Belts

The belts are constructed of monofilament polyester and are seamed with 316 stainless steel clipper seams. Both belts are of equal length to allow interchangeability and reduce inventory costs. The selection of the belt type is based upon the specific type of sludge.

2.10 Belt Washing

Cleaning of the belts is accomplished by two washing stations equipped with high-pressure nozzles. Water is sprayed continuously through the nozzles onto the filtering surface to thoroughly clean the belts. Each belt washing station consists of a 304 stainless steel box that encloses a spray pipe. Each pipe contains spray nozzles with an internal cleaning brush that is operated by a hand-wheel. Each belt washing station is located transverse to the belt and has an enclosure that contains any aerosols that may be produced by the spraying system. The housing is equipped with ANSI pattern flanges to allow for isolation of wash water from the filtrate.

2.11 Cake Discharge

The cake exiting the high-pressure zone is removed from the belts by two (2) replaceable doctor blades for the upper and lower belt. The blades, which contact the belt, are composed of reversible 3/8" UHMW and are fixed to a support bar. A pair of adjustable counterweights controls blade tension. The pressure of each doctor blade is independently adjustable.

2.12 Belt Drive System

The belts are independently driven by a dual gear motor drive system that provides superior control of torque transmission. The speed variation is provided by means of a single electronic controller (VFD) in parallel with the drive motors. Speed is variable (5:1) from 4-20 fpm.

2.13 Painting

All non-stainless steel metallic components requiring painting shall be slag free, ground, and sanded to remove all weld spatter and burrs. Components shall be blasted with aluminum oxide blast material to SSPC-SP10 near white finish to provide a surface texture of 1.5 - 2.5 mils. Excess dust and blasting grit shall be removed from components by using clean, oil free compressed air.

Note: external vendor supplied equipment such as motors are supplied with vendor standard coating system.

Prepared surfaces shall be painted for maximum corrosion resistance in accordance with the following:

- Description: One coat DTM urethane finish
- Dry film thickness: 3.0 – 5.0 mils
- Color: Siemens Blue

2.14 Control System

The control panel consists of a NEMA 4X enclosure containing a Allen Bradley CompactLogix PLC, an Operator Interface Terminal (OIT), emergency stop push-button, alarm horn, and alarm acknowledge. A ground fault, duplex 120 VAC receptacle will also be mounted internal to the enclosure.

All components in the control panel will be completely factory wired. All external control connection points shall terminate on terminal blocks and a minimum of 10% spare terminal connection points will be provided.

A modem will be provided to allow for fast troubleshooting of the belt press from Siemens Water Technologies Engineering Support Services in Holland, Michigan.

The OIT is capable of automatic or manual start/stop operations. The OIT will display readings of the following: sludge and polymer actual flow rates, sludge and polymer desired flow rates, pre-set and actual timing operations, local/remote control status, and auto/manual control status.

SECTION 3 Scope of Supply and Services

3.1 Mechanical

Two (2) Static Radial Wedge Belt Presses, Siemens Water Technologies Corp., Model BPS2000-8C, essentially consisting of:

- A. Main Structural Frame Fabricated from ASTM A36 Channels: Hot dip galvanized.
- B. Rollers:
 - 1. Drive and tracking: BUNA-N rubber covered.
 - 2. Perforated roll: 304 stainless steel roller shell, shafting and supports.
 - 3. Pressure rolls: BUNA-N rubber covered.
- C. Bearings: SKF Housings, nylon coated, double labyrinth seals, six (6) month lubrication cycle.
- D. Belt Drive System: Duplex gear motors, synthetic lubricant.
- E. Belt Tracking System: Proportional pneumatic, upper and lower belt.
- F. Belt Tensioning System: Upper and lower, pneumatic with cross-linked torsion tube.
- G. Shower System: 316 stainless steel Appleton or Stamm Header, with 304 stainless steel enclosure.
- H. Flocculation System: One (1) venturi type mixer, 304 stainless steel.
- I. Plows with Lifting Mechanism: Stainless steel hardware.
- J. Sludge Containment/Inlet System and Headbox: 304 stainless steel.
- K. Gravity Support Grids: 304 stainless steel with removable UHMW wear strips.
- L. Belt Doctoring Assembly: stainless steel support with UHMW-PE blades with adjustable hot dip galvanized counterweights.

Included Accessories:

- A. Two (2) Centrifugal Wash Water Booster Pumps.
- B. One (1) Air Compressor.
- C. One (1) Set of Recommended Spare Parts.

3.2 Instrumentation and Controls

- A. Local Control Panel: NEMA 4X enclosure with Allen Bradley PLC, Operator Interface Terminal, belt drive VFD, sludge feed pump VFD, wash pump motor starter, and operational components.
- B. Pneumatic Controls: Frame mounted regulators and gauges, lubricator and coalescing filter, low-pressure alarm switches.
- C. OSHA Safety Switches: Material control NEMA 4X, one (1) each side.
- D. Belt Skew Sensor: Siemens magnetic contact, NEMA 4X.

3.3 Engineering/Project Management Services

- A. Assignment of Project Manager for duration of contract.
- B. Four (4) sets of Submittals, electronic format.
- C. Four (4) sets of Operation and Maintenance Manuals, electronic format.

3.4 Field Services

- A. Installation Supervision: One (1) trip, three (3) days.
 - B. Startup/Training: Two (2) trips, five (5) days each.
- If additional days are required, they will be quoted at Siemens standard rate.

3.5 Exclusions

- A. The following items are specifically excluded from Section 3 – “Scope of Supply and Services” and shall be supplied by “others” unless otherwise noted in other sections.
 - 1. Conveyors.
 - 2. Polymer feed system.
 - 3. Sludge pumps.
 - 4. Operator platform.
 - 5. Civil engineering for preparation of building and foundations.
 - 6. Calculations for suitability of machine load on building structure.
 - 7. Building modifications.
 - 8. Unloading at job site and uncrating of the proposed equipment.
 - 9. Installation labor for the proposed equipment.
 - 10. All interconnecting piping to the proposed equipment.
 - 11. All interconnecting wiring and labor from the machine to the panel.
 - 12. State or local taxes.
 - 13. Any other equipment not specifically included under “Scope of Supply”.

SECTION 4 Pricing/Commercial Information

- A. Two (2) Static Radial Wedge Presses, Model BPS2000-8C, as described above
.....**\$550,000.00/Lot**
- B. Validity: Pricing is guaranteed for 30 days from date of proposal.
- C. Payment Terms:
 - 1. 20% due upon acceptance of approval drawings.
 - 2. 70% Net 30 days from shipment.
 - 3. 10% due upon successful startup or 120 days from shipment, whichever occurs first.
- D. Submittal Drawings for Approval (unless waived) will be sent 6 weeks after receipt and acceptance of Purchase Order. Standard Delivery: 18 - 22 weeks after return of approval drawings.
- E. Pricing is F.O.B. factory, Holland, MI, freight allowed.
- F. If shipment is delayed per customer request, storage charges and a change in payment terms may be required.
- G. Prior to shipment of goods, an approved credit application must be on file.
- H. Sales and/or use tax is not included in the price quoted. Such taxes will be added unless the purchaser can provide a direct pay permit or an exemption certificate for the applicable tax.
- I. This quotation is subject to the following Siemens Water Technologies Corp. "Standard Conditions of Sale".

SECTION 5 Data Sheet

STATIC RADIAL WEDGE BELT PRESS 2.0 METER MODEL BPS2000-8C MACHINE SPECIFICATIONS

General Machine Data

High pressure module	8	Pressure rollers
Overall Length (excluding feedbox)	235	Inches (approx.)
Overall Width	124	Inches (approx.)
Overall Height (excluding feedbox)	100	Inches (approx.)
Overall Belt width	2100	mm
Actual Working Belt width	2000	mm
Dry Weight	18,300	lbs.
Estimated Operating Weight	20,600	lbs.

Effective Filtration Areas

Gravity Zone	90	sq. ft.
Wedge Zone	90	sq. ft.
High Pressure Zone	<u>120</u>	<u>sq. ft.</u>
Total Filtration Area	300	sq. ft.

Utilities

Connected Load (belt drive)	4	Hp.
Air Requirements	3.0 - 4.0	cfm @ 100 psi
Washwater Requirements	80	gpm @ 120 psi

Note: Water for cleaning sprays must be filtered plant effluent or utility water with a maximum TSS level of 10-20 mg/L.

Main Frame

MC8x22 channel
Moment of inertia: 63.4 in 4 in the major load bearing axis.
Hot Dip Galvanized coating, surface density of 3.7 oz. Zn per sq. ft. of surface.

Rolls

A-106 B pipe, A-36 flanges with 1045 steel double end-plate journals.

Bearings

Spherical roller E type. L-10 life: 670,000 operating hours

Belt Tracking & Tensioning

Pneumatically controlled for automatic operations. Air bellows actuators.

Belts

Seamed design; chosen for the applications.

Belt Showers

Pipe with recessed nozzles cleaned with hand wheel operated wire brush.

Motor Drive Type

Helical Bevel Gear, Hollow Shaft, TEFC Motor +VFD.

Control Panels

NEMA 4 X

304 Stainless Steel Components

Headbox assembly
Sludge/polymer mixer
Filtrate pans
Shower housing, pipe, nozzle & brush
All nuts, bolts & fasteners

SECTION 1 Standard Terms of Sale

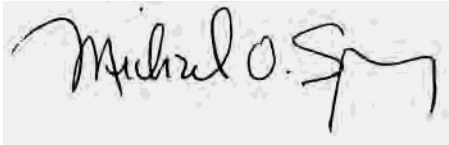
1. Applicable Terms. These terms govern the purchase and sale of the equipment and related services, if any (collectively, "Equipment"), referred to in Seller's purchase order, quotation, proposal or acknowledgment, as the case may be ("Seller's Documentation"). Whether these terms are included in an offer or an acceptance by Seller, such offer or acceptance is conditioned on Buyer's assent to these terms. Seller rejects all additional or different terms in any of Buyer's forms or documents.
2. Payment. Buyer shall pay Seller the full purchase price as set forth in Seller's Documentation. Unless Seller's Documentation provides otherwise, freight, storage, insurance and all taxes, duties or other governmental charges relating to the Equipment shall be paid by Buyer. If Seller is required to pay any such charges, Buyer shall immediately reimburse Seller. All payments are due within 30 days after receipt of invoice. Buyer shall be charged the lower of 1 ½% interest per month or the maximum legal rate on all amounts not received by the due date and shall pay all of Seller's reasonable costs (including attorneys' fees) of collecting amounts due but unpaid. All orders are subject to credit approval.
3. Delivery. Delivery of the Equipment shall be in material compliance with the schedule in Seller's Documentation. Unless Seller's Documentation provides otherwise, Delivery terms are F.O.B. Seller's facility.
4. Ownership of Materials. All devices, designs (including drawings, plans and specifications), estimates, prices, notes, electronic data and other documents or information prepared or disclosed by Seller, and all related intellectual property rights, shall remain Seller's property. Seller grants Buyer a non-exclusive, non-transferable license to use any such material solely for Buyer's use of the Equipment. Buyer shall not disclose any such material to third parties without Seller's prior written consent.
5. Changes. Seller shall not implement any changes in the scope of work described in Seller's Documentation unless Buyer and Seller agree in writing to the details of the change and any resulting price, schedule or other contractual modifications. This includes any changes necessitated by a change in applicable law occurring after the effective date of any contract including these terms.
6. Warranty. Subject to the following sentence, Seller warrants to Buyer that the Equipment shall materially conform to the description in Seller's Documentation and shall be free from defects in material and workmanship. The foregoing warranty shall not apply to any Equipment that is specified or otherwise demanded by Buyer and is not manufactured or selected by Seller, as to which (i) Seller hereby assigns to Buyer, to the extent assignable, any warranties made to Seller and (ii) Seller shall have no other liability to Buyer under warranty, tort or any other legal theory. If Buyer gives Seller prompt written notice of breach of this warranty within 18 months from delivery or 1 year from acceptance, whichever occurs first (the "Warranty Period"), Seller shall, at its sole option and as Buyer's sole remedy, repair or replace the subject parts or refund the purchase price therefor. If Seller determines that any claimed breach is not, in fact, covered by this warranty, Buyer shall pay Seller its then customary charges for any repair or replacement made by Seller. Seller's warranty is conditioned on Buyer's (a) operating and maintaining the Equipment in accordance with Seller's instructions, (b) not making any unauthorized repairs or alterations, and (c) not being in default of any payment obligation to Seller. Seller's warranty does not cover damage caused by chemical action or abrasive material, misuse or improper installation (unless installed by Seller). THE WARRANTIES SET FORTH IN THIS SECTION ARE SELLER'S SOLE AND EXCLUSIVE WARRANTIES AND ARE SUBJECT TO SECTION 10 BELOW. SELLER MAKES NO OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR PURPOSE.
7. Indemnity. Seller shall indemnify, defend and hold Buyer harmless from any claim, cause of action or liability incurred by Buyer as a result of third party claims for personal injury, death or damage to tangible property, to the extent caused by Seller's negligence. Seller shall have the sole authority to direct the defense of and settle any indemnified claim. Seller's indemnification is conditioned on Buyer (a) promptly, within the Warranty Period, notifying Seller of any claim, and (b) providing reasonable cooperation in the defense of any claim.
8. Force Majeure. Neither Seller nor Buyer shall have any liability for any breach (except for breach of payment obligations) caused by extreme weather or other act of God, strike or other labor shortage or disturbance, fire, accident, war or civil disturbance, delay of carriers, failure of normal sources of supply, act of government or any other cause beyond such party's reasonable control.
9. Cancellation. If Buyer cancels or suspends its order for any reason other than Seller's breach, Buyer shall promptly pay Seller for work performed prior to cancellation or suspension and any other direct costs incurred by Seller as a result of such cancellation or suspension.
10. LIMITATION OF LIABILITY. NOTWITHSTANDING ANYTHING ELSE TO THE CONTRARY, SELLER SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, SPECIAL, PUNITIVE OR OTHER INDIRECT DAMAGES, AND SELLER'S TOTAL LIABILITY ARISING AT ANY TIME FROM THE SALE OR USE OF THE EQUIPMENT SHALL NOT EXCEED THE PURCHASE PRICE PAID FOR THE EQUIPMENT. THESE LIMITATIONS APPLY WHETHER THE LIABILITY IS BASED ON CONTRACT, TORT, STRICT LIABILITY OR ANY OTHER THEORY.
11. Miscellaneous. If these terms are issued in connection with a government contract, they shall be deemed to include those federal acquisition regulations that are required by law to be included. These terms, together with any quotation, purchase order or acknowledgement issued or signed by the Seller, comprise the complete and exclusive statement of the agreement between the parties (the "Agreement") and supersede any terms contained in Buyer's documents, unless separately signed by Seller. No part of the Agreement may be changed or cancelled except by a written document signed by Seller and Buyer. No course of dealing or performance, usage of trade or failure to enforce any term shall be used to modify the Agreement. If any of these terms is unenforceable, such term shall be limited only to the extent necessary to make it enforceable, and all other terms shall remain in full force and effect. Buyer may not assign or permit any other transfer of the Agreement without Seller's prior written consent. The Agreement shall be governed by the laws of the Commonwealth of Pennsylvania without regard to its conflict of laws provisions.
12. Export Compliance. Buyer acknowledges that seller is required to comply with applicable export laws and regulations relating to the sale, exportation, transfer, assignment, disposal and usage of the Equipment and Services provided under the Contract, including any export license requirements. Buyer agrees that such Equipment and Services shall not at any time directly or indirectly be used, exported, sold, transferred, assigned or otherwise disposed of in a manner which will result in non-compliance with such applicable export laws and regulations. It shall be a condition of the continuing performance by seller of its obligations hereunder that compliance with such export laws and regulations be maintained at all time. BUYER AGREES TO INDEMNIFY AND HOLD SELLER HARMLESS FROM ANY AND ALL COSTS, LIABILITIES, PENALTIES, SANCTIONS AND FINES RELATED TO NON-COMPLIANCE WITH APPLICABLE EXPORT LAWS AND REGULATIONS.

Revised July 14, 2009

If you have any questions, please feel free to contact me or our representative indicated below.

Best regards,

Siemens Water Technologies Corp.

A handwritten signature in black ink on a light gray background. The signature reads "Michael O. Spring" in a cursive, slightly stylized font.

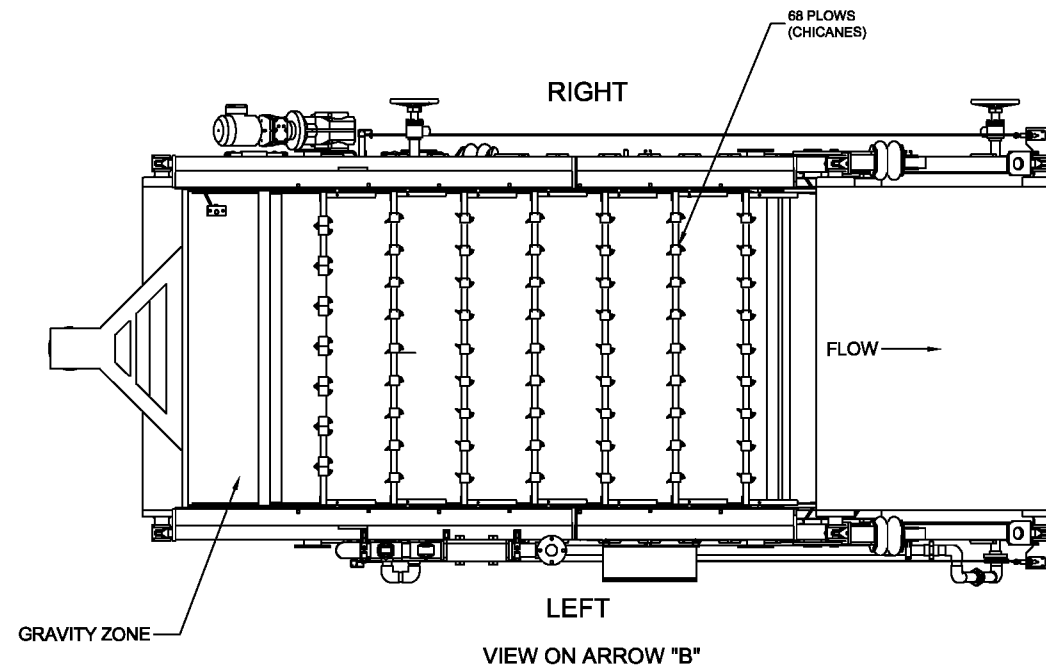
Michael O. Spring

Technical Sales Manager

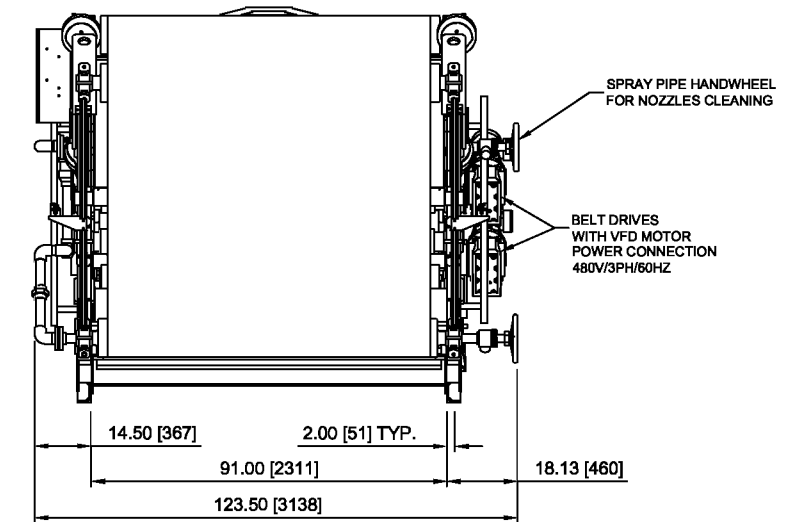
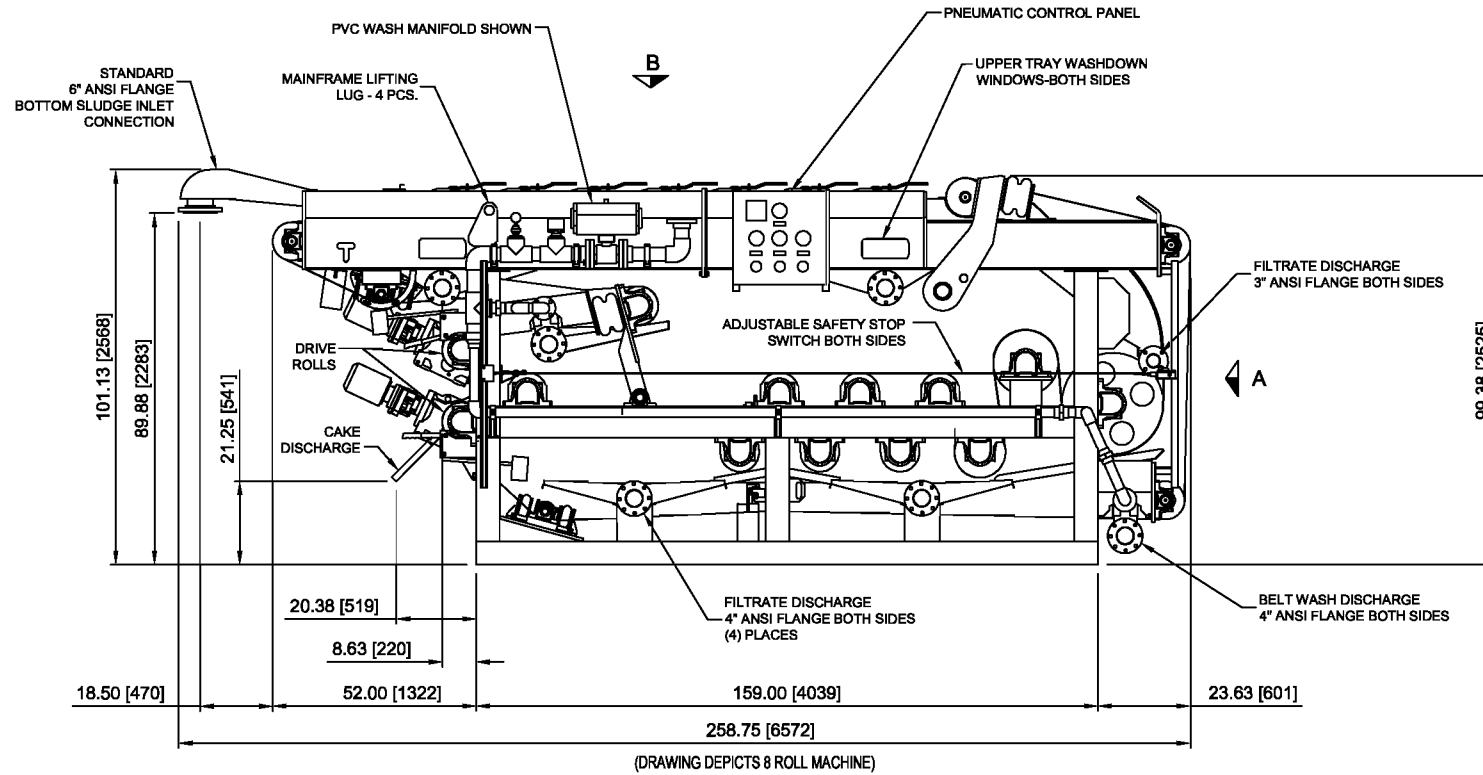
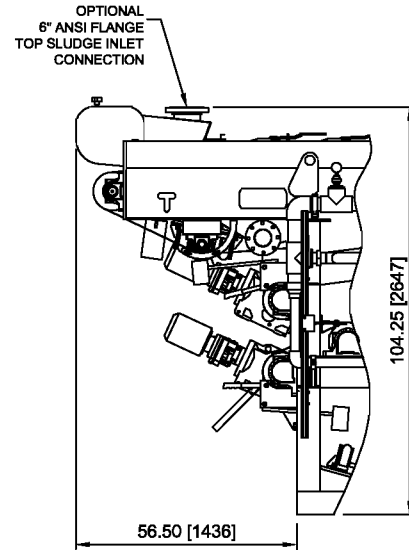
Manufacturer's Representative

Granich Engineered Products, Inc.
John Hayes
Office: 206-315-2940
Cell: 360-481-4801

- NOTES:
1. AIR CONSUMPTION : 3 - 4 cfm AT 90 psi.
 2. SLUDGE AND FILTRATE PIPING MUST BE INDEPENDENTLY SUPPORTED. NO LOADS SHALL BE PLACED ON MACHINE PIPING.
 3. DRAWING IS PRELIMINARY AND SHOULD NOT BE USED FOR CONSTRUCTION.



TECHNICAL DATA				
ROLL CONFIGURATION	EMPTY WEIGHT (POUNDS)	OPERATING WEIGHT (POUNDS)	WASHWATER CONSUMPTION (GPM)	BELT DRIVE HORSEPOWER
8 PRESSURE ROLLS	18,300	20,600	80-85	2 @ 2.0 HP EACH



VIEW ON ARROW "A"

RIGHT HAND VERSION SHOWN

- NOTES:
1. DRAWING IS FOR REFERENCE ONLY. CONSULT FACTORY FOR DETAILED CONSTRUCTION DRAWINGS AND SPECIFICATIONS.
 2. ALL DIMENSIONS ARE IN INCHES AND [MILLIMETERS].
 3. USF RESERVES THE RIGHT TO CHANGE EQUIPMENT SPECIFICATIONS, OPTIONS, AND PRICING AND/OR DISCONTINUE MODELS AND OPTIONS AT ANY TIME WITHOUT NOTICE OR OBLIGATION. ILLUSTRATED EQUIPMENT MAY INCLUDE OPTIONAL COMPONENTS.

<p>THIRD ANGLE PROJECTION</p>	<p>STD: BORDER-0106-22X34D 244-06</p>	<p>INTL REF:</p>	<p>BAR = 1" AT PLOT SCALE</p>	<p>REV</p>	<p>DESCRIPTION</p>	<p>DATE</p>	<p>DWN</p>	<p>CHKD</p>	<p>APVD</p>	<p>ECN</p>	<p>COMPANY CONFIDENTIAL. THIS DOCUMENT AND ALL INFORMATION CONTAINED HEREIN ARE THE PROPERTY OF SIEMENS AND/OR ITS AFFILIATES. THE DESIGN CONCEPTS AND INFORMATION CONTAINED HEREIN ARE PROPRIETARY TO SIEMENS AND ARE SUBMITTED IN CONFIDENCE. THEY ARE NOT TRANSFERABLE AND MUST BE USED ONLY FOR THE PURPOSE FOR WHICH THE DOCUMENT IS EXPRESSLY LOANED. THEY MUST NOT BE DISCLOSED, REPRODUCED, LOANED OR USED IN ANY OTHER MANNER WITHOUT THE EXPRESS WRITTEN CONSENT OF SIEMENS. IN NO EVENT SHALL THEY BE USED IN ANY MANNER DETRIMENTAL TO THE INTEREST OF SIEMENS. ALL PATENT RIGHTS ARE RESERVED. UPON THE DEMAND OF SIEMENS, THIS DOCUMENT, ALONG WITH ALL COPIES AND EXTRACTS, AND ALL RELATED NOTES AND ANALYSES, MUST BE RETURNED TO SIEMENS OR DESTROYED, AS INSTRUCTED BY SIEMENS. ACCEPTANCE OF THE DELIVERY OF THIS DOCUMENT CONSTITUTES AGREEMENT TO THESE TERMS AND CONDITIONS.</p>	<p>DESIGNER</p> <p>DRB</p>	<p>DATE</p> <p>7/20/06</p>	<p>TITLE</p> <p>2.0 METER STATIC RADIAL WEDGE BELT PRESS</p> <p>8 PRESSURE ROLL CONFIGURATION</p> <p>GENERAL ARRANGEMENT</p>
												<p>CHECKER</p>	<p>DATE</p>	
<p>ENGINEER</p>	<p>DATE</p>	<p>MANAGER</p>	<p>DATE</p>	<p>FILE: BPS2000-08CGA.DWG</p>	<p>PROJECT</p>	<p>CODE</p>	<p>DRAWING</p> <p>BPS2000-8C</p>	<p>SHEET</p> <p>1 OF 1</p>	<p>REV</p> <p>-</p>					



Always the Right Solution™

14-Apr-11
Version 9.0.1 C

Computer Aided Pump Selection

Moyno Pump Model: B1CSSF3APA

File Reference
Prepared For:
Requested By
Material:

Parameters:

Rate Of Flow: 5 GPM

Suction Pressure: 0 PSI
Discharge Pressure: 30 PSI

Fluid Character:

Viscosity: 100 CP
Specific Gravity: 1
Temperature: 70 F
Abrasion Level: None

Fluid Type: Viscous
Solids Contents: 1 %
Max Particle Size: 0.1 IN
Average Particle Size: 0.01 IN

Performance (Calculated Values):

Diff Pressure: 30 PSI
Slip: 0.25 GPM
Delta Temp: 0.08 F
Internal Vel: 0.6 Ft/S
Shear Rate: 209.89 Inv Secs

Rate Of Flow: 5 GPM
Pump Speed: 369.51 RPM
Operating Torque: 51.3 In-Lbs
Starting Torque: 88.08 In-Lbs
Required Power: 0.34 HP
Intake Index: 10

Remark Codes: 903

Notes: *Hp req'd for VFD Connection: 0.52



Always the Right Solution™

14-Apr-11
Version 9.0.1 C

Computer Aided Pump Selection

Moyno Pump Model: B1DSSF3APA

File Reference
Prepared For:
Requested By
Material:

Parameters:

Rate Of Flow: 10 GPM

Suction Pressure: 0 PSI
Discharge Pressure: 30 PSI

Fluid Character:

Viscosity: 100 CP
Specific Gravity: 1
Temperature: 70 F
Abrasion Level: None

Fluid Type: Viscous
Solids Contents: 1 %
Max Particle Size: 0.1 IN
Average Particle Size: 0.01 IN

Performance (Calculated Values):

Diff Pressure: 30 PSI
Slip: 0.56 GPM
Delta Temp: 0.11 F
Internal Vel: 4.68 Ft/S
Shear Rate: 234.85 Inv Secs

Rate Of Flow: 10 GPM
Pump Speed: 365.45 RPM
Operating Torque: 87.1 In-Lbs
Starting Torque: 134.74 In-Lbs
Required Power: 0.52 HP
Intake Index: 10

Remark Codes: 903

Notes: *Hp req'd for VFD Connection: 0.78



Always the Right Solution™

14-Apr-11
Version 9.0.1 C

Computer Aided Pump Selection

Moyno Pump Model: B1DSSF3APA

File Reference
Prepared For:
Requested By
Material:

Parameters:

Rate Of Flow: 15 GPM

Suction Pressure: 0 PSI
Discharge Pressure: 30 PSI

Fluid Character:

Viscosity: 100 CP
Specific Gravity: 1
Temperature: 70 F
Abrasion Level: None

Fluid Type: Viscous
Solids Contents: 1 %
Max Particle Size: 0.1 IN
Average Particle Size: 0.01 IN

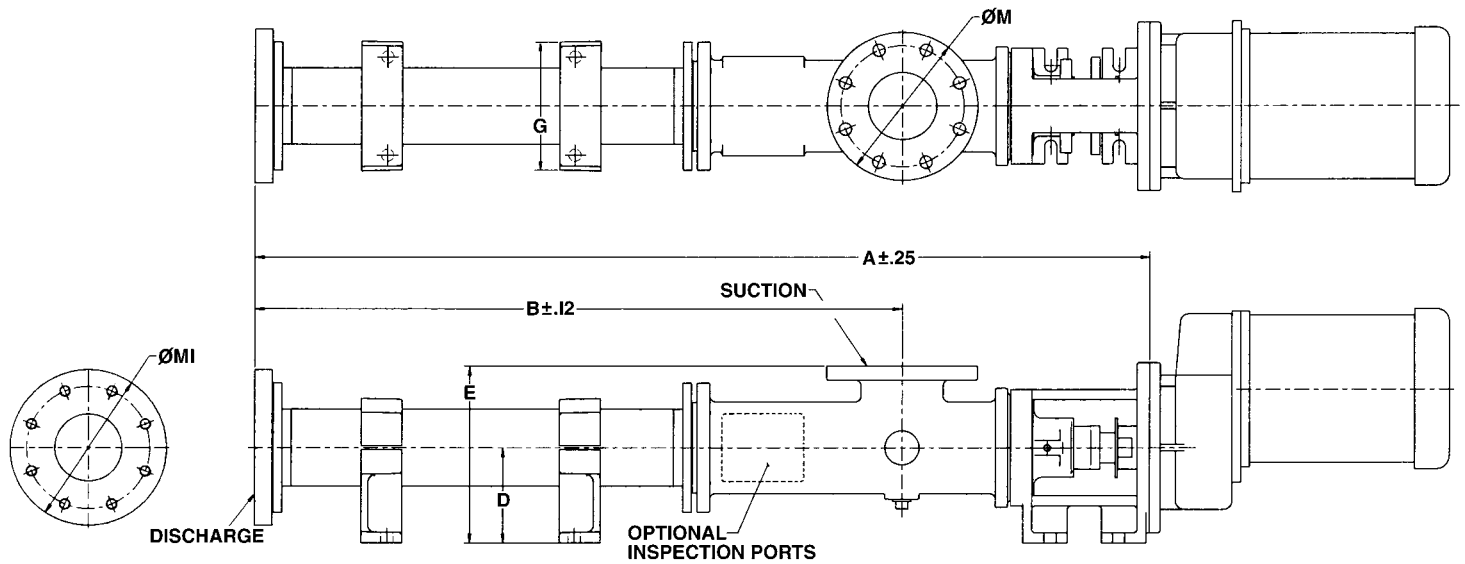
Performance (Calculated Values):

Diff Pressure: 30 PSI
Slip: 0.56 GPM
Delta Temp: 0.17 F
Internal Vel: 6.9 Ft/S
Shear Rate: 346.04 Inv Secs

Rate Of Flow: 15 GPM
Pump Speed: 538.46 RPM
Operating Torque: 87.1 In-Lbs
Starting Torque: 134.74 In-Lbs
Required Power: 0.77 HP
Intake Index: 10

Remark Codes: 903

Notes: *Hp req'd for VFD Connection: 1.15



MODEL NO.	STANDARD PUMP DIMENSIONS					SUCTION		DISCHARGE		PUMP
	A	B	D	E	G	Size	M	Size	M1	Wt. Lb.
→ B1B	16.50	7.00	3.54	6.69	4.88	1.50	5.00	1.50	5.00	40
→ B2B	21.00	11.50	3.54	6.69	4.88	1.50	5.00	1.50	5.00	43
→ B1C	19.63	9.31	3.54	6.69	4.88	2.00	6.00	2.00	6.00	50
B2C	24.88	14.56	3.54	6.69	4.88	2.00	6.00	2.00	6.00	53
B4B	34.38	23.50	4.49	8.44	6.00	2.50	7.00	1.50	6.12	80
→ B1D	22.69	11.81	4.49	8.44	6.00	2.50	7.00	2.50	7.00	80
B2D	29.75	18.88	4.49	8.44	6.00	2.50	7.00	2.50	7.00	87
B4C	39.13	27.88	4.49	8.44	6.00	3.00	7.50	2.00	6.50	105
B1E	26.13	14.88	4.49	8.44	6.00	3.00	7.50	3.00	7.50	95
B2E	34.94	23.69	4.49	8.44	6.00	3.00	7.50	3.00	7.50	110
B4D	55.72	41.44	5.51	10.25	7.50	4.00	9.00	2.50	7.50	195
B1F	37.53	23.25	5.51	10.25	7.50	4.00	9.00	4.00	9.00	175
B2F	48.60	34.31	5.51	10.25	7.50	4.00	9.00	4.00	9.00	200
B4E	67.03	50.25	5.51	11.00	7.50	4.00	9.00	3.00	8.25	255

All dimensions in inches.

Attachment C—Schematic Design Fact Sheets

Polymer System Evaluation

ATTACHMENT C TO: TM 8 – Solids Treatment Improvements
 PROJECT: Schematic Design Report
 Bend Water Reclamation Facility Secondary Expansion

Objective

The objective of the evaluation is to confirm if the existing polymer system is adequate to serve the new solids building modifications through the year 2030 solids production rates and planned operational schedules. Also it is to identify recommended upgrades and improvements to address operational requirements of the upgraded solids facility.

Background

The existing polymer system has the following issues:

- One system for both thickening and dewatering.
- Changes in pressure of the plant potable water system affects polymer batching.
- Changes in pressure of polymer feed tank may impact feed loop stability.
- Variations in post diluted polymer feed rates due to lack of post dilution control valves and possible instability of maintaining constant polymer feed pump flow rate.
- Clogging in polymer static mixers may cause pressure and flow variations.

The upgraded polymer system will be required to support the parallel operation of one existing gravity belt thickener (GBT) and two dewatering belt filter presses (BFPs).

Design Criteria

Table 1 lists the design criteria and existing polymer system data.

TABLE 1
 Polymer System Design Criteria
City of Bend Water Reclamation Facility

Criterion	Value
Gravity Belt Thickener	
GBT Polymer dose	4-13 lb/dt
GBT peak solids loading	405 lb/hr/m
Effective belt width per GBT	2 meter
Number of GBT units	1

TABLE 1
 Polymer System Design Criteria
City of Bend Water Reclamation Facility

Criterion	Value
Dry polymer to GBT (min to max)	0.7 to 5.3 lb/hr
Belt Filter Press	
BFP Polymer dose	8-15 lb/dt
BFP Peak solids loading	1100 lb/hr/m
Effective belt width per BFP	2 meter
Number of BFP units	1 existing, 1 new
Dry polymer to each BFP (min to max)	4.5 to 18.0 lb/hr
Dry Polymer System	
Capacity of polymer big bags	1,650 lb
Dry polymer storage size	105 CF, 2.7 bags, 4,450 lbs of polymer
Maximum dry polymer usage	38.3 lb/hr
Polymer storage time in hopper	4.8 days
Dry polymer conveyor feed rate	90-360 lb/hr
Dry polymer conveyor motor size	0.5 hp
Dry polymer gravimetric feeder	18-300 lb/hr
Gravimetric feeder motor size	0.45 kW
Dry polymer Eductor	240 lb/hr
Polymer Tanks	
Polymer Mix tank volume	600 gallon
Polymer Feed tank volume	700 gallon
Polymer Mix & Feed Tank concentration	0.1% – 0.5%
Polymer bulk density	42.45 lb/cf
Minimum Polymer age time	30 min
Mix tank mixer	1 hp
Polymer Feed Pumps	
Number of polymer feed pumps	2 existing, 1 new
Pump type	Progressive cavity - Moyno
Polymer pump motor size	2 hp
Flow per pump	Approx 15 gpm
Post Dilution Polymer	
Post dilution polymer concentration	0.1%
Max Post dilution water rate to GBT	8.4 gpm

TABLE 1
 Polymer System Design Criteria
City of Bend Water Reclamation Facility

Criterion	Value
Max Post dilution water rate to each BFP	26 gpm
Total post dilution water rate	61 gpm
Polymer (cake) injection pump	
Number of polymer injection pumps	1
Pump type	Progressive cavity - Moyno
Polymer pump motor size	1 hp
Flow per pump	1 gpm @ 100 psi

Evaluation of Existing System

The existing dry polymer system, with recommended modifications, has adequate capacity to support the parallel operation of one gravity belt thickener and two dewatering belt filter presses throughout the year 2030 planning criteria.

Based on year 2030 maximum month solids production quantities and the range of polymer dosage to the thickening and dewatering processes, approximately 0.1 to 0.3 dry polymer big bags will be required per operational week day. The dry polymer conveyance equipment is adequately sized to convey the required polymer to the mix tank. The existing dry polymer storage hopper (with capacity of 105 cubic feet) provides storage for 2.7 big bags.

The existing dry polymer makeup system polymer age time is currently limited by the ability to water fill the polymer mix tank, because a fast fill water source does not currently exist. Dilution water is currently only added to the mix tank through the polymer wetting head at a maximum rate of approximately 25 gallons per minute (gpm). At this existing fill rate, the age time in the mix tank only is reduced from the minimum criteria of 30 minutes to 9 minutes with one GBT and two BFPs in parallel operation. Additional polymer batch cycle time and polymer age time, can be provided for the existing system by incorporating a mix tank fast fill water source (125 gpm) and increasing the polymer make concentration up to 0.5 percent.

The existing polymer feed tank capacity is adequate to support parallel operation of one GBT and two BFPs at maximum solids loadings and polymer dosages if the polymer mix concentration is increased up to 0.5 percent.

The two existing polymer feed pumps can provide 10 gpm each, 20 gpm total. With two BFPs in operation and one GBT, and a polymer mix concentration of 0.5 percent, the required flow rates of feed tank polymer to the system equals 5.6 to 22.5 gpm, based on minimum to maximum polymer dosages. To support one GBT and two BFPs operating in parallel, a minimum of one additional polymer pump will be required.

The existing polymer feed system does not allow use of individual feed pump control to the thickening and dewatering processes. The existing feed system incorporates a common polymer feed pump discharge header followed by dedicated flow meters and flow control valves to the existing GBT and BFP. The existing common polymer feed discharge header requires a separate pressure control loop to recirculate excess polymer feed pump discharge back to the feed tank.

Providing the ability for dedicated polymer feed pumps to control polymer flow rates to the points of use will help alleviate the current system operational problems associated with polymer dosage instabilities due to dynamic pressure variations.

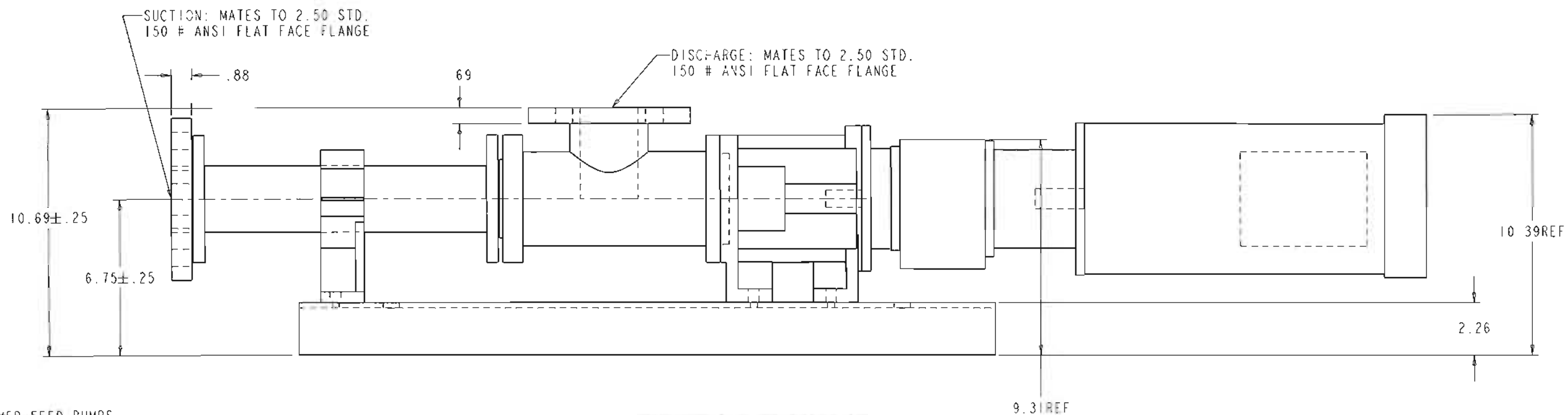
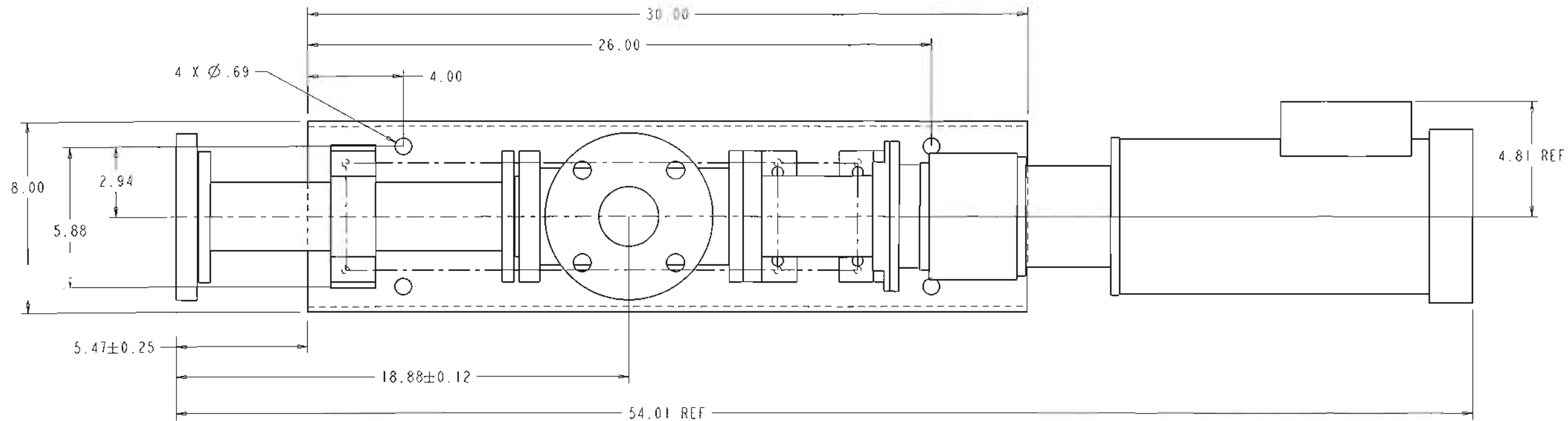
Recommendations

- Increase polymer mix and feed tank concentration up to 0.5 percent as solids loadings increase in order to lengthen batch cycle time and increase polymer age time.
- Install a polymer mix tank fast fill water source capable of 125 gpm to provide adequate polymer batch cycle time and polymer age time. Further evaluation should determine if the fast fill water is plant water or potable water.
- Change polymer feed system from a pressurized loop to individually dedicated polymer feed pumps to the GBT and each dewatering BFP. The speed and flow of each dedicated polymer feed pump would be controlled by an individual magnetic flow meter to each GBT and BFP utilizing flow ratio setpoint control.
- Install a third polymer feed pump sized to feed the GBT (3.1 to .4 gpm). The existing two polymer feed pumps will feed each BFP. To improve reliability/redundancy, maintain spares for critical components of the existing polymer system. Provide a shelf spare of the GBT polymer pump. Stock spare polymer pump seals and other spare parts.

Appendix A

- New Polymer Feed Pump Cut Sheet – Moyno

Appendix A— New Polymer Feed Pump Cut
Sheet: Moyno



POLYMER FEED PUMPS
 10 GPM @ 30 PSI 2 HP @ 372 RPM
 SERIAL NO. AS4923005-1 & AS4923005-3

REDUCER MANUFACTURER: NORD
 REDUCER MODEL: SK172F-145TC
 REDUCER OUTPUT RPM: 372

MOTOR MANUFACTURER: RELIANCE
 MOTOR HP: 2
 MOTOR RPM: 1750
 MOTOR FRAME: 145TC
 MOTOR ASSEMBLY: FI

MINIMUM DIMENSION REQUIRED TO
 DISASSEMBLE AT DISCHARGE END: 14.00
 PUMP SHAFT ROTATION IS CCW WHEN
 LOOKING AT THE PUMP SHAFT END.
 EST. UNIT WEIGHT: 201 LBS

				Moyno, Inc.	
				A Unit of Robbins & Myers, Inc.	
				MODEL: B20 SSQ3SPA	
				DESCP: UNIT ASSEMBLY	
A	3/9/2005	----	SIZE	DRW NO	REV
REV	DATE	ECO NO			
DWN: PRO/E	DATE		D	S492300500	A
CHKD: EES	DATE		SCALE	WEIGHT	SHEET
	3/9/2005		0.440	*	1 OF 1

(A) NEW DRAWING

Existing Digester Volume, Capacity, and Projected Life

ATTACHMENT C TO: TM 8 – Solids Improvements

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Objective

Recent digester mixing modifications and upgrades (City Project SW0705) were constructed as part of a previous project at the Bend Water Reclamation Facility (WRF). The City is now moving toward consistent digester operation with primary sludge (PS) feed at 5 percent solids and thickened waste activated sludge (TWAS) feed at 8 percent solids. This fact sheet evaluates the capacity of the existing digesters based on the following:

- Existing active volumes in Digesters 1, 2, and 3
- Projected flows and sludge yields (based on the integrated fixed-film activated sludge (IFAS) aeration basin configuration proposed in the Project Definition Report).
- Continuing to operate the biosolids facilities to produce a Class B biosolids product, as described in the 2010 Biosolids Management Plan.

Existing Infrastructure

Based on the 2010 Biosolids Management Plan submitted to the Oregon Department of Environmental Quality (DEQ), the existing anaerobic digesters have the active digester volumes presented in Table 1.

TABLE 1
Active Digester Volume
Bend WRF Secondary Expansion

Digester	Diameter (feet)	Operating Height (feet SWD)	Active Volume (gallons)
Digester 3	50	56.5	800,000
Digester 1	50	26	375,616
Digester 2	50	15	216,690
Total Active Volume			1,392,306

SWD = side water depth.

Design Criteria

Anaerobic digestion process sizing is determined by the following requirements:

- Meet the 503C Biosolids regulations for Class B Solids
- Provide a minimum solids retention time (SRT) of 15 days at maximum month conditions.
- Solids retention times were calculated based on the solids production estimated through CH2M HILL's process modeling, utilizing the population and flow projections contained in the 2007 Facilities Plan.

The process modeling results are presented as an attachment at the end of this fact sheet.

Table 2 summarizes the estimated primary sludge and TWAS flow rates for the current operation (6 million gallons per day [mgd] maximum month) and projected future flows and associated loads.

TABLE 2
Digester Influent Flows
Bend WRF Secondary Expansion

Maximum Month Influent Flows (mgd)	5% PS (gallons/day)	8% TWAS (gallons/day)
6	35,198	11,013
8.5	58,034	16,055
11.9	81,823	26,219
17.5	120,340	38,485

Findings

Figure 1 shows that the digester SRT is reduced as plant flows increase. The plant's ability to consistently produce PS and WAS at the intended concentration directly and immediately affects the plant's ability to meet the Class B biosolids requirements for time and temperature treatment. Consistently feeding TWAS at 8 percent and PS at 5 percent to the digesters pushes out the timeline for construction of the next digester to 10.5 average daily maximum month (ADMM) flows (which is sometime between 2020 and 2025).

Anaerobic Digester Capacity (Total Existing Vol = 1.392 Mgal)

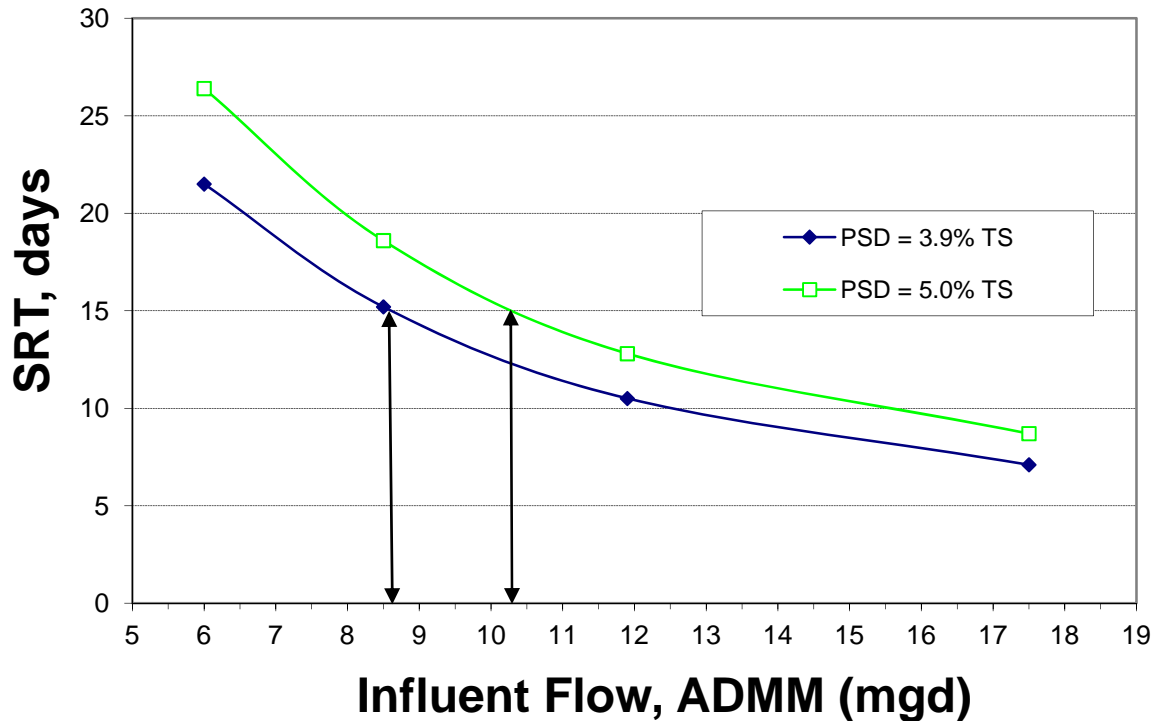


FIGURE 1
Total Digester SRT

Figure 2 below shows the digested sludge hydraulic detention time in Digester 2 (Belt Press Feed Tank) as flows increase. Storage capacity of Digester 2 (Belt Press Feed Tank) is limited by the 13 feet of vertical tank height available for storage over a 2.5 day weekend (Friday evening at 5 p.m. to Monday morning at 7 a.m.). Further, the results show that the ability to consistently produce PS at 5 percent total solids pushes the capacity of Digester 2 out to about 8.8 mgd ADMM flow.

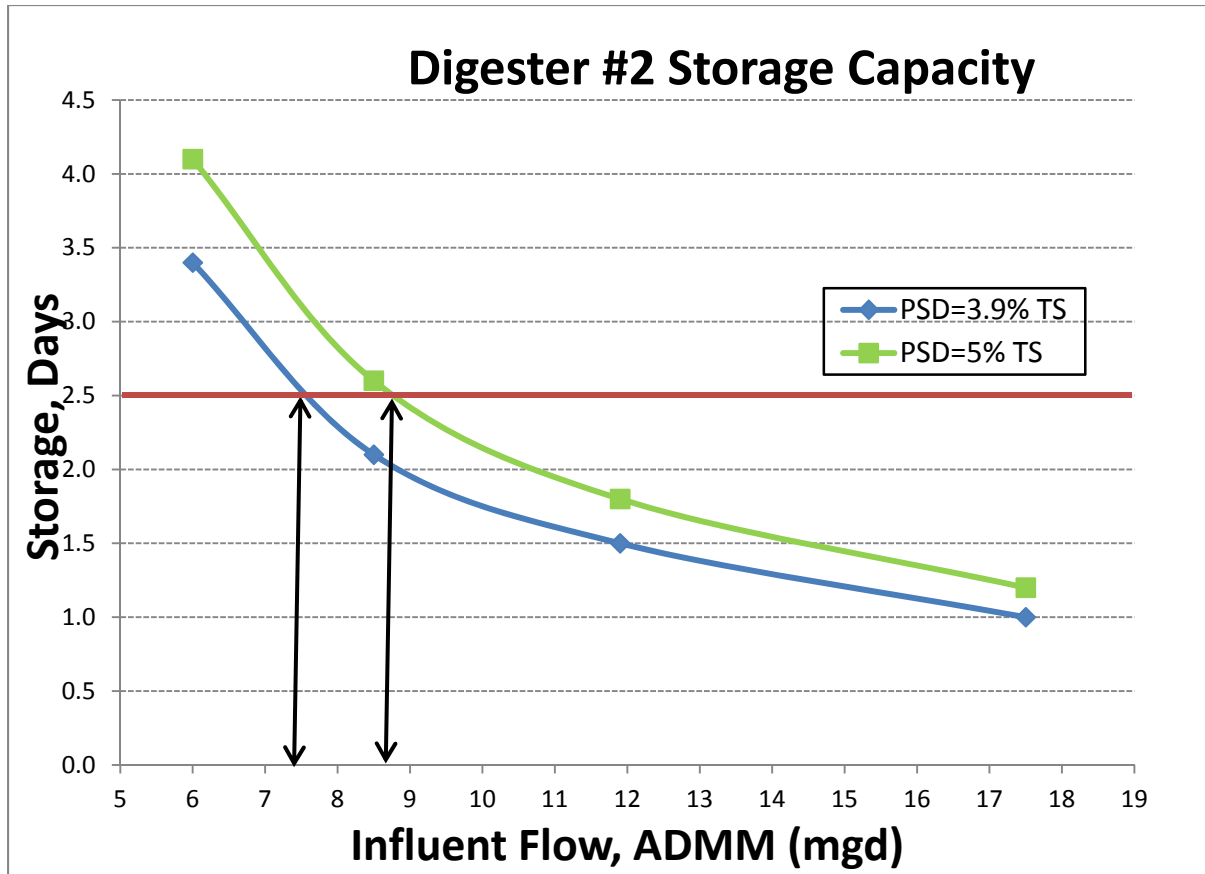


FIGURE 2
Digester 2 Storage

As indicated in the graphs above, with two belt presses running, eventually the volume of digested solids produced over the weekend will exceed the storage volume available within 13 feet of vessel height. This would necessitate the operation of the dewatering process during the weekend, or drive the construction of additional storage.

Recommendations

1. Consistent digester feed operation:
 - Average 5 percent PS
 - Average 8 percent TWAS
2. Design and ensure that both sludge pumping systems (primary sludge and TWAS) can bypass the existing digester feed tank and pump, and convey digester feed sludge directly to Digester 3.
3. Over the next year, develop a strategy and schedule for digester expansion, or develop a new approach to managing biosolids that does not depend on meeting the EPA Class B

biosolids criteria through anaerobic digestion (time and temperature). Development of this strategy would involve the following steps:

- a. Collection of critical biosolids data, definition of regulatory criteria, and definition of City of Bend objectives/goals for biosolids.
 - b. Brainstorming session to identify possible solutions/alternatives (i.e., anaerobic digestion, drying beds, etc.) that meet regulatory criteria.
 - c. Shortlist of solutions/alternatives that meet City of Bend goals and objectives.
 - d. Evaluation and cost analysis of shortlisted solutions/alternatives.
 - e. Selection of preferred solution, development of process and capital requirements, and development of implementation schedule.
 - f. Integration of preferred solution into overall capital plan.
4. Plan and design new digester capacity (or another approach) to meet the EPA Class B biosolids criteria.

			Description of Design Condition							
			Start up Avg Annual 5.5 MGD		8.5 MGD Max Month		2030 FP Condition 11.9 MGD MM		Build out 17.5 MGD	
OPERATIONS FOR THICKENED SLUDGE										
THICKENED WAS PRODUCTION										
TWAS CAPTURE EFFICIENCY	%		90%	90%	90%	90%	90%	90%	90%	90%
TWAS MASS RATE - TSS- FROM PRO2D	LBS/DAY		7,349	7,350	10,901	10,715	17,494	17,498	25,681	25,684
TWAS DRYNESS	% TS		8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
TWAS EFFLUENT VOL RATE - AVGERAGE	GAL/DAY		11,012	11,013	16,334	16,055	26,213	26,219	38,480	38,485
PRIMARY SLUDGE										
PRIMARY SLUDGE PRODUCTION										
PRIMARY SLUDGE DRY MASS RATE - TSS - AVERAGE	LBS/DAY		14,694	14,687	24,243	24,216	34,155	34,143	50,234	50,215
PRIMARY SLUDGE VOL RATE - AVERAGE	GAL/DAY		45,145	35,198	74,485	58,034	104,940	81,823	154,340	120,340
PRIMARY SLUDGE CONC	% TS		3.9%	5.0%	3.9%	5.0%	3.9%	5.0%	3.9%	5.0%
DIGESTION										
COMBINED DIGESTER FEED TWAS+PS										
TWAS+PS DIGESTER FEED MASS RATE - TSS	LBS/DAY		22,043	22,037	35,144	34,931	51,649	51,641	75,915	75,899
TWAS+PS DIGESTER FEED MASS RATE - VSS	LBS/DAY		17,147	17,141	28,549	28,501	40,670	40,651	59,811	59,780
VS	%		78%	78%	81%	82%	79%	79%	79%	79%
TWAS+PS DIGESTER FEED VOL RATE	GAL/DAY		56,157	46,211	90,819	74,089	131,153	108,042	192,820	158,825
TWAS+PS DIGESTER FEED CONC	% TS		4.7%	5.7%	4.6%	5.7%	4.7%	5.7%	4.7%	5.7%
SOLIDS RETENSION TIME (SRT)										
DIGESTER 3 VOLUME	GAL		800,000		800,000		800,000		800,000	
DIGESTER 1 VOLUME	GAL		375,616		375,616		375,616		375,616	
DIGESTER 2 VOLUME	GAL		216,690		216,690		216,690		216,690	
FUTURE DIGESTER 4	GAL						800,000		800,000	
FUTURE DIGESTER 5	GAL								800,000	
TOTAL DIGESTER VOLUME	GAL		1,392,306		1,392,306		2,192,306		2,992,306	

		Description of Design Condition							
		Start up Avg Annual 5.5 MGD		8.5 MGD Max Month		2030 FP Condition 11.9 MGD MM		Build out 17.5 MGD	
VS LOADING (TOTAL DIGESTER)	LB/CF/DAY	0.09	0.09	0.15	0.15	0.14	0.14	0.15	0.15
SRT DIGESTER 3	DAYS	14.2	17.3	8.8	10.8	6.1	7.4	4.1	5.0
SRT DIGESTER 1	DAYS	6.7	8.1	4.1	5.1	2.9	3.5	1.9	2.4
SRT DIGESTER 2	DAYS	3.9	4.7	2.4	2.9	1.7	2.0	1.1	1.4
SRT (FUTURE DIGESTER 4)	DAYS					6.1	7.4	4.1	5.0
SRT (FUTURE DIGESTER 5)	DAYS							4.1	5.0
TOTAL DIGESTERS SRT	DAYS	24.8	30.1	15.3	18.8	16.7	20.3	15.5	18.8
DIGESTED SLUDGE EFFLUENT									
DIGESTED SLUDGE MASS RATE - TSS	LBS/DAY	12,872	12,708	21,296	20,985	30,676	30,335	45,381	44,866
DIGESTED SLUDGE MASS RATE - VSS	LBS/DAY	8,966	8,788	15,529	15,212	21,756	21,346	32,266	31,645
DIGESTED SLUDGE CONC	% TS	2.7%	3.3%	2.8%	3.4%	2.8%	3.4%	2.8%	3.4%

Filtrate Return Process Evaluation

PREPARED FOR: Jim Wodrich, P.E./City of Bend
City of Bend, Oregon

PREPARED BY: Bill Leaf, P.E./CH2M HILL

REVIEWED BY: Dave Green, P.E./CH2M HILL
Brady Fuller, P.E./CH2M HILL

DATE: October 3, 2011

PROJECT: Schematic Design Phase
City of Bend WRF Secondary Expansion Project

Introduction

The purpose of this fact sheet is to document the process evaluation completed to determine the impacts of adjusting dewatering filtrate return at the Bend Water Reclamation Facility (WRF). The biosolids dewatering process at the Bend WRF operates 8 hours per day, 5 days per week. Filtrate from this process is conveyed to the degas beds, allowing for the equalization of this filtrate prior to return to the main liquids unit processes. The filtrate is then returned to the liquids treatment process during the diurnal low flow and load condition. As the filtrate is high in ammonia ($\text{NH}_3\text{-N}$), the current operational practice equalizes the ammonia load on the secondary treatment process to the extent possible.

The degas beds result in conditions that favor the development of struvite (magnesium ammonium phosphate [$\text{MgNH}_4\text{PO}_4\cdot 6\text{H}_2\text{O}$]). Struvite has been developing in the filtrate pump and piping system to the point that the system is becoming inoperable. A number of alternatives are being considered by the City to address this issue. The fact sheet addresses the alternative of bypassing the degas beds, returning the filtrate directly to the liquids treatment unit processes (without equalization) during the existing dewatering operational schedule.

Process Evaluation Conditions

The process evaluation was conducted for the existing conditions at the Bend WRF. The existing unit processes are included in the process evaluation, assuming all major unit processes are in service. Three aeration basins, operating in the Modified Ludzak-Ettinger (MLE) configuration, and the associated secondary clarifiers provide secondary treatment.

The influent wastewater conditions used for this evaluation are presented in Table 1.

TABLE 1
Existing WRF Conditions
City of Bend WRF Secondary Expansion Project

Parameter (unit)	Value
<i>Influent</i>	
Influent Flow (mgd)	5.5
Influent BOD pounds per day (ppd)	16,779
Influent TSS (ppd)	18,479
Influent NH ₃ -N (ppd)	1,296
Influent Total PO ₄ -P (ppd)	357
<i>Operational Conditions</i>	
SVI (mL/g)	185
Dewatering Hours per Day	8
Dewatering Days per Week	5
Dewatering Solids Capture	80%
Dewatering Solids Concentration	11.9%
Return Activated Sludge (% of Q)	100%
Solids Residence Time (days)	9.0
Aeration Basin MLSS (mg/L)	2,400
Primary Sludge Concentration (% solids)	4%
Waste Activated Sludge Concentration (% solids)	4.5%

Methodology

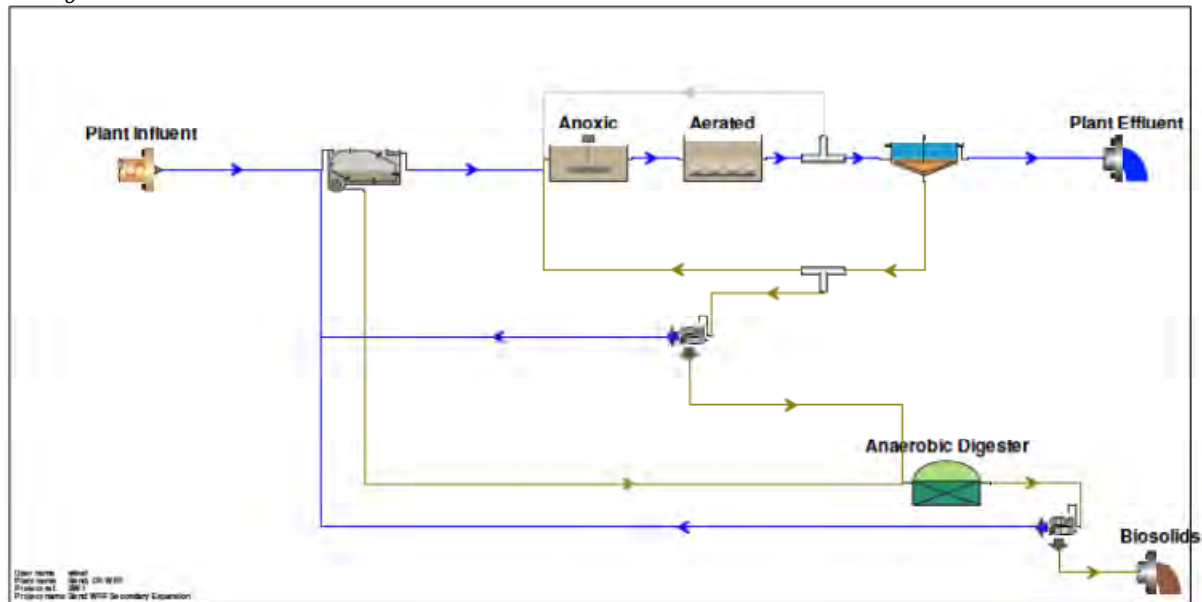
The process evaluation was completed through the use of two wastewater process simulators, CH2M HILL's Pro2D whole-plant process simulator and EnviroSim's BIOWIN™ Version 3.1. Previous work on the Bend WRF Secondary Expansion Project included the calibration of a Pro2D™ simulation. These process simulators are similar in that they include the same primary mathematical models. Pro2D™ is a steady-state simulator, with some features that allow for the estimation of diurnal impacts. BIOWIN™ Version 3.1 includes features to allow for the dynamic simulation of a treatment facility.

Pro2D™ was initially used to evaluate the impacts of bypassing the degas beds with the filtrate, returning this to the secondary treatment process during the current dewatering schedule. The calibrated Pro2D™ simulation was used to estimate possible adverse impacts to the treatment performance. It was unclear, from this initial estimate that the impacts from the ammonia-rich filtrate would not be detrimental to the process. A dynamic BIOWIN™ simulation was then developed to complete the process evaluation. Pro2D™ has a feature allowing for the transfer of wastewater characteristics to the BIOWIN™ platform. These

values are based on the calibration of the steady-state Pro2D™ simulation. While this does not provide for a calibrated dynamic simulation of BIOWIN™, it does help match the characterization of the wastewater to the Bend WRF. With this, the trends developed in the BIOWIN™ dynamic simulation can be used to estimate the resulting performance impacts of the filtrate return.

Figure 1 presents the process flow diagram (PFD) developed as part of the BIOWIN™ process simulation. This represents the existing WRF, assuming all unit processes are in service.

FIGURE 1
BIOWIN™ Process Flow Diagram
Existing Bend WRF



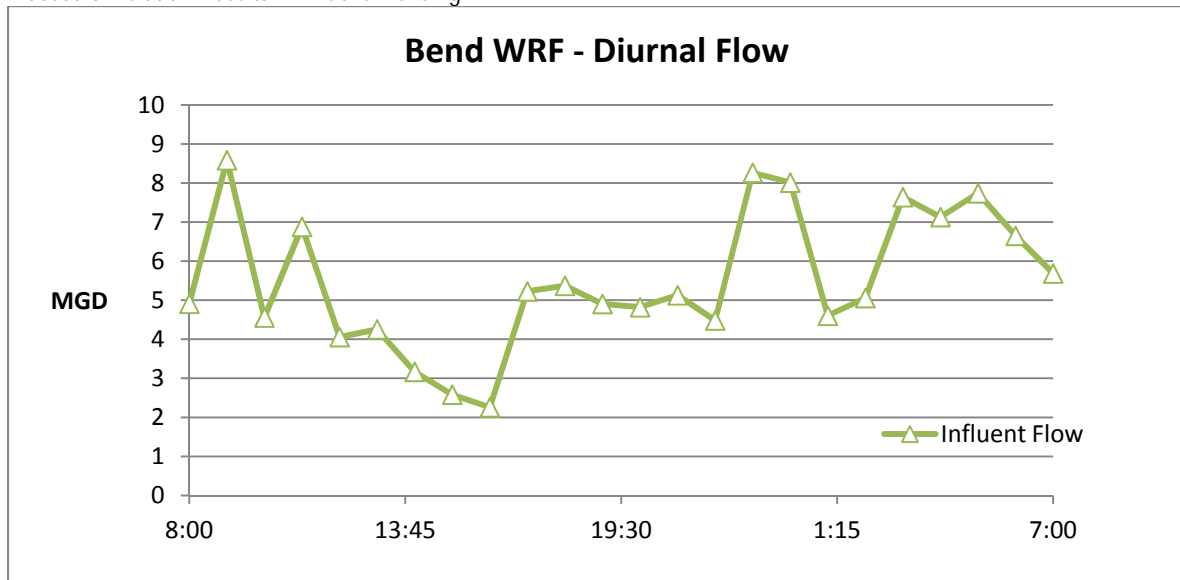
Process Simulation Results

The dynamic simulation was completed for the average conditions presented previously within Table 1. Diurnal influent flow and load conditions, measured at the WRF in February 2010, are incorporated into this process simulation. The flow and wastewater characteristics used in the evaluation are presented in Table 2. Figure 2 presents the diurnal flow conditions used in the simulation. For this evaluation it is assumed that the dewatering operation is 8 hours per day, 5 days per week. It is assumed that dewatering filtrate is returned to the front to the WRF starting at 8:00 a.m.

TABLE 2
Existing WRF Diurnal Projections
City of Bend WRF Secondary Expansion Project

Time	Flow	Total Carbonaceous BOD (mg/L)	Volatile Suspended Solids (mg/L)	Total Suspended Solids (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Total P (mg/L)
8:00 a.m.	4.91	235.71	117.76	128	49	7.78
9:00	8.59	549.11	329.36	358	52.2	7.78
10:00	4.56	446.43	353.28	384	55.9	7.78
11:00	6.88	438.84	443.44	482	46.7	7.78
12:00	4.06	376.34	355.12	386	55.4	7.78
13:00	4.26	464.29	402.96	438	46.1	7.78
14:00	3.17	491.07	397.44	432	51	7.78
15:00	2.58	436.61	353.28	384	52	7.78
16:00	2.26	411.16	253.92	276	51.8	7.78
17:00	5.23	562.5	351.44	382	50.5	7.78
18:00	5.37	553.57	253.92	276	45.9	7.78
19:00	4.91	464.29	312.8	340	43.1	7.78
20:00	4.82	347.32	312.8	340	39.7	7.78
21:00	5.13	355.8	384.56	418	35.9	7.78
22:00	4.48	343.75	349.6	380	35.1	7.78
23:00	8.27	346.88	322	350	32.3	7.78
0:00	8.01	289.73	329.36	358	34.9	7.78
1:00	4.61	373.21	257.6	280	37.1	7.78
2:00	5.06	286.16	218.96	238	36.7	7.78
3:00	7.64	271.88	196.88	214	38.9	7.78
4:00	7.13	208.48	130.64	142	37.7	7.78
5:00	7.74	221.88	200.56	218	40.7	7.78
6:00	6.65	196.88	97.52	106	52.5	7.78
7:00	5.69	196.88	119.6	130	45.8	7.78

FIGURE 2
Process Simulation Results – Effluent Trending



The dynamic simulation was completed for two, 24-hour periods to highlight any impacts with the return of the ammonia-rich filtrate. Simulations were completed for three different wastewater temperature scenarios: 12.86 degrees Celsius ($^{\circ}\text{C}$) (minimum week), 17.0 $^{\circ}\text{C}$ (annual average), and 23 $^{\circ}\text{C}$ (maximum week). As noted previously, the dynamic simulation is only calibrated in part to the previous steady-state model developed. While additional levels of calibration are preferred, this still provides a representation of the effluent total nitrogen and ammonia trends given the modifications in filtrate return.

From the three wastewater temperature scenarios, the minimum week (winter) conditions prove to be the most critical. The results from this dynamic simulation are presented in Figures 3 and 4. The simulation for the existing dewatering filtrate return operation, where filtrate is returned during the low-flow period, is presented in Figure 3. This shows the concentrations of effluent total nitrogen, ammonia-N, and nitrate-N for a 2 day period. This trend is compared with the results in Figure 4, which represent the dynamic simulation with the dewatering filtrate being returned on an 8-hour per day basis, with the filtrate return starting at 8:00 a.m. The primary difference between the two charts is that the effluent TN peak is located at different times throughout the day. Both of these scenarios indicate that the overall trend for effluent TN is similar and that an exceedance of the annual effluent TN limit is unlikely.

FIGURE 3
 Process Simulation Results
 Current Filtrate Return

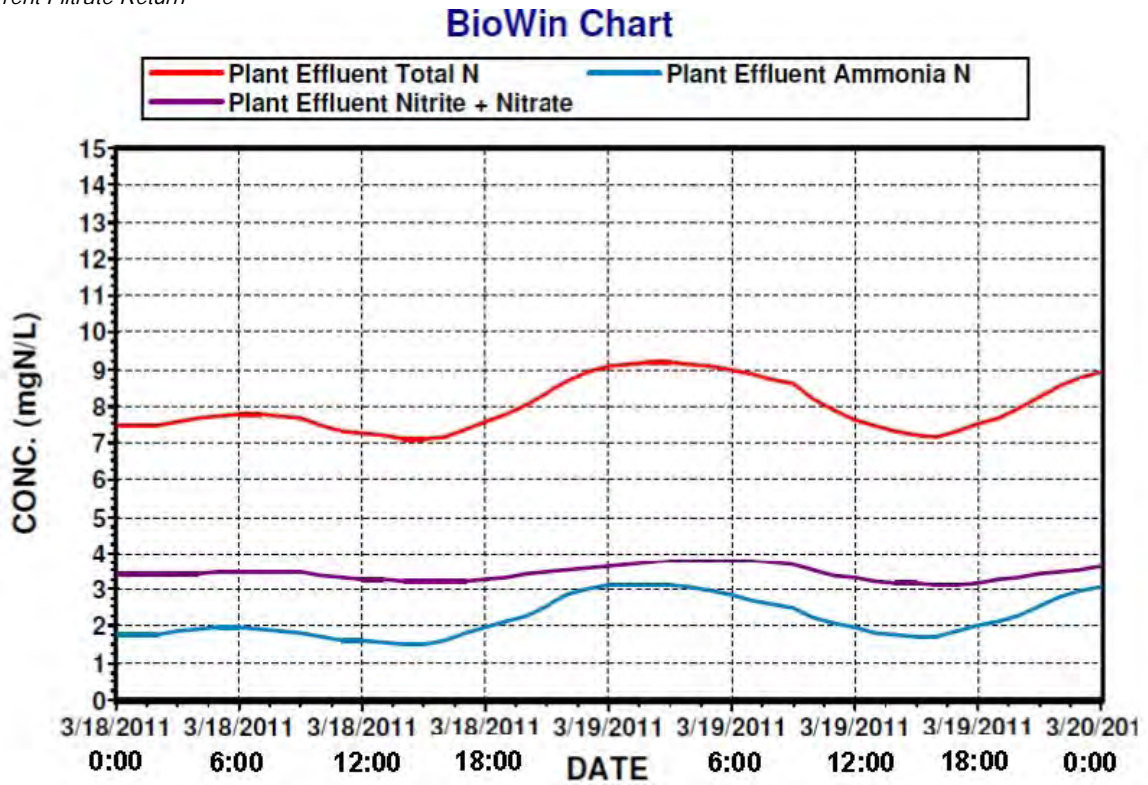
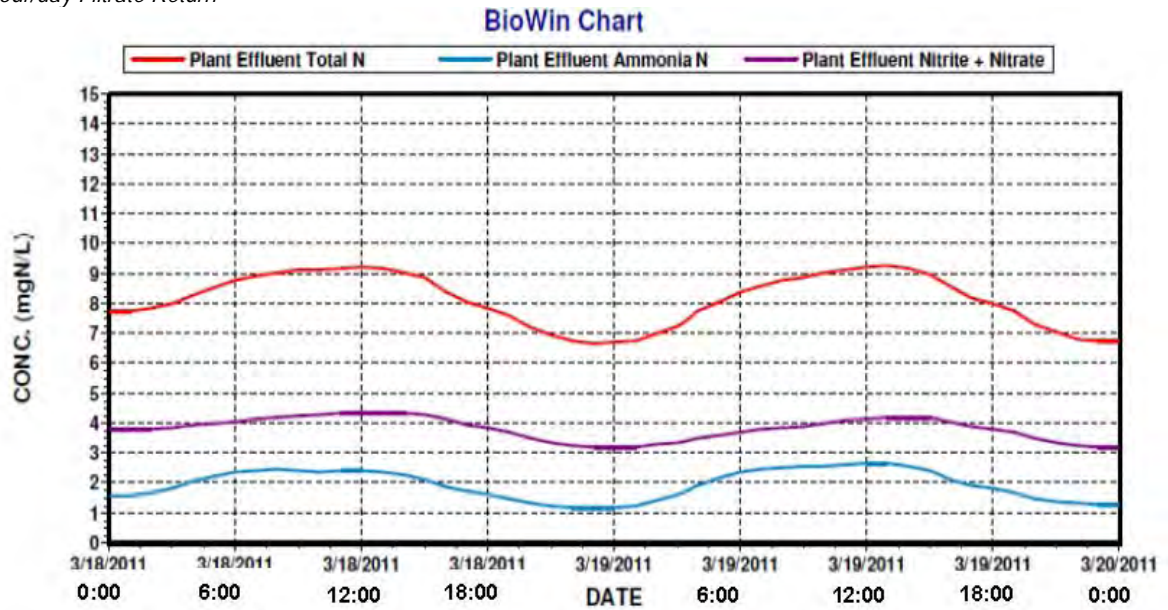


FIGURE 4
 Process Simulation Results
 8-hour/day Filtrate Return



Summary

The dynamic simulation indicates that the existing unit processes in the Bend WRF can assimilate the return of filtrate directly from the dewatering process, bypassing the degas beds. This evaluation indicates that there will not be a detrimental impact on overall effluent quality and that the WRF can continue to meet the annual total nitrogen limit.

If the City moves forward with this approach, the effluent quality should be closely monitored during the return of filtrate. While the dynamic simulation indicates that the effluent TN trend will be similar, this should be validated with the existing performance.

Benefits of Replacing Existing Belt Filter Press

ATTACHMENT C TO: TM 8 – Solids Treatment Improvements

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Objective

The original scope of the project included replacing the existing dewatering centrifuge with one new belt filter press, and leaving the existing BDP belt filter press (BFP) in service. This fact sheet explores the costs and benefits associated with installing two new BFP in the existing solids building, and replacing the existing centrifuge as well as the existing BDP BFP.

Background

The Bend Water Reclamation Facility (WRF) currently dewateres digested sludge with a 2-meter BFP, manufactured by BDP. This BFP is housed in the existing solids building on the mezzanine floor, adjacent to an existing dewatering centrifuge. The existing centrifuge is no longer used to dewater digested solids due to numerous operation and maintenance problems.

Currently, the existing BFP is operating slightly beyond its actual capacity for dewatering digested sludge based on a preferred operational schedule of 8 hours per day, and 5 days per week. Two BFPs will be required to operate in parallel to provide the City with adequate dewatering capacity for the future year 2030 average solids production, based on the preferred operational schedule of 8 hours per day, and 5 days per week.

The original facility planning and Project Definition scope included the replacement of the existing centrifuge with one new 2-meter BFP, and continued utilization of the existing BFP. During Project Definition and Schematic Design, it was recognized that there are various deficiencies associated with the existing BFP arrangement. Therefore, it was decided to investigate the potential advantages and disadvantages associated with the option of installing two new BFP in the existing solids building, which would replace both the existing centrifuge and the existing BFP.

Some of the major deficiencies associated with the existing BFP arrangement include the following:

- Fugitive foul air emissions result in odors and corrosion of interior building structure.
- The odorous wet cake discharge and high profile BFP pressure shear zone is located in close proximity to the existing dry polymer big bag loading station, resulting in operational hazards.

- Maintenance access for BFP components has proven to be difficult due to location of drives adjacent to building wall in addition to the high profile machine design.
- Existing arrangement requires a cake transfer screw conveyor prior to pumping the cake to the cake storage bin.
- The existing cake pump has proven to not be capable of conveying high solids dewatered sludge.
- Providing stable, optimum polymer-to-sludge set point feed rates has been problematic.

Design Criteria

The design criteria for the digested sludge dewatering are summarized in *TM 8 – Solids Treatment Improvements*.

Evaluation of Alternatives

Two belt filter press dewatering improvement alternatives were evaluated.

Alternative 1 consists of modification and continued utilization of the existing BDP BFP and installation of one new BFP that replaces the existing centrifuge.

Alternative 2 consists of installation of two new BFP that replace both the existing BFP and the existing centrifuge.

For Alternative 1, modifications were assumed to be made to the existing BFP in an attempt to overcome the previously listed existing deficiencies and to provide a more equitable comparison of the two options. For example, the evaluation assumes that the drives for the existing press would be relocated to the opposite side of the machine to improve maintenance access. However, some deficiencies associated with the existing BFP arrangement cannot be fully mitigated. For example, due to the larger footprint of the existing BFP, providing additional distance from the existing dry polymer loading station cannot be mitigated without providing a remote polymer big bag loading station, which would likely trigger an expansion of the existing solids building in addition to new equipment and pneumatic conveyance costs.

Plan and section view sketches for both alternatives are included as Appendix B to this fact sheet.

Alternative 1—Modify Existing Belt Filter Press

Advantages

- Lower initial capital costs.

Disadvantages

- More expensive 20-year total present worth.
- Less foul air containment and more interior building corrosion potential, resulting in need for more frequent re-coating.

- Reduced operations and maintenance (O&M) access due to larger BFP footprint and higher profile machine.
- Dry polymer loading is compromised due to close proximity to existing larger footprint BFP.
- Additional cake transfer conveyor required resulting in greater O&M.
- Hydraulic belt tensioning versus pneumatic has greater O&M.
- Risk associated with a potential major re-build of the existing BFP within the 20 year planning period.

Alternative 2—Replace Existing Belt Filter Press

Advantages

- Less expensive 20-year total present worth.
- Extended useful life of all dewatering equipment and less maintenance.
- Commonality of operations, maintenance, and spares inventories.
- Improved uniform instrumentation and control resulting in more stable dewatering performance.
- Improved maintenance access for drives, pneumatic tensioning devices, and roller assemblies, with LH/RH low profile BFP arrangement and common access via center maintenance area, away from exterior walls.
- More reliable cake conveyance with improved anti-bridging cake pumps and elimination of existing cake cross conveyor.
- Cake drops directly by gravity into improved cake hopper/anti bridging progressing cavity cake pump, equipped with weigh elements.
- Reduced footprint and lower profile BFP (Andritz SMX, or equal) provides opportunities for improved O&M access.
- Allows provisions for individual foul air pickup hoods and side curtains to help contain odors, spray water, mitigate building corrosion, and reduce heating & ventilation energy.
- Provides additional physical distance separation and curtain containment of dewatered sludge, belt sprays, and fugitive foul air emissions from the existing dry polymer loading station.

Disadvantages

- Higher initial capital cost.

Present Worth Analysis

Table 1 provides the relevant project factors used in the present worth analysis. Table 2 summarizes the present worth analysis used in the BFP equipment evaluation. The detailed present worth analysis spreadsheet tables, complete with comprehensive scope and cost assumptions, are included as Appendix C to this fact sheet.

TABLE 1
Present Worth Analysis Approach
City of Bend Water Reclamation Facility

Factors	Unit	Value
Power Cost	\$/kWh	\$0.041
Labor Cost	\$/hour	50
Inflation	Annual %	Not used
Discount Rate	Annual %	1%
Time Length	Years	20

kWh = kilowatt-hour.

TABLE 2
Present Worth Analysis—Belt Filter Press Evaluation
City of Bend Water Reclamation Facility

Type of Cost	Alternative 1 Modify Existing BFP & Add One New BFP^a (\$ millions)	Alternative 2 Replace Existing BFP & Add Two New BFPs^b (\$ millions)
Relative Initial Capital Costs	\$1.23	\$1.63
Present Worth of Initial Capital Costs & Periodic Re-Coating of Building Interior	\$1.75	\$1.75
Present Worth of Relative Annual O&M Costs	\$0.13	\$0.04
TOTAL Net Present Worth	\$1.88	\$1.79

^a Alternative 1 assumes existing BFP has remaining 20-year life.

^b Alternative 2 assumes no salvage value credit for removal of existing BFP.

Recommendations

The total present worth analysis indicates a slight (approximately \$96,000) economic advantage to replacing the existing BFP and centrifuge with two new BFPs (Alternative 2). However, with respect to initial capital costs, modification and continued use of the existing BFP (Alternative 1) is approximately \$400,000 less expensive than Alternative 2. It should be noted that these estimates assume that the existing BFP has a remaining 20-year service life for Alternative 1, and there would be zero salvage value credit for the removal of the existing BFP for Alternative 2.

If the O&M benefits associated with providing two new BFPs are determined to be important, and if the overall project cost constraints can accommodate the additional capital costs, the recommendation is to replace the existing BFP with a new BFP identical to the unit being installed to replace the existing centrifuge (Alternative 2 above). If initial capital project costs are the primary decision driver due to affordability issues, then Alternative 1 is recommended.

Appendixes

Appendix A—Vendor Catalog Cuts

- BDP Belt Filter Press (Existing dewatering unit)
- Andritz Belt Filter Press

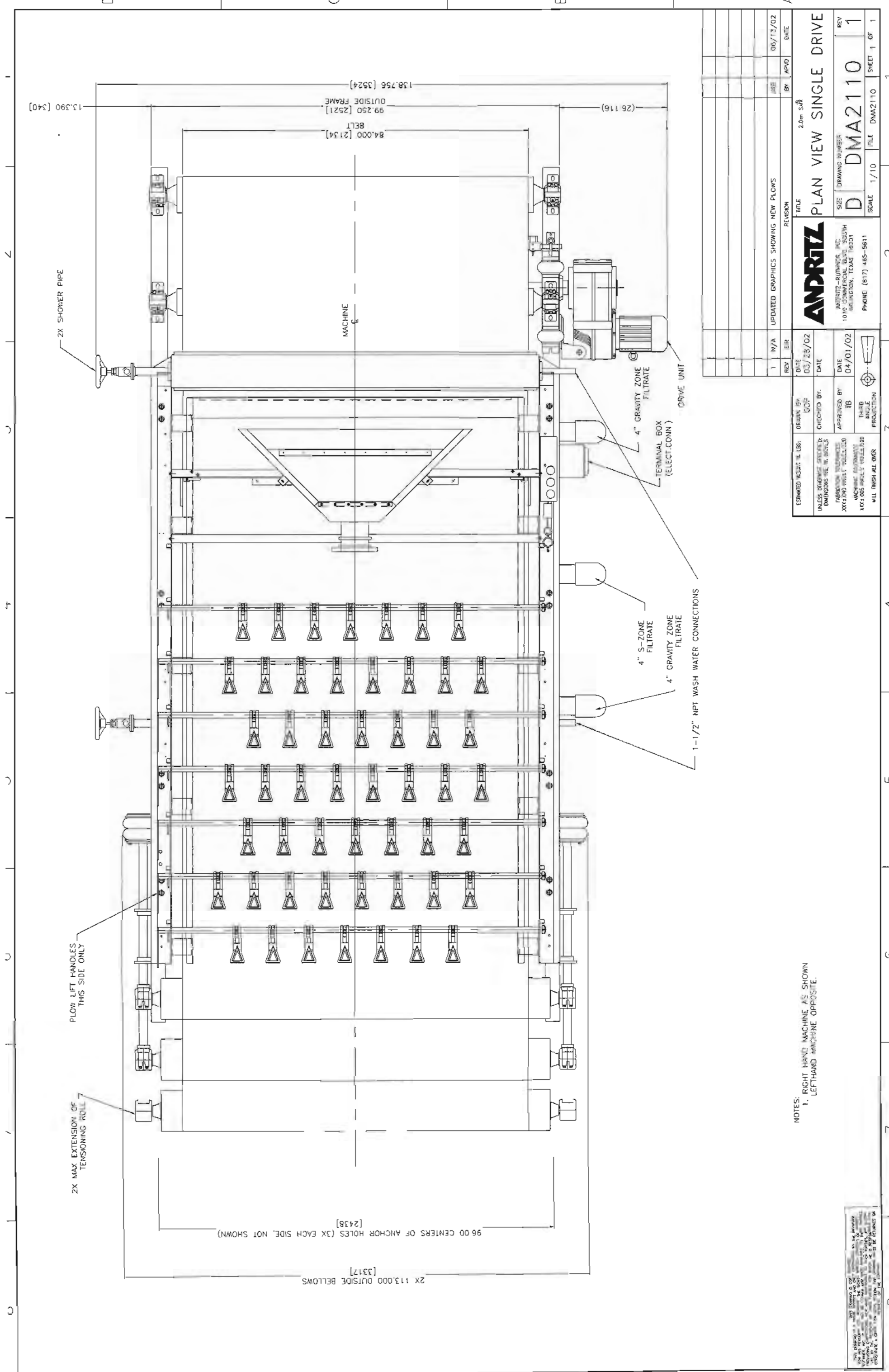
Appendix B—Plan and Section Views

- Plan View and Section View Sketches Comparing to Existing BFP Unit
- Plan View and Section View Illustrating Two New BFPs

Appendix C—Detailed Present Worth Evaluation Spreadsheets

Detailed Present Worth Evaluations

Appendix A—Vendor Catalog Cuts



NOTES:
 1. RIGHT HAND MACHINE AS SHOWN
 LEFT HAND MACHINE OPPOSITE.

REV	DATE	BY	APPROVED
1	05/13/02		

REV	DATE	BY	APPROVED
1	03/28/02		
	04/01/02		

ESTIMATED WEIGHT IN LBS:
 UNLESS OTHERWISE SPECIFIED:
 DIMENSIONS ARE IN INCHES

FABRICATION TOLERANCES:
 UNLESS OTHERWISE SPECIFIED:
 FRACTIONS: AS SHOWN
 DECIMALS: 0.005 INCHES
 HOLE SIZES: 0.015 INCHES
 WILL FINISH ALL OVER

DATE: 03/28/02
 CHECKED BY: GCP
 APPROVED BY: TB

DATE: 04/01/02
 THIRD ANGLE PROJECTION

2.0m SUB

REVISED: 05/13/02

FILE: DMA2110

SHEET 1 OF 1

SCALE: 1/10

DMA2110

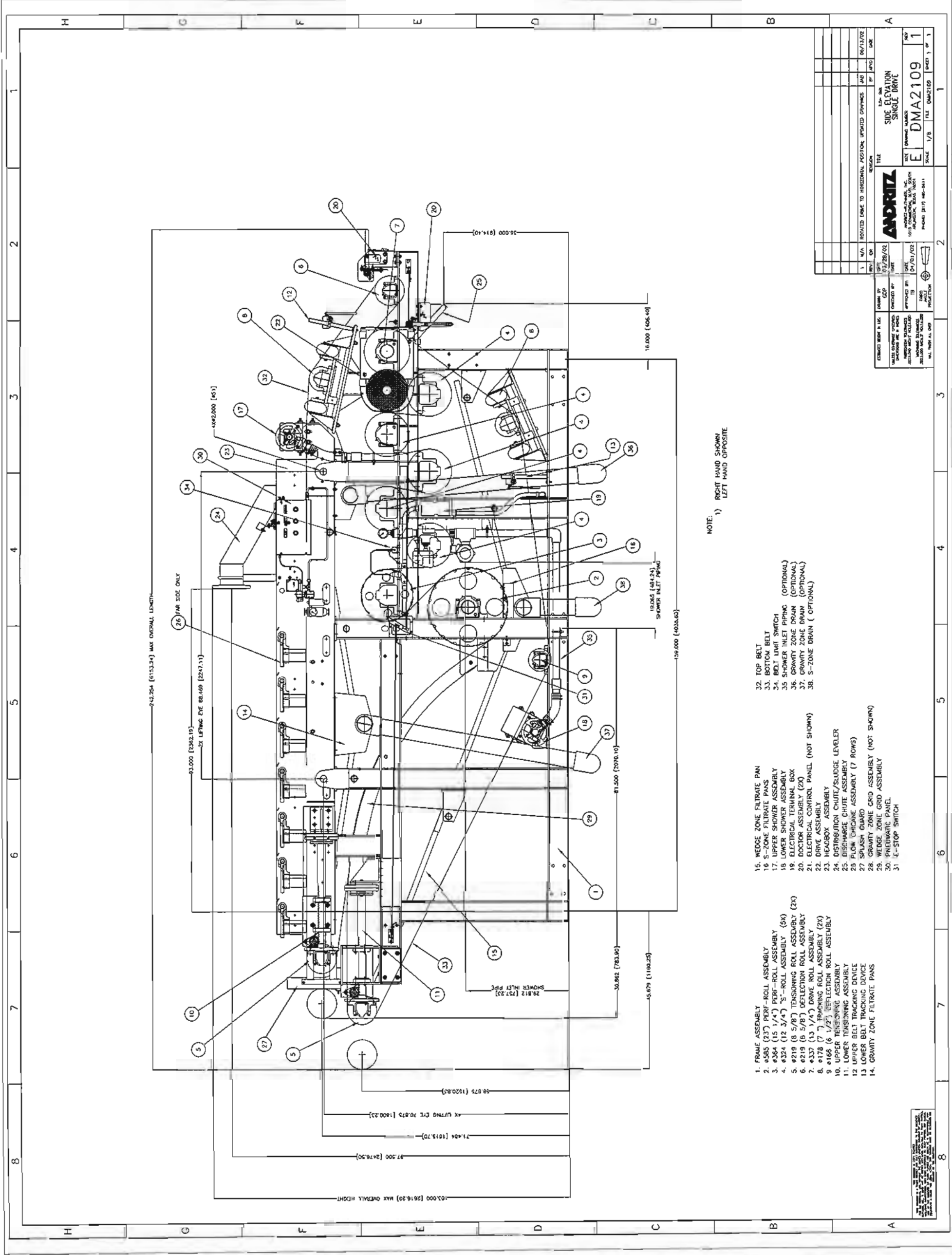
DMA2110

1

ANDRITZ

ANDRITZ-ROBINER, INC.
 1016 COMMERCIAL BELT, SOUTH
 WASHINGTON, TEXAS 75301
 PHONE: (817) 485-5811

13,390 [340]

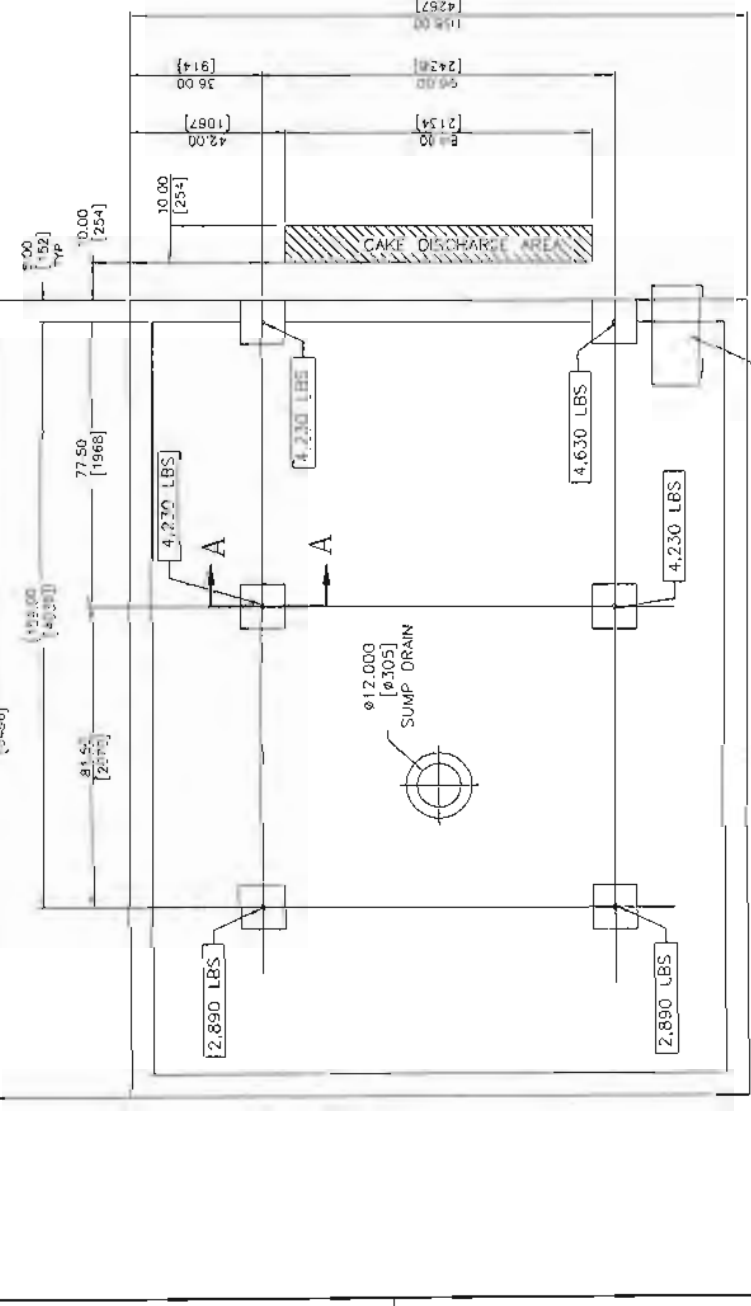


NOTE: 1) RIGHT HAND SHOWN
LEFT HAND OPPOSITE

- 1. FRAME ASSEMBLY
- 2. #585 (23) PERF-ROLL ASSEMBLY
- 3. #364 (15 1/4") PERF-ROLL ASSEMBLY
- 4. #324 (12 3/4") S"-ROLL ASSEMBLY (5X)
- 5. #219 (8 5/8") TENSIONING ROLL ASSEMBLY (2X)
- 6. #219 (8 5/8") DEFLECTION ROLL ASSEMBLY
- 7. #337 (13 1/4") DRIVE ROLL ASSEMBLY
- 8. #178 (7") TRACKING ROLL ASSEMBLY (2X)
- 9. #166 (6 1/2") REFLECTION ROLL ASSEMBLY
- 10. UPPER TENSIONING ASSEMBLY
- 11. LOWER TENSIONING ASSEMBLY
- 12. UPPER BELT TRACKING DEVICE
- 13. LOWER BELT TRACKING DEVICE
- 14. GRAVITY ZONE FILTRATE PANS
- 15. WEDGE ZONE FILTRATE PAN
- 16. S-ZONE FILTRATE PANS
- 17. UPPER SHOWER ASSEMBLY
- 18. LOWER SHOWER ASSEMBLY
- 19. ELECTRICAL TERMINAL BOX
- 20. DOCTOR ASSEMBLY (2X)
- 21. ELECTRICAL CONTROL PANEL (NOT SHOWN)
- 22. DRIVE ASSEMBLY
- 23. HEADBOX ASSEMBLY
- 24. DISTRIBUTION CHUTE/SLUDGE LEVELER
- 25. DISCHARGE CHUTE ASSEMBLY
- 26. FLOW CHICANE ASSEMBLY (7 ROWS)
- 27. SPLASH GUARD
- 28. GRAVITY ZONE CRID ASSEMBLY (NOT SHOWN)
- 29. WEDGE ZONE CRID ASSEMBLY
- 30. PNEUMATIC PANEL
- 31. E-STOP SWITCH
- 32. TOP BELT
- 33. BOTTOM BELT
- 34. BELT LIMIT SWITCH
- 35. SHOWER INLET PIPING (OPTIONAL)
- 36. GRAVITY ZONE DRAIN (OPTIONAL)
- 37. GRAVITY ZONE DRAIN (OPTIONAL)
- 38. S-ZONE DRAIN (OPTIONAL)

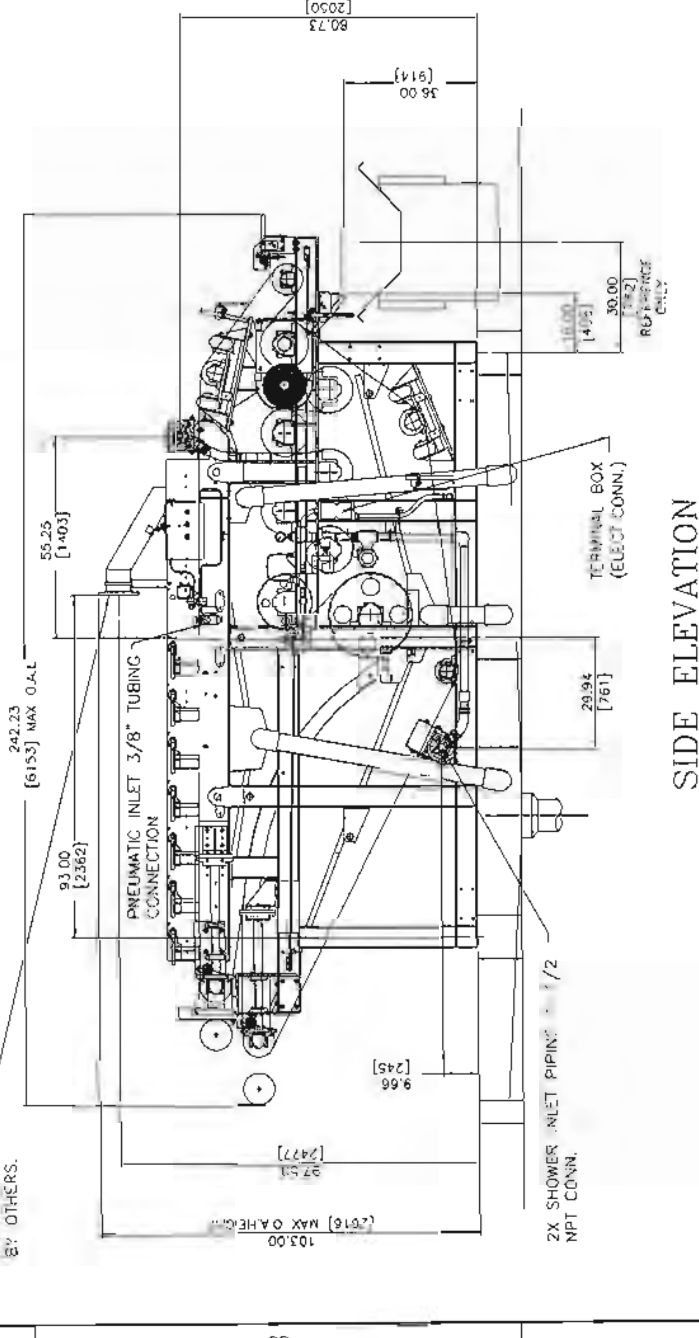
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CHKD BY	DATE		
APPROVED BY	DATE		
PROJECT NO.			
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PROJECT	DMA2109		
SCALE	1/8"	FILE	DMA2109
SHEET	1	OF	1
ANDRITZ 1615 COMMERCIAL BLVD., SUITE 200 HUNTSVILLE, AL 35894 PHONE: (256) 460-1811			
ESTIMATED WEIGHT	0.27/29/02	REVISED TO	06/13/02
MAINT. SUPPLY	1	REVISION	

ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED ARE IN INCHES AND DECIMALS THEREOF. DIMENSIONS IN PARENTHESES ARE METRIC EQUIVALENTS. DIMENSIONS IN SQUARE BRACKETS ARE APPROXIMATE. DIMENSIONS IN BRACKETS ARE FOR INFORMATION ONLY.

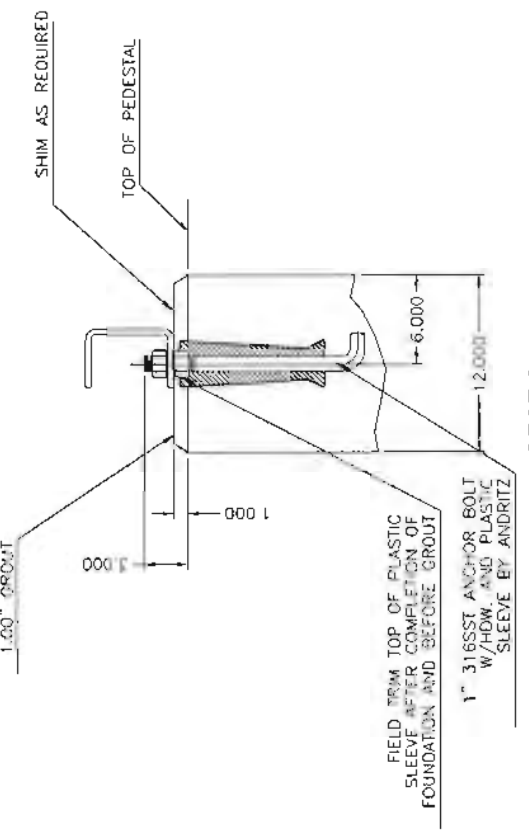


FOUNDATION PLAN

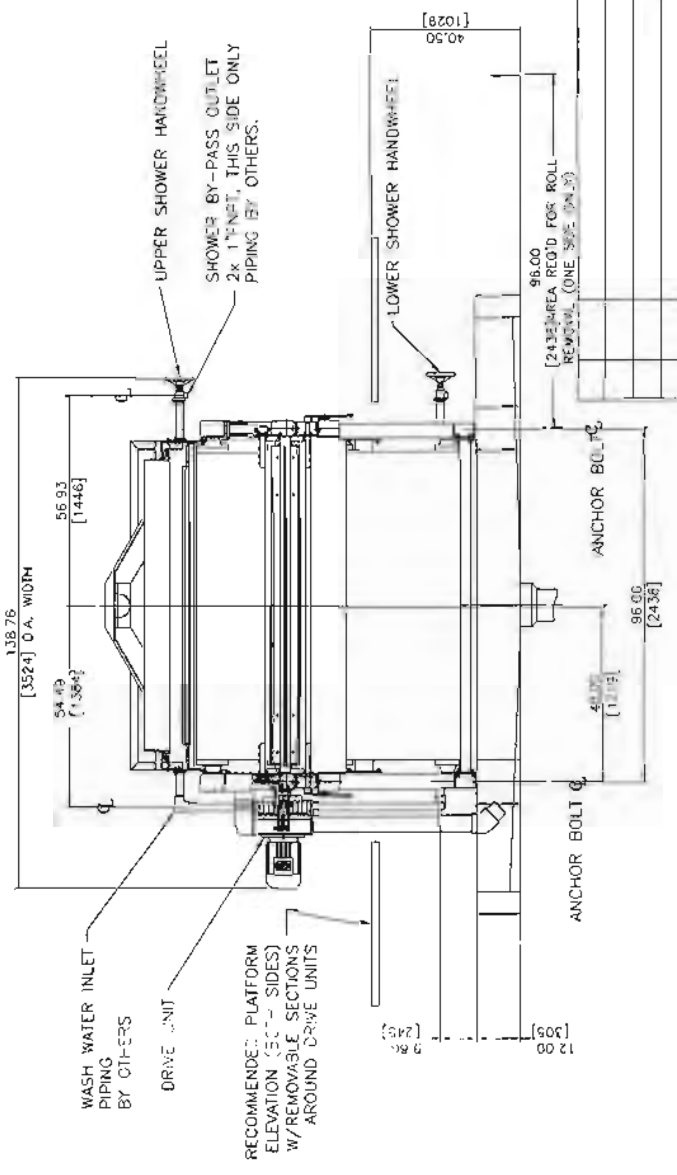
FEED INLET 6" 150#
FLG CONN PIPE
SUPPORTS &
EXPANSION JOINT
BY OTHERS.



SIDE ELEVATION



SECTION A-A
(SCALE: 1/8)



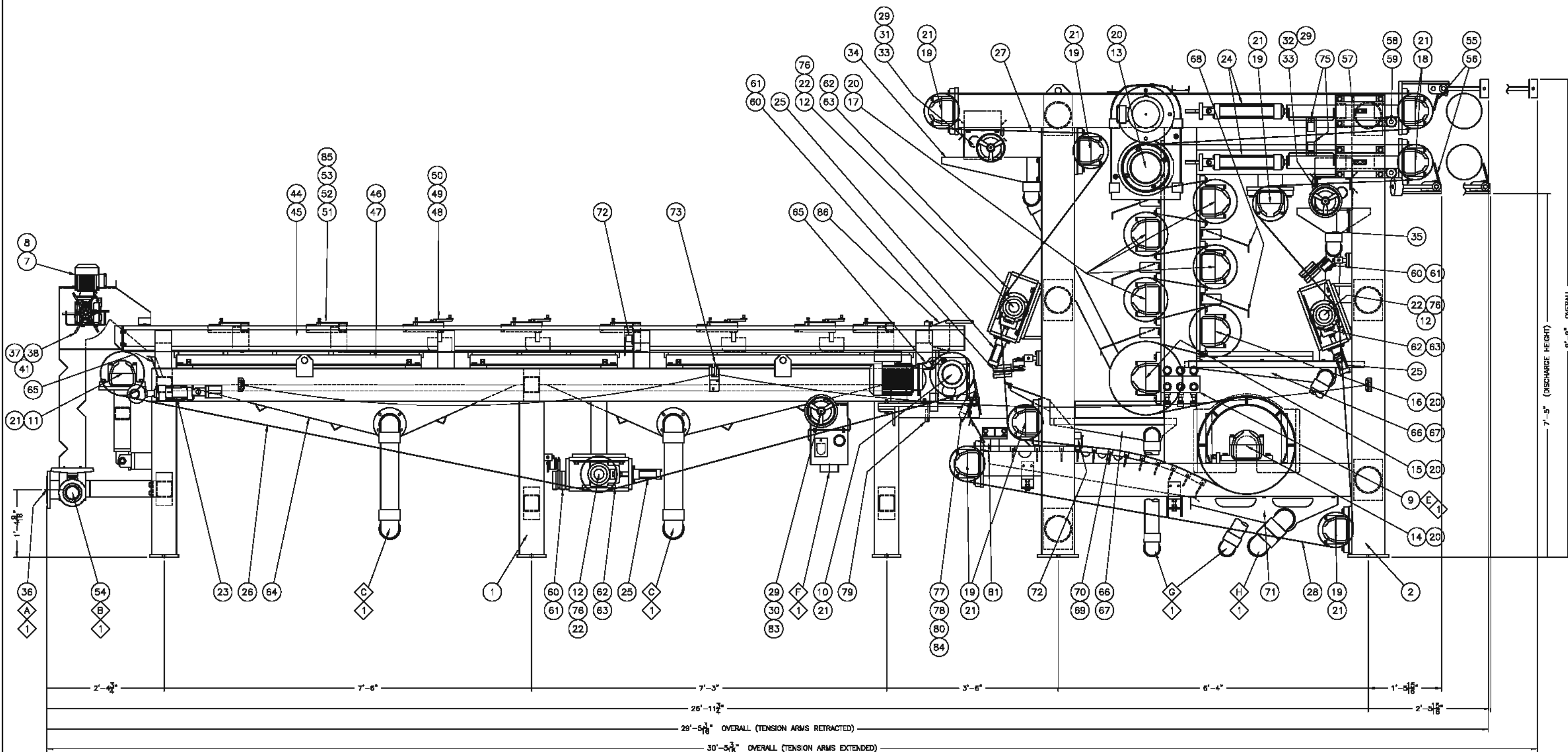
END ELEVATION

GENERAL NOTES AND INFORMATION

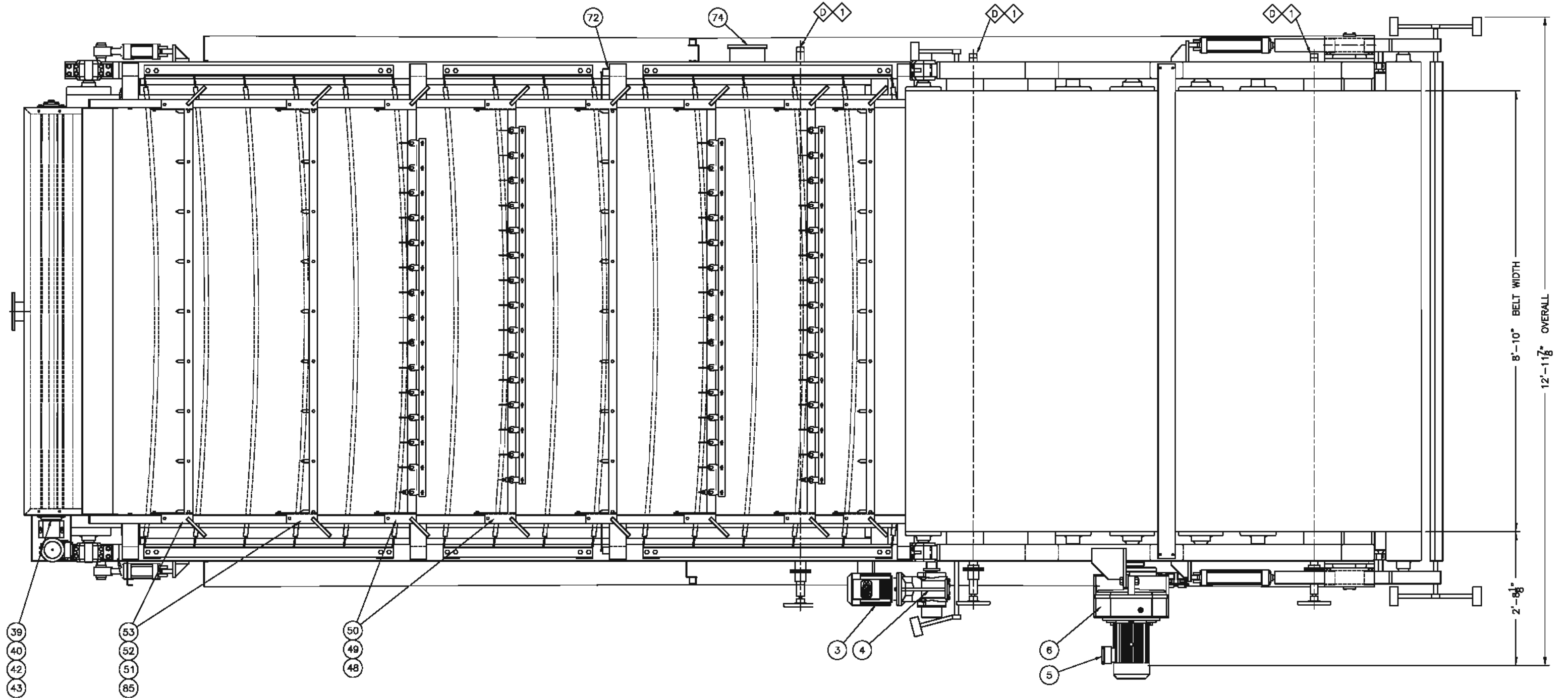
1. THE LOADINGS INDICATED INCLUDE VIBRATION EFFECTS.
2. THE FOUNDATION DESIGN SHOWN INDICATES MINIMUM REQUIREMENTS FOR CLEARANCE AND DRAINAGE. ACTUAL FOUNDATION DESIGN AND CONSTRUCTION TO BE FURNISHED BY OTHERS.
3. MINIMUM UTILITIES REQUIRED TO BE FURNISHED BY THE OWNER. THE FIGURES BELOW ARE FOR THE MACHINE ONLY. ANY ANCILLARY EQUIPMENT WILL REQUIRE ADDITIONAL UTILITIES.
 - A. AIR - FOUR (4) CUBIC FEET PER MINUTE OF CLEAN AIR @ 90 PSIG.
 - B. WATER - 90 GALLONS PER MINUTE AT AMBIENT TEMPERATURE AND 120 PSIG. MIN.
 - C. DRY WEIGHT OF MACHINE: 20,100 LBS
WET WEIGHT: 23,100 LBS
 - 5. RIGHT HAND MACHINE - AS SHOWN


ESTIMATED WEIGHT IN LBS EXCLUDES DRIVE UNITS (DIMENSIONS ARE IN INCHES)	DRAWN BY GDP	DATE 03/28/12	REVISION 1	TITLE FOUNDATION PLAN RH
FABRICATION TOLERANCES FINISHING AREA: MIL/1000	CHECKED BY TB	DATE 04/01/12	BY DMF	REV 1
MACHINING TOLERANCES MILL FINISH ALL SURF.	APPROVED BY TB			
WELDING TOLERANCES MILL FINISH ALL SURF.	THIRD ANGLE PROJECTION			
<p>2.0 SW4 - SB FOUNDATION PLAN RH SINGLE DRIVE</p> <p>SIZE: DRAWING NUMBER D: DMF1381</p> <p>SCALE: 1/2"=1' FILE: DMF1381 SHEET 1 OF 1</p>				

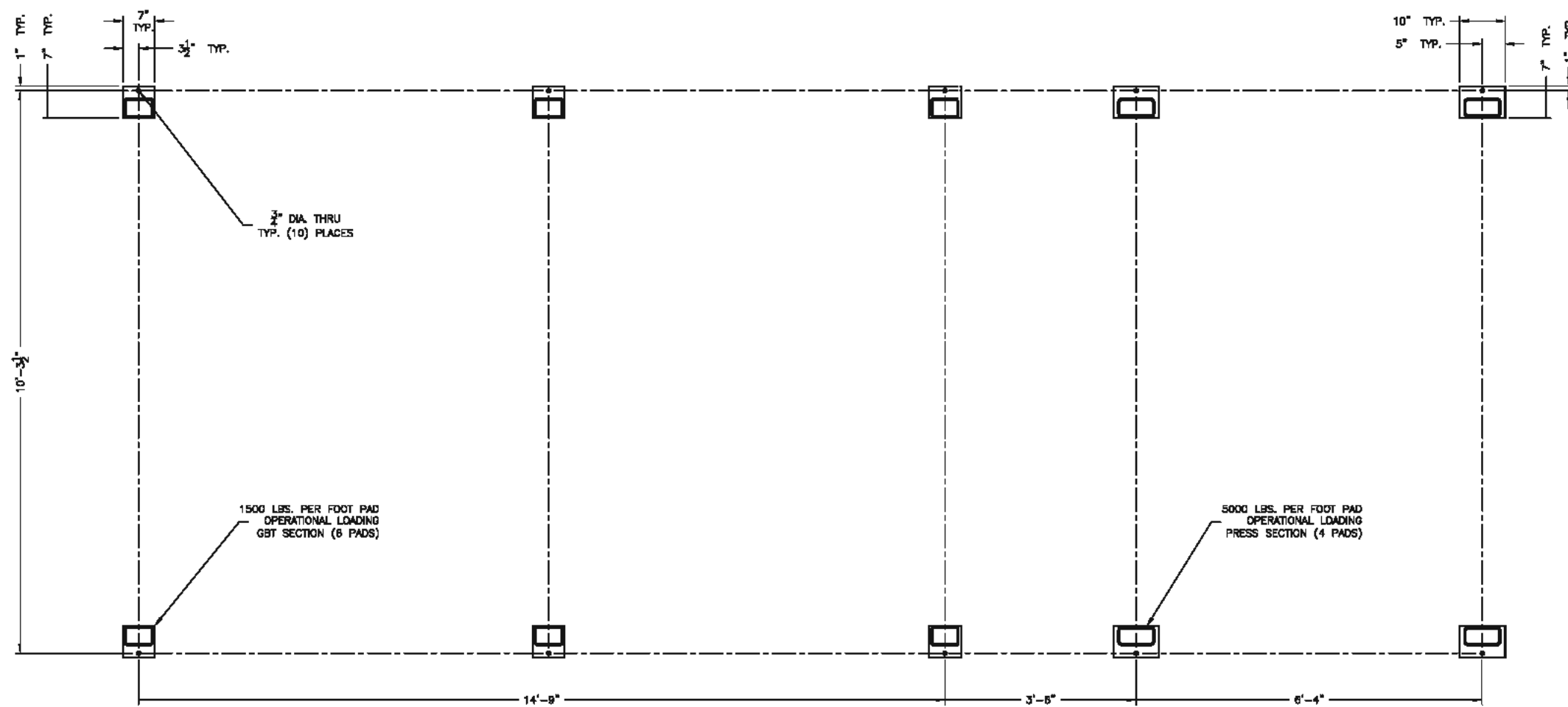




QTY.	DESCRIPTION	MAT.	ITEM	REMARKS
		BDP INDUSTRIES, INC. GREENWICH, N.Y. 12834		
CUSTOMER:	MACHINE:	DWG TITLE		
	2.5m 3DP	GENERAL ARRANGEMENT		
REF JOB NO.	DWG BY:	DATE:	DWG NO.	
	SKD	12/9/08	1-700-577	
APP'D BY:	SCALE:	SHT.:	OF:	REV.
	1" = 1'-0"	1	3	1



QTY.	DESCRIPTION	MAT.	ITEM	REMARKS
		BDP INDUSTRIES, INC. GREENWICH, N.Y. 12834		
CUSTOMER:	MACHINE:	DWG TITLE		
	2.5m 3DP	GENERAL ARRANGEMENT		
REP JOB NO.	DWG BY:	DATE:	DUAL MODE 2.5m 3DP W/16' GBT	
	SKD	12/7/08		
APP'D BY:	SCALE:	SHT.:	OF:	REV.
	1" = 1'-0"	2	3	1
DWG NO. 1-700-577				



FOOT PAD LAYOUT

NOTES:

- 1 PIPING BEYOND THIS POINT INDEPENDENTLY SUPPORTED (NOT BY BDP).
2. FRAME IS HOT DIP GALVANIZED PER ASTM A123.
3. ALL STAINLESS STEEL SHEET AND PLATE IS TYPE 316 SS. ALL FASTENERS AND HARDWARE IS TYPE 316 SS.
4. ITEMS NOT OTHERWISE PROTECTED ARE COATED WITH 8 MILS DFT NEMEC SERIES 104 HIGH SOLIDS EPOXY PER BDP PAINT SPECIFICATION QA94-006.
5. HYDRAULIC TUBING AND FITTINGS ARE STAINLESS STEEL.
6. APPROXIMATE WEIGHT: 27,000 LB. DRY
29,000 LB. OPERATING
7. ELECTRICAL CONDUIT IS PVC.

CONNECTION LEGEND:

- A 4" FEED INLET FLANGE; HOLE PATTERN PER A.S.A. B16.5 150# FLANGE
- B 3" FEED BOX DRAIN
- C (4) 4" GBT MAIN COLLECTION PAN OUTLET
- D (3) 1-1/2" VICTAULIC SHOWER INLET
- E 1/2" SAE-8 HYDRAULIC MANIFOLD INLET/RETURN
- F (2) 4" GBT SHOWER ENCLOSURE DRAIN
- G (2) 3" COMPRESSION PAN OUTLET
- H (2) 4" PERFORATED PAN OUTLET

1	SLUDGE REDISTRIBUTION DAM	304 SS	88	
8	EXCELSIOR FLOW END BLADE	UHMW	85	
1	DISCHARGE GATE POSITION SWITCH	NEMA 4X	84	
4	GBT SHOWER ENCLOSURE SEAL	RUBBER	83	
			82	
1	TRANSITION ASSEMBLY	304/UHMW	81	
1	THICKENER MODE DISCHARGE GATE	304 SS	80	
1	THICKENER MODE DOCTOR BLADE	UHMW	79	
1	PRESS MODE DOCTOR BLADE	UHMW	78	
1	GBT DOCTOR BAR ASSEMBLY	304 SS	77	
3	2-7/16" TAKE-UP BEARING		76	SPHERICAL ROLLER
2	BELT TENSION LIMIT SWITCH	NEMA 4X	75	PRESS SECTION
1	ELECTRICAL JUNCTION BOX	FRP	74	NEMA 4X

2	EMERGENCY STOP ASSEMBLY		73	EACH SIDE
4	BELT MISALIGNMENT SWITCH		72	EACH SIDE
1	PERFORATED ROLL PAN	304 SS	71	
1	ELLIPTICAL WEDGE ASSEMBLY	304 SS	70	
12	WEDGE SLIDE BAR	UHMW	69	
5	DRIP DEFLECTION PAN	304 SS	68	
2	DRIP PAN BELT SCRAPER	UHMW	67	
2	COMPRESSION SECTION PAN	304 SS	66	
2	MAIN PAN EXTENSIONS	304 SS	65	
2	GBT COLLECTION PAN	304 SS	64	
3	ALIGNING BEARING SLIDE	UHMW	63	
3	ALIGNING BEARING GUIDE	BRASS	62	
3	BELT ALIGNING PADDLE	304 SS	61	
3	HYDRAULIC BELT ALIGNING VALVE		60	HYDRAULIC
4	TENSION PINION SHAFT SUPPORT	304 SS	59	
4	TENSION RACK GEAR	303 SS	58	
4	TENSION RACK GUIDE	STEEL	57	
2	PRESS BELT DOCTOR BLADE	UHMW	56	
2	PRESS DOCTOR BAR ASSEMBLY	304 SS	55	
1	3" BALL VALVE	PVC	54	
36	EXCELSIOR FLOW UPRIGHT	UHMW	53	
24	EXCELSIOR FLOW CENTER BLADE	UHMW	52	
4	EXCELSIOR FLOW SUPPORT ASM.	STEEL	51	GALVANIZED
60	PMOT FLOW BLADE LEVER	POLY-E	50	
60	PMOT FLOW BLADE	POLY-E	49	
4	PMOT FLOW SUPPORT ASSEMBLY	STEEL	48	GALVANIZED
18	GRAVITY SLIDE BAR	UHMW	47	
3	SLIDE BAR SUPPORT ASSEMBLY	304 SS	46	
2	GUIDE RAIL SEAL	RUBBER	45	
2	GUIDE RAIL ASSEMBLY	304 SS	44	
2	1" SHAFT SEAL	RUBBER	43	
1	COUPLING INSERT		42	
5	AGITATOR BAR PADDLE FLAP KEEPER	304 SS	41	
2	1" HALF COUPLING		40	
2	1" 4-BOLT FLANGE BEARING		39	BALL BEARING
8	AGITATOR BAR PADDLE FLAP	RUBBER	38	
1	FEEDBOX AGITATOR BAR	304 SS	37	
1	GBT FEED BOX; 4" INLET	304 SS	36	
1	LOWER SHOWER MIST COLLECTOR	304 SS	35	
1	UPPER SHOWER DRIP PAN	304 SS	34	
8	PRESS SHOWER ENCLOSURE SEAL	RUBBER	33	
1	PRESS LOWER SHOWER ENCLOSURE	304 SS	32	
1	PRESS UPPER SHOWER ENCLOSURE	304 SS	31	
1	GBT SHOWER ENCLOSURE	304 SS	30	
3	BELT WASH SHOWER	304SS	29	SELF-CLEANING
1	DEWATERING BELT, PRESS		28	
1	DEWATERING BELT, PRESS		27	
1	DEWATERING BELT, GBT		26	
3	ALIGNING CYLINDER		25	#2" x 3"
4	TENSION CYLINDER, PRESS		24	#3.25" x 12"
2	TENSION CYLINDER, GBT		23	#3.25" x 4"
3	2-7/16" UNIBLOCK BEARING		22	SPHERICAL ROLLER
20	75mm USAF BEARING		21	SPHERICAL ROLLER
18	85mm USAF BEARING		20	SPHERICAL ROLLER
5	9" IDLER ROLL, PRESS	STEEL	19	NYLON COVERED
2	9" TENSION ROLL, PRESS	STEEL	18	NYLON COVERED
4	11" COMPRESSION ROLL, PRESS	STEEL	17	NYLON COVERED
1	12" COMPRESSION ROLL, PRESS	STEEL	16	NYLON COVERED
1	18" COMPRESSION ROLL, PRESS	STEEL	15	NYLON COVERED
1	24" PERFORATED ROLL	304 SS	14	
1	11" DRIVE ROLL, PRESS	STEEL	13	EAA COVERED
3	7" ALIGNING ROLL	STEEL	12	EAA COVERED
1	11" TENSION ROLL, GBT	STEEL	11	NYLON COVERED
1	11" DRIVE ROLL, GBT	STEEL	10	EAA COVERED
1	HYDRAULIC VALVE STATION		9	
1	FEEDBOX REDUCER; 137:1		8	
1	FEED BOX MOTOR; 1/3 HP		7	
1	PRESS REDUCER; 199.31:1		6	
1	PRESS DRIVE MOTOR; 7.5 HP		5	
1	GBT REDUCER; 97.05:1		4	
1	GBT DRIVE MOTOR; 3 HP		3	
1	PRESS TUBULAR STEEL FRAME	A500GR.B	2	GALVANIZED
1	GBT TUBULAR STEEL FRAME	A500GR.B	1	GALVANIZED

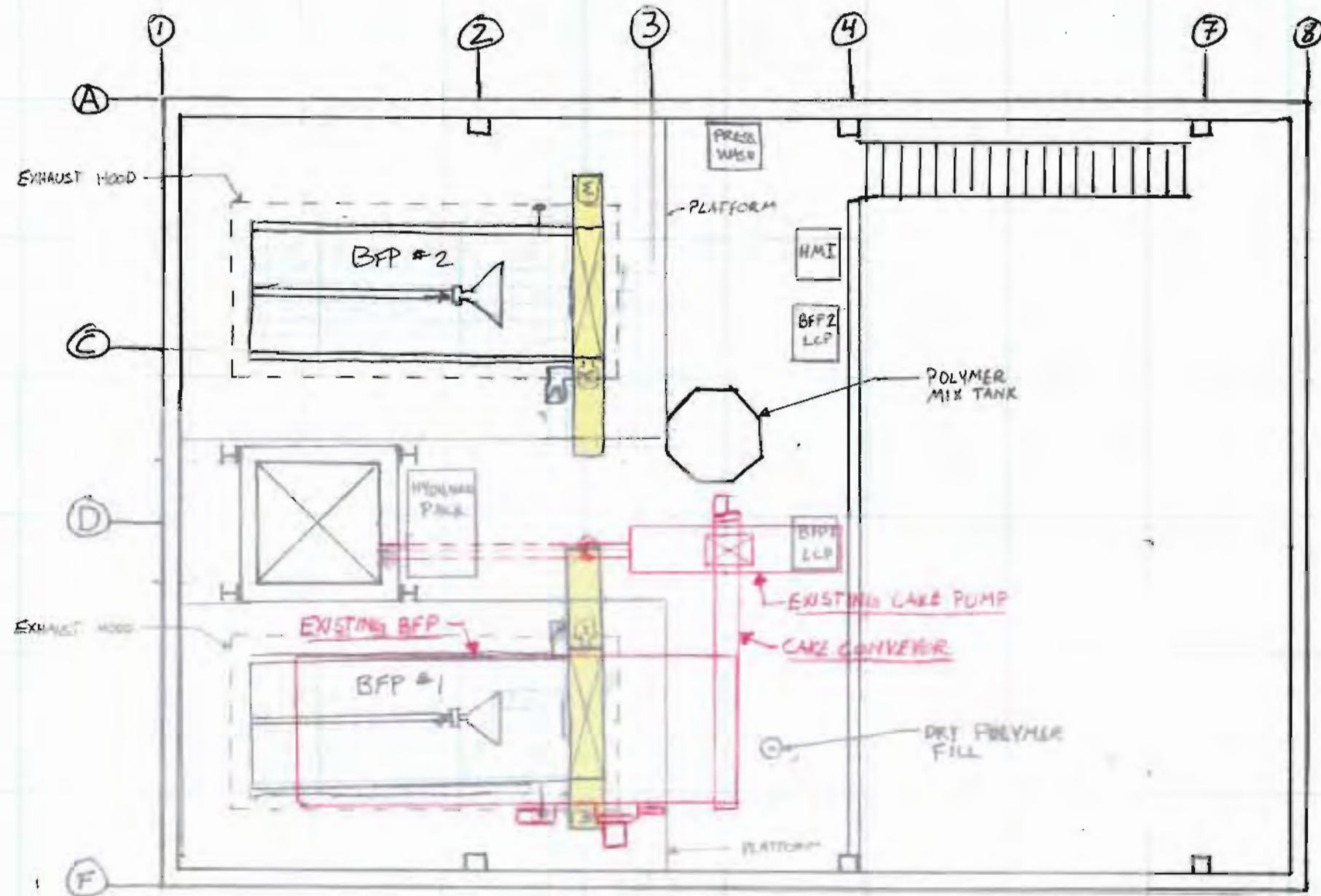
BDP INDUSTRIES, INC.
GREENWICH, N.Y. 12834

CUSTOMER: MACHINE: 2.5m 3DP
DWD TITLE: GENERAL ARRANGEMENT
DUAL MODE 2.5m 3DP W/16' GBT

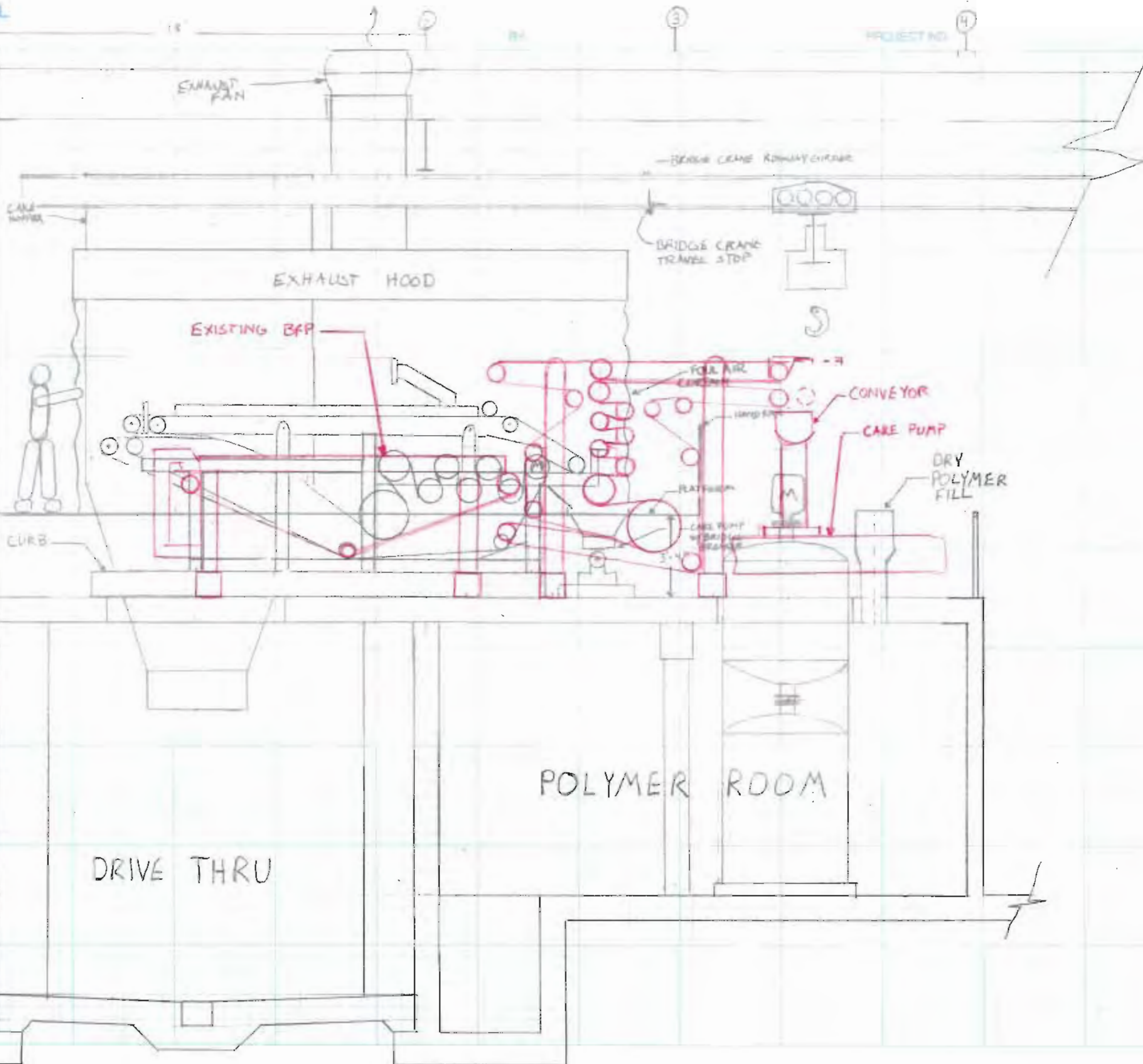
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APP'D BY: SCALE: 1" = 1'-0" QTY: 3 3
REV. NO. 1-700-577

REV.	DESCRIPTION	DATE	BY

Appendix B—Plan and Section Views



MEZZANINE PLAN
SCALE 1/8" = 1'-0"



W 1171

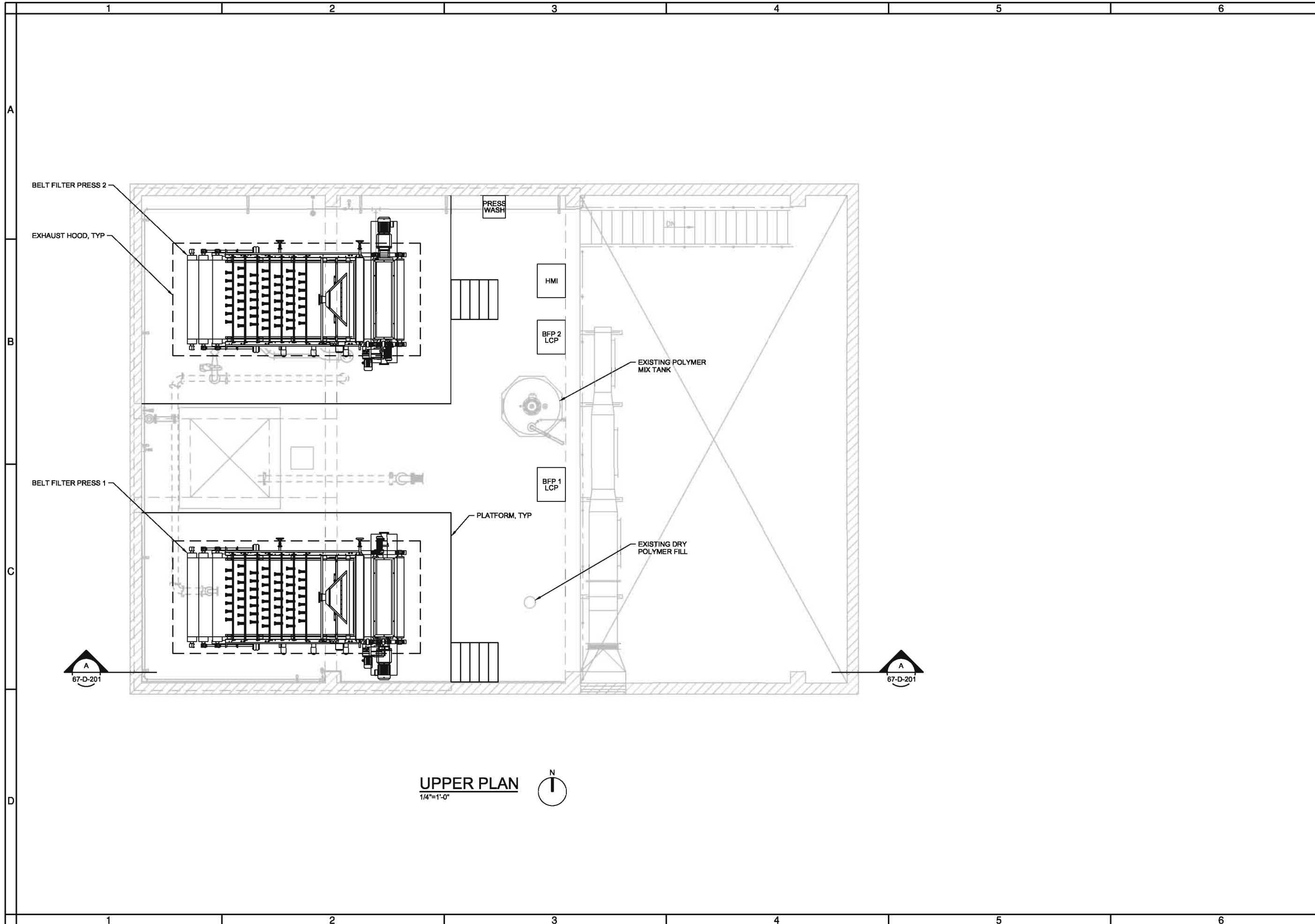
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Railway Charge
PL 3342.25

EL 3360.08

EL 3376.60

EL 3364.50

EL 3360.50



UPPER PLAN
1/4"=1'-0"

PRELIMINARY
NOT FOR
CONSTRUCTION

WRF SECONDARY EXPANSION
SOLIDS DEWATERING BUILDING
PROCESS
UPPER PLAN



REVISIONS:

CH2MHILL
SECONDARY
EXPANSION
WATER RECLAMATION FACILITY
CITY OF BEND, OREGON

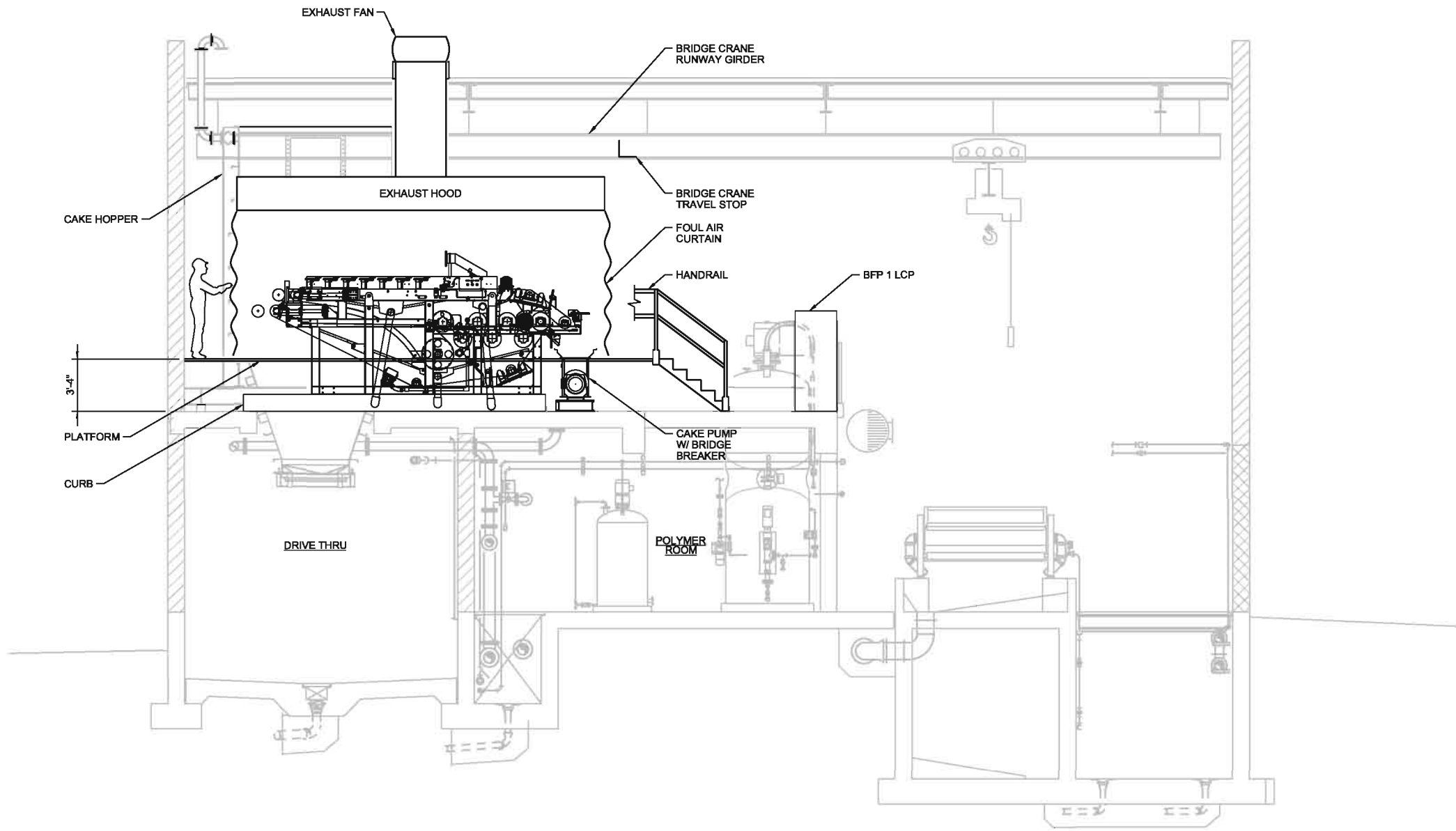
ENGINEER	DATE
GS MCFARLAND	
CHECKED-BY	
APPROVED-BY	
SCALE	

VERIFY SCALES
0 1"
BAR EQUALS ONE INCH
ON ORIGINAL DRAWING

DWG: 67-D-142

SHEET:

COB # SW0802



A SECTION
 1/4"=1'-0"
 67-D-142

PRELIMINARY
 NOT FOR
 CONSTRUCTION

WRF SECONDARY EXPANSION
 SOLIDS DEWATERING BUILDING
 PROCESS SECTION



REVISIONS:

CH2MHILL
 SECONDARY EXPANSION
 WATER RECLAMATION FACILITY
 CITY OF BEND, OREGON

ENGINEER: GS MCFARLAND
 DRAW BY: GS MCFARLAND
 CHECKED BY: _____
 APPROVED BY: _____
 SCALE: _____
 DATE: _____

VERIFY SCALES
 0 1"
 BAR EQUALS ONE INCH
 ON ORIGINAL DRAWING

DWG: 67-D-201

SHEET:

COB # SW0802

Appendix C—Detailed Present Worth Evaluation Spreadsheets

Bend WRF BFP Alternative Costs
Present Worth Calculations

Assumptions: electric cost = \$0.041/kWh; labor costs \$50/hr
 Discount Rate: 1.00%

	20 yr PW of Capital Costs	20 yr PW of Annual Costs	Total 20 yr PW
Bend BFP - Alt 1	\$1,753,000	\$131,000	\$1,884,000
Bend BFP - Alt 2	\$1,748,000	\$40,000	\$1,788,000
Delta (Alt 2 - Alt 1)	-\$5,000	-\$91,000	-\$96,000

Capital Costs

Alternatives	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Bend BFP - Alt 1	\$1,229,075	\$0	\$0	\$0	\$0	\$148,000	\$0	\$0	\$0	\$0	\$148,000	\$0	\$0	\$0	\$0	\$148,000	\$0	\$0	\$0	\$0	\$148,000	
Bend BFP - Alt 2	\$1,626,700	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$148,000
Delta (Alt 2 - Alt 1)	\$397,625																					

PW of Capital Costs (Yr 2011\$)

Alternatives	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Bend BFP - Alt 1	\$1,229,075	\$0	\$0	\$0	\$0	\$140,817	\$0	\$0	\$0	\$0	\$133,982	\$0	\$0	\$0	\$0	\$127,480	\$0	\$0	\$0	\$0	\$121,293	
Bend BFP - Alt 2	\$1,626,700	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$121,293

Annual O&M Costs

Alternatives	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Bend BFP - Alt 1	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889	\$6,889
Bend BFP - Alt 2	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099	\$2,099

PW of Annual Costs (Yr 2011\$)

Alternatives	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Bend BFP - Alt 1	\$6,889	\$6,821	\$6,753	\$6,686	\$6,620	\$6,555	\$6,490	\$6,425	\$6,362	\$6,299	\$6,236	\$6,175	\$6,114	\$6,053	\$5,993	\$5,934	\$5,875	\$5,817	\$5,759	\$5,702	\$5,646
Bend BFP - Alt 2	\$2,099	\$2,078	\$2,057	\$2,037	\$2,017	\$1,997	\$1,977	\$1,957	\$1,938	\$1,919	\$1,900	\$1,881	\$1,862	\$1,844	\$1,826	\$1,808	\$1,790	\$1,772	\$1,754	\$1,737	\$1,720

TM 9 – Plant Hydraulic Improvements and Yard Piping

PREPARED FOR: Jim Wodrich, P.E./City of Bend

PREPARED BY: Brady Fuller, P.E./CH2M HILL
Jim Frost/WHPacific

REVIEWED BY: Dave Green, P.E./CH2M HILL
Jim Griffiths, P.E./CH2M HILL
Rich Frankenfield, P.E./CH2M HILL

DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Introduction

This technical memorandum details the options that were evaluated for plant hydraulic improvements and yard piping around the primary clarifiers, aeration basins, secondary clarifiers and ultraviolet (UV) disinfection facility. The entire facility was modeled from the effluent discharge structure at the ponds and back up through the treatment processes to the headworks influent pipe. The resulting hydraulic profile is included in the drawing set (See Drawing 1-G-41) and shows the water surface elevations throughout the treatment facility under several flow conditions.

Background

The Schematic Design Report documents the following decisions:

- Primary influent piping and connection at primary splitter structures
- Buried primary effluent piping configuration
- Aeration basin primary effluent piping configuration
- Aeration basin weirs, baffles, channel configurations
- Mixed liquor piping configuration
- Secondary effluent, filter feed, and conveyance to plant effluent ultraviolet (UV) disinfection
- Plant effluent configuration

Hydraulic Analysis Method

The hydraulic model was created using HYDRO and AFT Fathom computer software.

The HYDRO computer model (CH2M HILL proprietary program) calculates energy and hydraulic grade line elevations upstream and downstream of the hydraulic elements in the treatment plant. The hydraulic analysis begins at the water surface datum elevation at the downstream end of the plant. The hydraulic calculations proceed upstream from this datum elevation, one element at a time.

The AFT Fathom computer model uses matrix methods to solve the governing equations of pressurized pipes in a network and can calculate capacities, and energy and hydraulic grade lines for each element in the system. AFT Fathom was generally used to determine flow splits between elements when such calculations were not automatically determined using HYDRO. An example of this flow split is the primary effluent distribution piping where pipe diameters, lengths, and minor losses vary between different parallel paths and the more hydraulic calculations of AFT Fathom are able to automatically resolve the flow split.

Design Criteria

Design criteria are summarized in Table 1.

TABLE 1
Plant Hydraulic Improvements Design Criteria
City of Bend Water Reclamation Facility

Criterion	Design Value
Peak hour wet weather flow (2030 design condition)	29.1 mgd (hydraulics calculated at 30 mgd)
Maximum month flow	11.9 mgd (hydraulics calculated at 12 mgd)
Average annual flow	10.9 mgd
Maximum RAS rate	12 mgd (RAS = 65% ADMM plant inflow, not to exceed maximum beneficial RAS rate)
Maximum mixed liquor recycle rate	400% of plant inflow (turn off during peak flow events)
Plant recycles	Assume 1 mgd maximum
Design minimum freeboard to top of wall	18 inches
No surcharge of clarifier weirs under peak hour wet weather flows	--
Effluent flow measurement required at disinfection for flow pacing disinfection	--
IFAS screen wall maximum headloss	4 inches per wall per CH2M HILL experience

ADMM = average day maximum month; IFAS = integrated fixed-film activated sludge; mgd = million gallons per day; RAS = return activated sludge.

Note: Current collection system limits flow to about 30 mgd.

The water surface elevation at Pond 3 served as a starting point for the hydraulic model. The effluent pipes were evaluated to determine if the diameter was large enough to pass the ultimate buildout plant capacity of 50 million gallons per day (mgd).

The proposed plant effluent UV disinfection facility, including effluent magmeter, was sized for a peak wet weather flow of 30 mgd split equally into three online UV channels (with provision for a fourth UV channel and second magmeter for a buildout flow of 50 mgd). The equal flow split is intended to be accomplished through downstream level control maintaining similar level in each reactor, and inlet energy dissipation to disrupt the velocity head and momentum from the 54-inch influent pipeline. Baffling and channel design will be refined during design development. The UV reactor channel water surface elevation was selected to provide 30 mgd peak flow (three secondary clarifiers in service), and 50 mgd (five secondary clarifiers in service) with minimal submergence at the secondary clarifier weirs under peak flow conditions. The UV reactor water surface elevation will be finally resolved during Design Development through consultation with UV vendors.

The secondary clarifier influent (mixed liquor) and effluent pipes (secondary effluent) were sized to be able to take a maximum plant ultimate flow of 50 mgd, assuming 10 mgd per secondary clarifier. Clarifier effluent weirs are designed to remain unsubmerged at peak dry weather flows of 7.74 mgd per clarifier.

The aeration basin mixed liquor effluent channel was evaluated to convey peak flows of 50 mgd. The aeration basin baffles were designed to allow a drop over each baffle wall and between each zone. The maximum flow through each aeration basin is 10.5 mgd, which corresponds to the buildout peak wet weather conditions, with four basins in service. The integrated fixed-film activated sludge (IFAS) influent weir will be kept unsubmerged under all flow conditions.

The existing and proposed improvements to aeration basin influent (primary effluent) pipes were evaluated to determine required in-gallery piping and buried yard piping between facilities to convey the ultimate flows of 10.5 through each aeration basin ($4 \times 10.5 = 42$ mgd). Pipes will be sized large enough to maintain the primary clarifier effluent weir unsubmerged at peak dry weather flows of 7.74 mgd per clarifier. Additionally, new and existing primary clarifier influent and effluent pipes were evaluated and designed to pass the ultimate flow of 10 mgd per clarifier.

The primary influent pipes (between headworks and primary splitter structure) were designed to provide 9 inches freeboard in the screen channel at the headworks at the ultimate plant capacity of 50 mgd and at least 12 inches of freeboard at 30 mgd. Due to concerns for minimum scouring velocity, installation of a new 30-inch parallel primary influent pipe is recommended as shown on the site plan (Drawing 5-CY-100). The model evaluated the vertical drop pipe out of the downstream side of the influent screens, which throttles flow to maintain backwater on the downstream side of the screens.

While not within the scope of the report, the collection system for this plant is being improved. Some components (such as the adjacent canal crossing, also known as the plant interceptor siphon) currently limit flow to the plant. While this report addresses hydraulic improvements within the plant, improvements outside of the plant are also required to convey and treat the entire ultimate flow.

All process units as summarized below were assumed to be in service for the analysis performed for ultimate peak wet weather flow:

- One headworks facility (three 6-millimeter [mm] screens, and one 3-mm screen)
- Five circular primary clarifiers
- Five IFAS aeration basins
- Five circular secondary clarifiers
- Two UV channels in service and one UV channel out of service
- Two effluent pipes to the ponds

Evaluations

The following items were evaluated during Schematic Design:

- *Refinement of primary effluent (PE) header sizing, extent of layout, flow meter sizing, PE control valve sizing, and most-open valve control scheme for distributing PE flow at minimum head.* This work was completed integrally with the hydraulic analysis described herein.
- *Structural/mechanical pipe connections to existing pipes/structures where non-conventional connections may be required (primary influent box, secondary effluent piping, outfall).* These connections were coordinated with the civil discipline. The primary influent junction box will be connected to by coring a new penetration in the east side and sealing with modular mechanical seal. The secondary effluent piping will be upsized and connected via replacing existing piping and using concrete closure collars. The plant effluent outfall piping will be connected to by placing a new manhole around the existing pipe and breaking out the pipe.
- *Mixed liquor (ML) effluent channel hydraulic refinement (channel depth, width, new 54-inch ML connection).* The mixed liquor effluent channel at AB4 will match the width of existing channels, but the bottom of channel will be 12 inches lower allowing more conveyance capacity.
- *Pipe sizing for plant drain and tank drains.* The plant drainage sizing is as shown on the yard piping drawings.
- *Yard utility - points of demand and pipe sizing (hot water loop, IA, W3, re-use).* The plant drainage sizing is as shown on the yard piping drawings.
- *Primary influent (PI) pipe access/cleaning provisions or control approach to flush PI pipes (PI pipes will be sized for peak flows, but sedimentation could occur at minimum flows).* Schematic Design refined the primary influent pipe layout as shown on the site plan. Parallel 30-inch PI pipes are provided with isolation valves to allow isolation for cleaning and to achieve higher velocities that will reduce the occurrence of sedimentation in the online pipes. During Schematic Design, options for cleaning and grit removal were considered and access ports into the 30-inch PI pipes were ultimately not recommended. Instead,

isolation valves on the 42-inch header east and west of the headworks will be provided along with isolation valves on each new 30-inch PI east of the headworks.

Process Description

Primary Clarifiers

Connection to Existing Primary Clarifiers 1 and 2

At the headworks facility, a 42-inch primary effluent header pipe combines the flow from each one of the four screens and exits the facility to the east and west. The pipe that exits to the west side is flanged for future use. The pipe that exits to the east side of the facility currently has a 42-inch x 30-inch reducer connected to a 30-inch line that flows into the primary influent junction box.

The primary influent junction box was used to facilitate the connection between the old and existing headworks buildings during the construction of the current headworks facility.

Besides the influent pipe from the headworks facility, the primary influent junction box has two additional connection pipes to the north and to the south. The 30-inch pipe connected to the south was the former connection to the old headworks facility. The 30-inch pipe connected to the north delivers the flow to the existing primary clarifier distribution box for Primary Clarifier 1 (PC 1) and Primary Clarifier 2 (PC 2).

The primary clarifier distribution box, distributes the flow over weirs and into drop boxes, and then to 24-inch pipes to the two existing Primary Clarifiers 1 and 2. A third weir was installed for future Primary Clarifier 3 (PC 3) (contemplated during original plant construction to be located south of PC 1), which will now not be used per Project Definition Report recommendations. PC 3 is recommended to be constructed west of PC 1 and 2.

The ultimate capacity of the plant requires that each primary clarifier will be able to treat 10 mgd. The sizes of the pipes from the headworks facility to the primary clarifier distribution box are too small to deliver the required flow to two primary clarifiers. Increased conveyance in the PI pipe from the headworks to the PC 1 and PC 2 distribution box is needed along with larger conveyance piping to future PC 3.

The segment of pipe between the headworks facility and the primary influent junction box needs to be increased from 30-inch to 42-inch. The reducer at the effluent of the headworks facility will be removed.

A second 30-inch parallel pipe between the primary influent junction box east of the headworks and the existing primary clarifier distribution box is required for flows above 30 mgd. This additional primary influent pipe is not required for the current phase of the project. The future parallel 30-inch pipe will connect to the east side of the primary influent junction box and at the primary clarifier distribution box section originally intended for PC 3. The future 30-inch parallel line will be reduced to 24-inch before entering the primary clarifier distribution box, and will connect to the existing wall pipe. The weir wall (or a portion thereof, equal to at least the area of a 42-inch circular penetration) originally intended for a PC 3 southeast of the splitter box will be removed in the future to allow flow into the center section of the primary clarifier distribution box. Coordination with any

filtrate gravity pipelines that are currently being contemplated to be designed and installed by the City must occur during final design. The new 30-inch PI feeding primary influent splitter box for PC 3 is sized to reduce sediment deposition and allow for a future 30-inch PI to serve additional clarifiers fed from the distribution structure.

The recommended improvements in the PI piping are sufficient to deliver 20 mgd to both PC 1 and PC 2, but the new 30-inch PI is not necessary for the current plant improvements. Providing equal flow split to the primary clarifiers is an objective of the design, and the proposed piping layout can achieve this. Adjustable weirs on the overflow to primary clarifiers could be provided to allow “trimming” of the flow split to the primaries, but this is not recommended. The primary sludge production rate during peak flow events of relatively dilute wastewater is not expected to be substantially affected by relatively minor inequalities in overflow rate.

The primary effluent pipes from PC 1 and PC 2 are 24-inch pipes (one from each clarifier effluent box) that combine into a 30-inch pipe (about 100 feet long), and tee into the aeration basin influent 42-inch pipe. This pipe is not large enough to convey the flow (10 mgd from each primary clarifier) to the aeration basins influent header; therefore, it needs to be upsized.

After the two 24-inch effluent pipes combine into a 30-inch, the pipe must be increased from 30-inch to 42-inch. The next 35 to 40 feet are replaced with 42-inch pipe followed by a wye that splits the flow to the remaining section of 30-inch pipe (about 70 feet), and to a new parallel 30-inch, which also connects to the 42-inch aeration basin influent pipe.

The new 30-inch parallel pipe connects to an existing segment of pipe that tees off the 42-inch aeration basin influent header. This connection point is currently flanged or plugged for future connection. Current hydraulic operation at daily diurnal peak dry weather flows causes backwater conditions in the primary effluent launders for substantial portions of the day. Improved PE conveyance provided by this project will help to reduce this occurrence.

Connection to New Primary Clarifier 3, and Future Primary Clarifiers 4 and 5

The segment of 42-inch pipe that is currently blind flanged at the west side of the headworks facility is used to deliver the flow to new PC 3 and future Primary Clarifier 4 (PC 4) and future Primary Clarifier 5 (PC 5). Modeling of the future facilities (PC 4, PC 5, AB 5) is done for hydraulic evaluation only although these facilities will not be constructed for some time.

The 42-inch pipe continues to the west; then a tee is provided to two new 30-inch diameter PI pipes to the new primary clarifier distribution box. Isolation valves at each end are provided to facilitate maintenance and flow isolation into each line to provide flushing velocities.

At the new primary clarifier distribution box, three weirs identical in elevation and length to the existing weirs for PC 1 and PC 2 (elevation 3,361.70 and 5-foot length) are required. On the effluent side of each weir, the drop box connects to a 30-inch pipe and delivers the flow to the primary clarifiers. At the existing PC 1 and PC 2, the influent pipe is 24-inch. This pipe is small, and could become a bottleneck at high flows, so the new clarifiers are designed with a 30-inch pipe for influent. At minimum flows of less than 2 mgd per

clarifier, the velocity inside the 30-inch pipe is less than 0.6 foot per second, and at maximum flows of 10 mgd, it is 3 feet per second.

The new PC 3 (and future PC 4 and PC 5) are identical in size to the existing primary clarifiers. The diameter of the existing primary clarifiers is 65 feet. The effluent v-notch weir is located at elevation 3,360.50. The effluent launder has a base width of 24 inches and has a low point at elevation 3,358.25.

The 30-inch effluent pipe from PC 3 through PC 5 tees into the new 42-inch aeration basin influent pipe.

Aeration Basin

Aeration Basin Influent Pipes

The aeration basin influent is comprised of an existing 42-inch pipe header and new connections to the east and west of the existing ends, which extend from Aeration Basin 1 through Aeration Basin 4 and future Aeration Basin 5. The new connecting pipes that attach to the existing header are also 42-inch diameter. The header extending west connects at the existing 42-inch blind flange. The header extending east connects at the existing 48-inch plug with a 48-inch x 42-inch reducer.

All primary effluent pipes tee into the aeration basin header. As discussed above, PC 1 and PC 2 flow into two 30-inch pipes before connecting to the header. New and future PC 3, PC 4, and PC 5 connect to the header through individual 30-inch pipes.

Currently, the primary effluent flow enters Aeration Basins 1, 2, and 3 (AB 1, AB 2, and AB 3) through three 12-inch and three 18-inch pipes (one of each size per basin). The flow is controlled with modulating electrically actuated butterfly valves and a flow meter on each pipe.

Eventually all aeration basins will be converted to an IFAS system. Due to this change, a new set of influent pipes will be needed for each of AB 1, AB 2, and AB 3 to deliver the remaining primary effluent up to 10.5 mgd per aeration basin. The new influent pipes to each aeration basin are 18-inch and have a flow control valve to accurately control the flow into each basin.

Aeration Basin 4 (AB 4) and Aeration Basin 5 (AB 5) will also have a 12-inch and two 18-inch pipes teeing off from the 42-inch influent header.

The 42-inch header is large enough to allow a combined flow of 50 mgd from the existing, new, and future primary clarifiers with all five units in service or with one of them out of service.

Existing AB 3 has a piping gallery attached to the south end. This piping gallery contains a 42-inch primary effluent (PE) header. Three 18-inch pipes and three 12-inch pipes are connected to the existing PE header. Each pipe is dedicated to a single aeration basin. The 18-inch pipes direct flow to the head of the basin and the 12-inch pipes direct flow to the first aerobic zone (Cell B). The existing piping gallery also contains an 18-inch return activated sludge (RAS) header. Three existing 10-inch RAS pipes are connected to the RAS

header. Each pipe conveys RAS to one of the three existing aeration basins. Each PE and RAS branch has a flow meter and control valve to monitor and control flow.

The existing primary effluent piping has insufficient capacity to convey the full design peak flow. Two 18-inch PE and one 12-inch PE pipes are necessary to convey the peak design flow through each basin. With the pipe arrangement presented above (two 18-inch and one 12-inch to each aeration basin), the maximum flows are as follows:

- Through one 18-inch pipe, the maximum flow that can be delivered to each Anoxic Zone 1 is approximately 4.8 mgd without submerging the weirs at the primary clarifiers.
- Through two 18-inch pipes, the maximum flow that can be delivered to each Anoxic Zone 1 is approximately 8.2 mgd without submerging the weirs at the primary clarifiers.
- At peak wet weather flows, 10.5 mgd, the 18-inch pipes discharge between 3.8 and 4.5 mgd each. The 12-inch pipes discharge between 1.8 and 2.3 mgd each. This is assuming that the 12-inch and one 18-inch pipes are 80 percent open and the valve at the second 18-inch pipe controls the remaining flow. These flows assume that the weirs at the primary clarifiers have just begun to submerge. The flow in each pipe varies due to the length and minor losses that each pipe has on its routing into each aeration basin.

The hydraulic flow split scenarios are presented on Figures 1 through 3. The system is designed to provide flexibility in routing primary effluent around the IFAS zone (Cell B) in each aeration basin. During wet weather conditions, the hydraulic system is designed to utilize a 12-inch PE and 18-inch PE to convey the associated flow to the IFAS zone bypass channel.

FIGURE 1
Total Forward Flow to IFAS Zone = 4.25 mgd
City of Bend Water Reclamation Facility

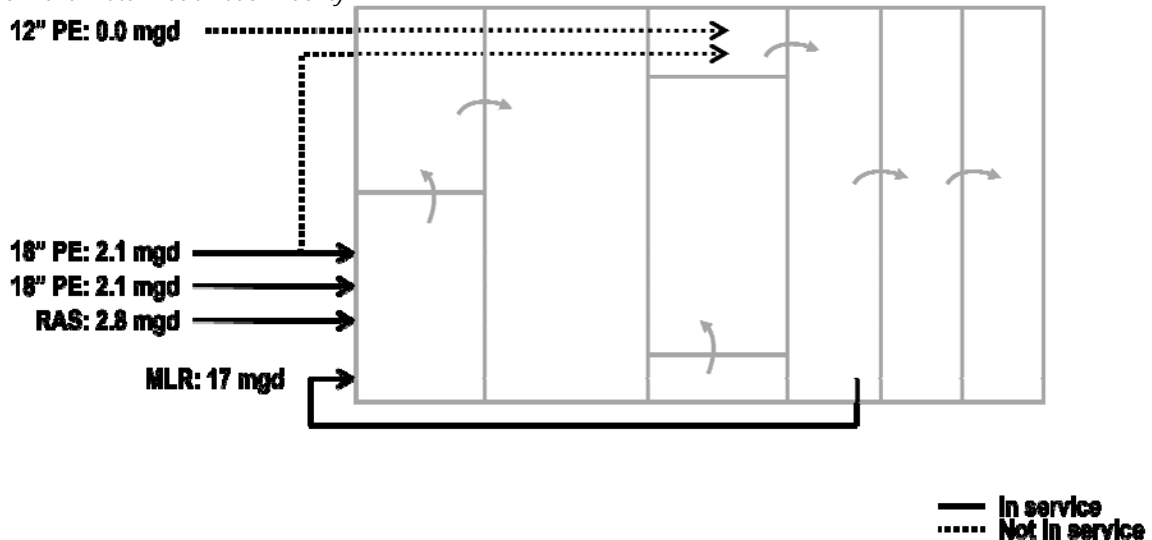


FIGURE 2
 Total Forward Flow to IFAS Zone = 7.74 mgd
 City of Bend Water Reclamation Facility

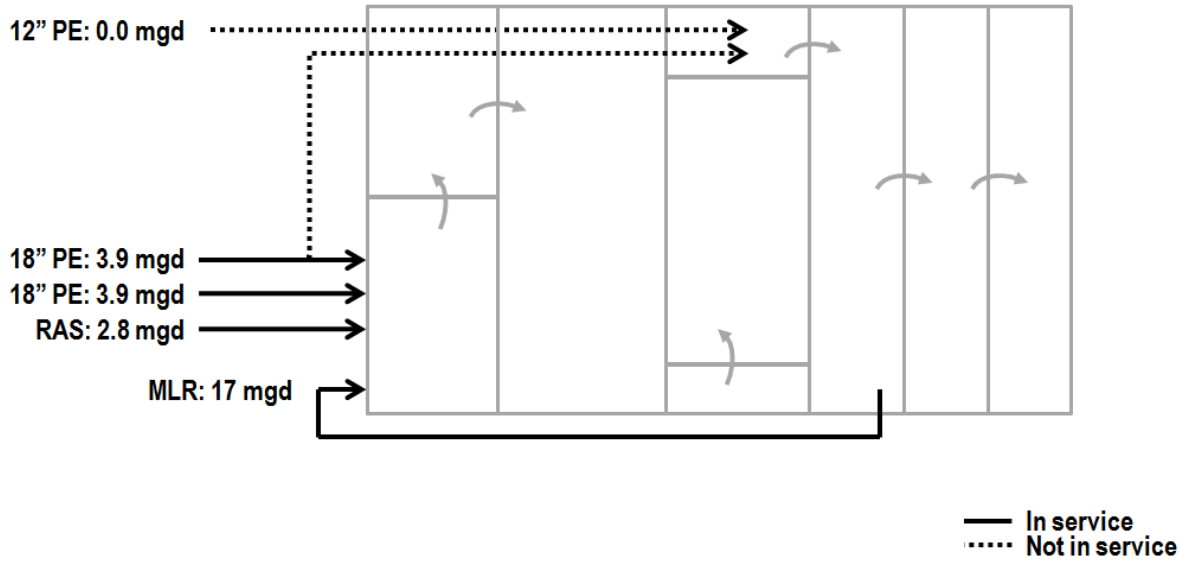
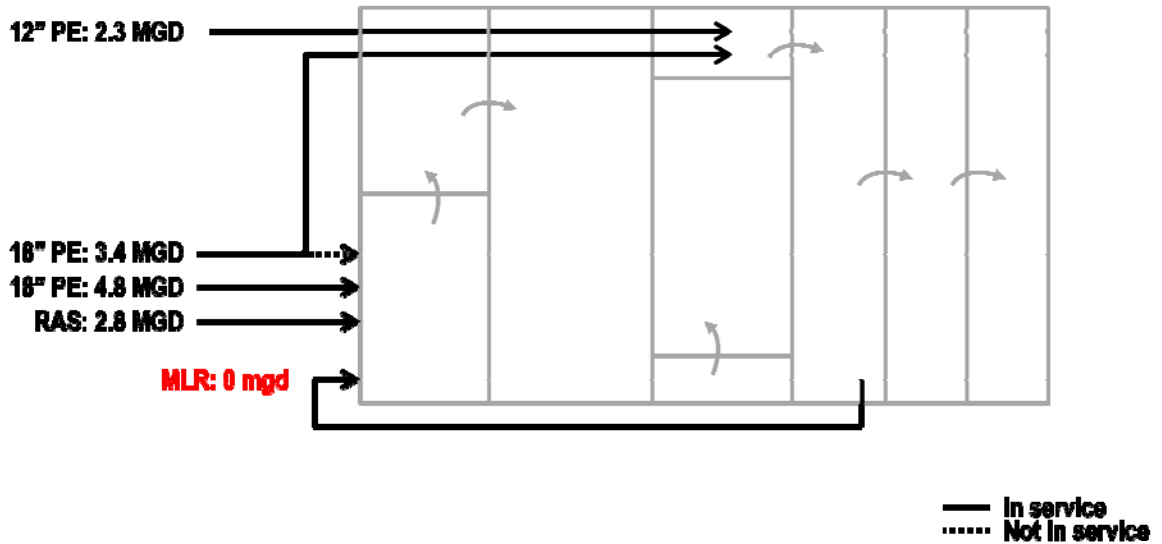


FIGURE 3
 Total Forward Flow to IFAS Zone = 10.5 mgd
 City of Bend Water Reclamation Facility



Aeration Basin Baffles

The aeration basin baffles allow a noticeable water elevation drop over each one of them with the intent of promoting movement of floatables and scum through the basin and in also preventing aerated mixed liquor from being conveyed back into the anoxic zone.

The RAS flow for all influent flow conditions is assumed to be equal to 65 percent of the average day max month (ADMM). The ADMM is 4.3 mgd per aeration basin, so the RAS flow is 2.8 mgd per basin.

The design of the IFAS zone influent channel and weir is an important part of the basin design. The proposed design incorporates six fabricated stainless steel side-flow weirs (weir elevation adjustable on each using slotted plates and bolted connections) which will allow uniform flow distribution into the IFAS zone. The design is intended to allow media retention (and not allow media to migrate upstream of the weir, and also avoids settling of suspended solids in the channel).

The mixed liquor recycle (MLR) for all influent flow conditions lower than 4.3 mgd per aeration basin, is equal to 400 percent of the ADMM. The MLR is assumed to be $4 * 4.3 = 17.2$ mgd per aeration basin.

Table 2 summarizes the baffle elevations at each location and the water surface elevation for each flow through aeration basin.

TABLE 2
 Baffle Elevations and Water Surface Elevations for Flow Conditions
City of Bend Water Reclamation Facility

Zone	Baffle Weir Elevation Downstream of Listed Zone	Water Surface Elevations			
		PWW 10.5 mgd *	PDW 7.74 mgd	ADMM 4.3 mgd	Minimum 1.2 mgd
Anoxic Zone 1	3,357.75	3,358.26	3,358.26	3,358.67	3,358.58
Anoxic Zone 2	3,357.6	3,358.18	3,358.18	3,358.55	3,358.46
Anoxic Zone 3	3,357.85	3,358.09	3,358.09	3,358.35	3,358.29
IFAS	No weir	3,357.79	3,357.73	3,357.67	3,357.58
Aerobic Zone 1	3,357.05	3,357.45	3,357.39	3,357.3	3,357.22
Aerobic Zone 2	3,357.05	3,357.36	3,357.31	3,357.24	3,357.17
Aerobic Zone 3	Effluent weir: 3,356.75	3,357.17	3,357.13	3,357.07	3,357

*Assumes 7.74 mgd through Anoxic Zones 1 and 2.76 mgd through the bypass, and four ABs at 10.5 mgd each – 42 mgd. This is approximately equal to the buildout peak hour wet weather flow. See *TM 4 – Secondary Treatment Improvements* - Table 1 for influent design criteria and range of flows and loads.

Per Table 2:

- The drop between Anoxic Zones 1 and 2 is between 0.7 inch and 1.4 inches.
- The drop between Anoxic Zones 2 and 3 is between 0.6 inch and 2.4 inches.
- The drop between Anoxic Zones 3 and IFAS is between 3.6 inches and 8.5 inches. This baffle is designed to be always non-submerged.
- The IFAS screen headloss is assumed as 4 inches for all conditions.
- The drop between Aerobic Zones 1 and 2 is between 0.6 inch and 1.1 inches.

- The drop between Aerobic Zones 2 and 3 is between 2 inches and 2.3 inches.

Aeration Basin Effluent Channel

The existing aeration basin effluent channel has an invert elevation of 3,355.00 and a 4-foot width. If the new channel on the effluent side of AB 4 and AB 5 were constructed with the same invert elevation and width, the channel would be too shallow to convey 50 mgd ultimate plant flow without backing flow up into the aeration basin.

Instead of modifying the existing effluent channel to increase conveyance, this channel is left without change, and the new effluent channels on the downstream end of AB 4 and AB 5 (future) is set at elevation 3,354, 12 inches lower than the existing effluent channel. This allows the aeration basin effluent weir to not be submerged when treating 10 mgd per basin.

The mixed liquor flows from the aeration basin effluent channel to the secondary clarifier new and existing distribution boxes through two pipes: the existing 42-inch pipe, and a new 54-inch pipe. The 54-inch pipe connects to a new mixed liquor drop box on the downstream end of AB 4, and into the new secondary clarifier distribution box.

Both new and existing secondary clarifier distribution boxes are hydraulically connected with a 30-inch pipe in order to evenly distribute mixed liquor to all the existing and future secondary clarifiers in operation.

Secondary Clarifiers

Existing Secondary Clarifiers 1, 2, and 3

The 30-inch pipe that hydraulically connects the two secondary clarifier distribution boxes will require a new connection to the existing box.

At the existing secondary clarifier distribution box, the mixed liquor flow splits into three identical drop boxes, after flowing over weirs with a length of 9.5 feet and an elevation of 3,354.36.

From the drop boxes, mixed liquor enters the center of the secondary clarifiers. The clarifiers are 80 feet in diameter. The effluent v-notch weirs are located at elevation of 3,353.63.

The effluent launder is 24 inches wide and is located at elevation 3,351.78 at its lowest position. From the launder, the flow enters the effluent drop box and a 24-inch pipe.

Currently, the secondary clarifier effluent pipes from all three clarifiers combine into a 30-inch pipe before flowing into the existing chlorine contact basin. The 30-inch pipe (with 24-inch effluent flow meter) is a very significant hydraulic restriction and the measures required to fix this hydraulic restriction are one reason that construction of new plant effluent disinfection facilities north of the filter building was recommended.

The existing 24-inch SE pipe between Secondary Clarifiers 1 and 2 will be kept as is. To the east of the 24-inch pipe, the diameter is increased to 42-inch. The new 42-inch is routed around the east side of Secondary Clarifier 1. This requires tying into a unique shaped tee fitting. This fitting is being exposed during Schematic Design with surveying of the top of pipe to determine location.

The Secondary Clarifier 3 24-inch effluent pipe is extended towards the east and tees into the new 42-inch pipe, which carries the effluent flow from Secondary Clarifiers 1 and 2. Following this connection, the pipe is increased to 54-inch. Schematic Design field potholing with City staff observed a rubber “Fernco-type” fitting on the 24-inch polyvinyl chloride (PVC) SE pipe from Secondary Clarifier 3.

The 54-inch will tee off toward the east to connect into the new plant effluent UV disinfection facility.

The north end of the tee will be flanged for connection to future Secondary Clarifiers 4 and 5.

Future Secondary Clarifiers 4 and 5

At the new secondary clarifier distribution box, the mixed liquor splits into two identical drop boxes, after flowing over weirs with the exact same length and elevation as the existing secondary clarifier distribution box; length of 9.5 feet and elevation of 3,354.36.

Exiting the drop boxes, 36-inch sections of pipe are capped for future use for Secondary Clarifiers 4 and 5.

Plant Effluent UV Disinfection Facilities

Due to the bottlenecks between the secondary clarifiers and existing chlorine contact basins (CCB), the current basins will be decommissioned after the new UV disinfection facilities are commissioned.

The secondary clarifier effluent enters the UV influent channel through a 54 inch pipe into a stilling well (at buildout two 54-inch pipes will enter the stilling well and the second 54-inch pipe is provided in this phase with a blind flange). The maximum water surface elevation in the stilling well is 3,351.87. From the stilling well, secondary effluent enters the three UV channels. Each channel is 66 inches wide and 60 inches deep. Final channels dimensions will be based on the requirements of the UV equipment supplier. The UV channels include a perforated metal plate screen baffle (for debris exclusion from the UV lamp zone, and cross-channel velocity equalization) at the beginning of the channel, two UV banks, and an automatic upstream level control gate. The total headloss for these components is estimated at 28 inches. The maximum water surface elevation in the effluent channel is 3,349.54.

A single channel collects the flow from the UV channels and directs it to the 42-inch plant effluent pipe and 42-inch flow meter (layout for future 42-inch meter is accommodated in design). A Parshall flume was the basis of design for Project Definition but now a magnetic flow meter is the basis of design as the design team determined that the accuracy of the meter for this installation would be acceptable and equivalent to the Parshall flume. The City has reported good experience with magnetic type flow meters. The pipe transitions to 54-inch diameter as it leaves the UV facility. The UV effluent pipe is capable of conveying the peak hour wet weather flow (2030 condition) of 30 mgd. A second pipe and flow meter is required to convey flow exceeding the ultimate plant capacity of 50 mgd.

The UV system and channels are capable of conveying 30 mgd, equivalent to the peak wet weather flow of the plant for the 2030 design with two channels in service and up to 50 mgd ultimate capacity with three channels in service. The recommended elevation for UV reactor

level control will be refined through coordinating with vendors during Design Development. The total headloss through the reactor zone (including lamp zone, effluent level control gate) has been conservatively assumed through coordination with vendors to date.

The existing plant effluent pipe cannot take the full future flow, so a parallel effluent pipe is required in the future for flows beyond 30 mgd to the 50 mgd peak flow capacity.

For the current design, the existing 42-inch plant effluent pipe is capable of conveying the peak wet weather flow of 30 mgd. There are no available calibration data for the 30 mgd condition and there remains related uncertainty about the hydraulic capacity of the existing outfall under peak flows. Placement of an outfall flow monitor (with pressure transducer to calculate water surface elevation) would allow calibration data for unexpected peak flow conditions. This would help clarify the flow conditions above which a parallel outfall would be needed without causing backwater on the UV facility.

A critical Design Development task is to confirm that the elevation of the outfall pipeline as measured during Schematic Design potholing matches assumptions made in this hydraulic analysis.

Reliability/Redundancy

The U.S. Environmental Protection Agency (EPA) reliability classifications (Class II) have been reflected in these hydraulic calculations. The determinations of reliability classifications have been addressed in the process technical memoranda. Design calculations substantiate that the tankage and yard piping can convey both the 30 mgd and ultimately the 50 mgd conditions with one unit out of service. Specifically, the Class II reliability requirements are as follows:

- Headworks – backup screen at design flow rate. (The three band screens installed currently in the headworks consist of two 6 mm and one 3 mm, with one empty channel for future screen installation. The 6 mm screens are rated at 15 mgd per screen; 3 mm screens are rated at 10 mgd per screen. The 45 mgd rated capacity of headworks is based on four screens at 6 mm each, one unit out of service.)
- Primary clarifier, secondary clarifier, plant effluent UV disinfection facility – capacity 50 percent of design flow with largest unit out of service.
- Aeration basin – minimum two of equal volume.

For Reliability Class I, the requirements are the same except for the aeration basins, which require capacity to treat and pass 75 percent of the design flow with the largest unit out of service. The hydraulic calculations also show that this condition is satisfied with the current design approach, essentially meaning that the WRF meets Reliability Class I requirements from a hydraulic standpoint.

Instrumentation and Control Strategy

The flow split to online process units, with exception of the primary effluent flow split to basins, is expected to be made with fixed distribution weirs that would impart an approximately equal flow split. Isolation gates exist on the influent to primary and secondary clarifiers. An automated isolation valve is expected to be provided on the 42-inch header out the west side of the headworks to allow PC 3 to be taken offline except during wet weather conditions.

The flow split to the aeration basin is accomplished through a most-open valve control scheme described in *TM 4 – Secondary Treatment Improvements*.

Hydraulic Profile

The hydraulic profile is included in the drawing set (See Drawing 1-G-41) and shows the water surface elevations throughout the treatment facility under several flow conditions. The conditions modeled are summarized in Table 3.

TABLE 3
Conditions Modeled

No.	Condition	Influent Flow (mgd)	RAS Flow (mgd)
1	Buildout peak instantaneous wet weather	50	14
2	Headworks peak design flow	45	14
3	Buildout peak dry weather flow	40	11.2
4	2030 peak instantaneous wet weather	29.1	8.4
5	Buildout average day maximum month (ADMM)	16	11.2
6	2030 average day max month (ADMM)	12	8.4

Outstanding Issues

- Confirm potholing data for outfall that was recently collected during Schematic Design matches the assumptions made in this hydraulic analysis for the outfall pipe.
- Confirm plant effluent UV disinfection reactor control elevation through coordination with vendors.

TM 10 – Instrumentation and Control Design Criteria

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DATE: October 3, 2011
PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum details the instrumentation and control approach to new facilities at the Bend Water Reclamation Facility (WRF).

Design Approach

Equipment Tagging

Instruments and equipment will be identified using the City's standard tagging scheme, which is currently being developed by Harris. That standard is currently in draft form awaiting final approval by the City.

Uninterruptible Power

Uninterruptible power supplies (UPSs) will be used to maintain power to control system critical loads during a power failure. Critical loads include HMI workstations, PLC power supplies, control system 24 volts direct current (VDC) power supplies, control system network components, field instruments that are monitored by the control system, and dry contacts monitored by the control system. UPSs are only intended to maintain power for a short period of time (a few minutes). Critical processes will have backup power supplied by onsite generators, so the UPSs in those areas only needed to maintain power until the generators are online.

Uninterruptible power will be supplied to field instruments from the PLC panels.

Human Machine Interfaces (HMIs)

Computer enclosures similar to the one recently installed at the digester facility will be provided where HMI workstations are to be located inside the new process facilities. HMI workstations will be located inside electrical rooms, where possible. Purge air will be supplied into the computer enclosures when installed in poor environmental areas.

Programmable Logic Controllers (PLCs)

All new PLCs will be Allen-Bradley ControlLogix. Existing Allen-Bradley SLC PLCs that are impacted significantly as part of this project will be upgraded to ControlLogix format. Remote input/output (I/O) centers will be based on either ControlLogix or Flex I/O (both Allen-Bradley formats), depending upon the quantity of I/O to be accommodated. The plant has one existing Flex I/O rack at the dissolved air flotation treatment (DAFT) building.

All new PLC discrete I/O will be 24 VDC for personnel safety, as instructed by City staff during the solids handling system improvements project. Interfaces for 120 VAC field wiring will be accommodated using interposing relays located inside the PLC panel. 4-20 milliamperes (mA) current signals will be used for all analog I/O.

As agreed during the solids handling control system upgrade, pre-wired terminal blocks will not be used.

The project plan for programmable logic controllers is outlined below:

- **Primary Treatment.** A new Allen-Bradley ControlLogix PLC will be provided at the new primary sludge pump station for the primary treatment processes. A new ControlLogix remote I/O rack will be provided at the existing primary treatment building.
- **Aeration.** A new Allen-Bradley ControlLogix PLC will be provided at the new blower building for monitoring and control of the aeration flow split, aeration, and blower processes. A new ControlLogix remote I/O rack may be considered for installation in the new gallery at the south end of the aeration basins as an I/O collection center to minimize conduit and wiring costs. Options that need to be evaluated for blower sequencing and master control include (1) requiring a master PLC to be provided by the blower system supplier, and (2) using the plant's new aeration area PLC. The existing blower and aeration PLCs that are located in the existing blower/aeration building are Allen-Bradley SLC format and will be either abandoned or demolished.
- **Plant Water.** A new Allen-Bradley ControlLogix PLC will be provided at the new plant water pump station for monitoring and control of the chemical storage, chemical feed, UV, and plant water pumping processes. A remote I/O rack may be considered for installation at the new chemical building as an I/O collection center to minimize conduit and wiring costs. The existing plant water PLC located in the existing plant water pump station is Allen-Bradley SLC format and will be either abandoned or demolished.
- **Potable Water.** A new Allen-Bradley ControlLogix PLC will be provided at the existing potable water building for monitoring and control of the potable water storage and distribution processes. Because the plant water area facilities will be built in the first phase of construction, it may be worth considering a plant water PLC remote I/O rack for the potable water building (instead of a ControlLogix processor) as a cost saving alternative.
- **Solids Handling.** The existing Allen-Bradley ControlLogix PLC at the existing solids handling building electrical room will be used to accommodate new I/O and

monitoring/control functions. It is possible that a new remote I/O rack will be required if the design requires large quantities of new I/O.

- **Package Systems.** All package system PLCs will be Allen-Bradley family with Ethernet communication capability. The following package system PLCs are anticipated on the project:
 - Turbine Blowers
 - UV
 - Belt Filter Press

Power Monitors

Allen-Bradley power monitors will be specified by electrical designers with an Ethernet interface for data communication with the plant's Allen-Bradley PLCs. Power monitors will be connected to the Allen-Bradley PLC remote I/O (Ethernet) networks. Data will be mapped in the PLC and communicated to the supervisory control and data acquisition (SCADA) system.

Control System Networks

Ethernet will be used for all control system networks, including remote I/O. Adjustable frequency drives and power monitors will be connected to the PLCs via Ethernet. Ethernet will also be used for PLC-HMI communication.

The use of Ethernet for PLC communication with smart MCCs is recommended for new MCCs added as part of the secondary expansion project. See *TM 18 – Electrical Design Criteria* for additional information.

No major changes are anticipated to the plant's existing Ethernet network infrastructure. Fiber optic cable will be used for Ethernet connections between buildings or to components located outdoors. Copper (CAT-5 or CAT-6 cable) will be used for connections within a building.

Surge Suppressors

Surge suppressors will be provided for instruments with wiring routed outdoors in order to protect instruments and PLC I/O modules from surges caused by lightning.

Valves

Pneumatic valve actuators will be used, wherever possible.

Deliverable Format

Control system deliverables, including P&IDs, control system block diagrams, and wiring diagram templates will be based on those provided by CH2M HILL for the recent solids handling control system upgrades.

Outstanding Issues

- Confirm that City SCADA standards that are in development are implemented into Design Development.
- The City should consider using Ethernet for PLC communication with smart MCC. This approach would allow the PLC monitor and control equipment MCC buckets via Ethernet.
- The City needs to determine how much backup time will be required from UPSs and where they would prefer the UPSs to be located (inside PLC panels or pad-mounted in the electrical rooms). If longer backup times are required, particularly where loads are not backed up by generators, UPSs may need to be mounted externally to the control panels due to size alone.
- The City needs to decide whether local equipment control interfaces will be provided at the MCCs or via local control stations.
- Need to determine whether a remote I/O rack should be installed at the south end of aeration basins as an I/O collection center to minimize conduit and wiring from the south end of the basins to the new PLC located at the north end of the basins.
- Need to determine whether blower sequencing should be controlled by a package-supplied master PLC or by plant's new aeration PLC. Use of a package-supplied master PLC may allow the installation to be backed by a performance guarantee from the manufacturer. The benefit of using the plant's new aeration PLC would be to minimize installed control system hardware.
- Need to determine whether the potable water building processes should be monitored and controlled by a new ControlLogix PLC or via a remote I/O rack to the plant water PLC.

TM 11 – Plant Water, Potable Water, Hot Water, and Compressed Air

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DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum presents the existing systems and the proposed site-wide upgrades for plant water, potable water, hot water, and compressed air distribution systems at the Bend Water Reclamation Facility (WRF).

Expansion of Plant Water, Potable Water, Compressed Air, and Hot Water Supply/Return Piping

Plant Water Distribution

The site plant water distribution system will consist of the existing distribution system, connection to the new plant water pump station, and expansion of the plant water distribution piping to the new facilities for the expansion of the WRF: Primary Clarifier 3, Aeration Basin 4, new blower building, the chemical facility, and reuse UV facility.

- Scum sprays at the primary clarifiers and aeration basins are constant flows.
 - Scum spray flow at Primary Clarifier 3 is based on existing clarifier scum sprays of approximately 12 gallons per minute (gpm).
 - Scum spray flow at Aeration Basin 4 is based on existing aeration basin scum sprays at the effluent launder of approximately 24 gpm.
- Yard hydrants and hose bibs for wash down and flushing are used intermittently and will be included in the basis for the maximum plant water flow for sizing of distribution piping and plant water pumps.

Existing and new plant water piping is shown schematically in Attachment A.

Potable Water Distribution

The site potable water distribution system will consist of the existing distribution system, the existing potable water pump station, and provision of potable water to the chemical facility for safety showers. The safety showers provide intermittent flows at a minimum of 20 gpm for 15 minutes.

Existing and new potable water piping is shown schematically in Attachment B.

Compressed Air Distribution

There are two air compressors and four air receivers for the existing compressed air system. Additional instrument air is required and two air compressors, two dryers, and four air receivers will be installed and connected to the existing compressed air distribution system. Compressed air distribution will also be routed to the new primary sludge pump station, primary influent splitter box, Aeration Basin 4, plant effluent disinfection facility, reuse disinfection facility, and the hypochlorite facility.

- Two existing 200 standard cubic feet per minute (scfm) compressors are located in the digester complex. A compressor and dryer are located near the maintenance building.
- Existing air receivers are located at the solids handling facility, and the headworks.
- Two new 200 scfm compressors will be located at the new blower building.
- New receivers will be located at the aeration basin gallery, blower building, hypochlorite facility, and plant effluent disinfection facility.

Existing and new plant air piping is shown schematically in Attachment C.

Hot Water Distribution

Hot water is produced in the digester complex with the existing boilers, fired primarily with digester gas. The City of Bend currently distributes hot water from these boilers to the new headworks facility for space heating and other uses.

This current WRF Secondary Expansion Project will extend and expand the hot water supply (HWS) and return (HWR) system to the following facilities:

- Upgraded solids building
- New and existing primary sludge pump stations
- New and existing primary effluent piping gallery (adjacent to the aeration basins)

In addition, accommodation will be made through pipe sizing and routing to further extend the hot water system around the plant site in the future. HWS and HWR lines will be stubbed out south of the existing digester building to allow service to the existing administration and maintenance buildings. Future heating uses for the HWS/HWR system will be possible when and if additional boiler capacity is provided. Existing, new, and possible future HWS/HWR piping is shown schematically in Attachment D.

Outstanding Issues

- A plant water use inventory will be conducted of all existing and new plant water demands. Constant and intermittent use will be accounted for and documented.
- Confirm compressed air demands and finalize air compressor sizing.

Attachments

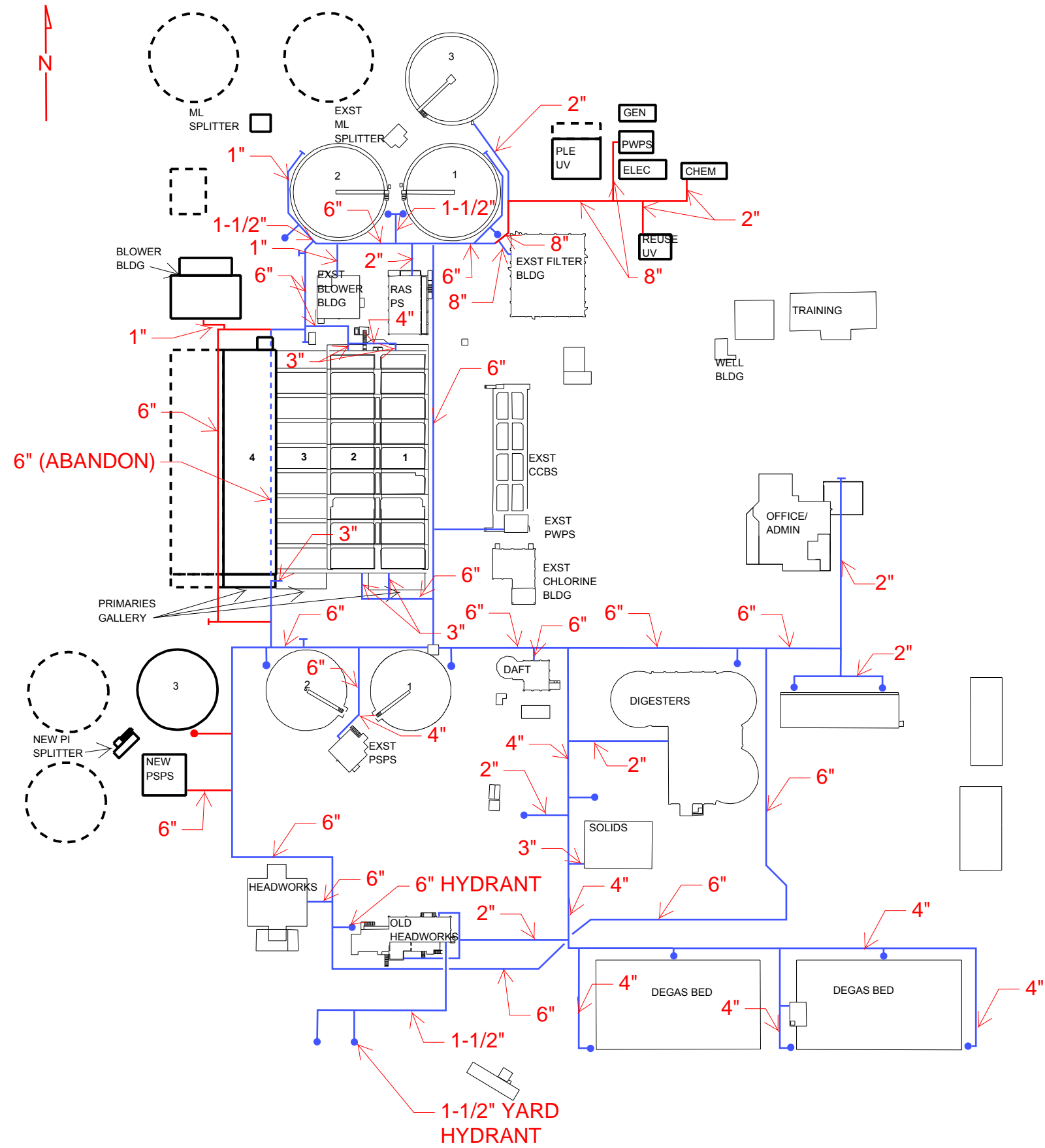
Attachment A—Plant Water Schematic

Attachment B—Potable Water Schematic

Attachment C—Compressed Air Schematic

Attachment D—Hot Water Supply/Return Schematic

Attachment A—Plant Water Schematic

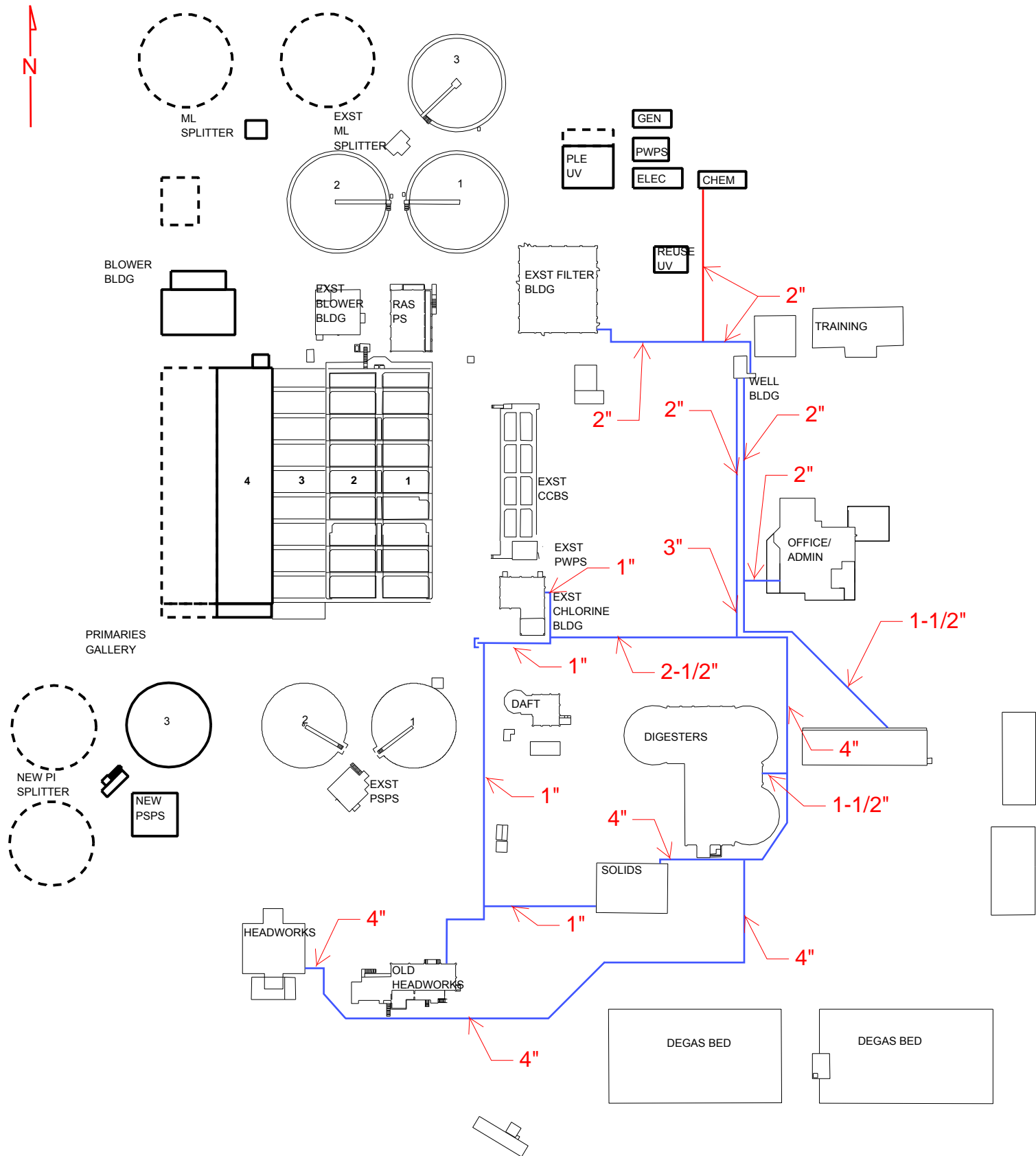


W4 (PLANT WATER) SYSTEM

- EXISTING
- PROPOSED

OVERALL SITE PLAN - 1"=60'

Attachment B—Potable Water Schematic

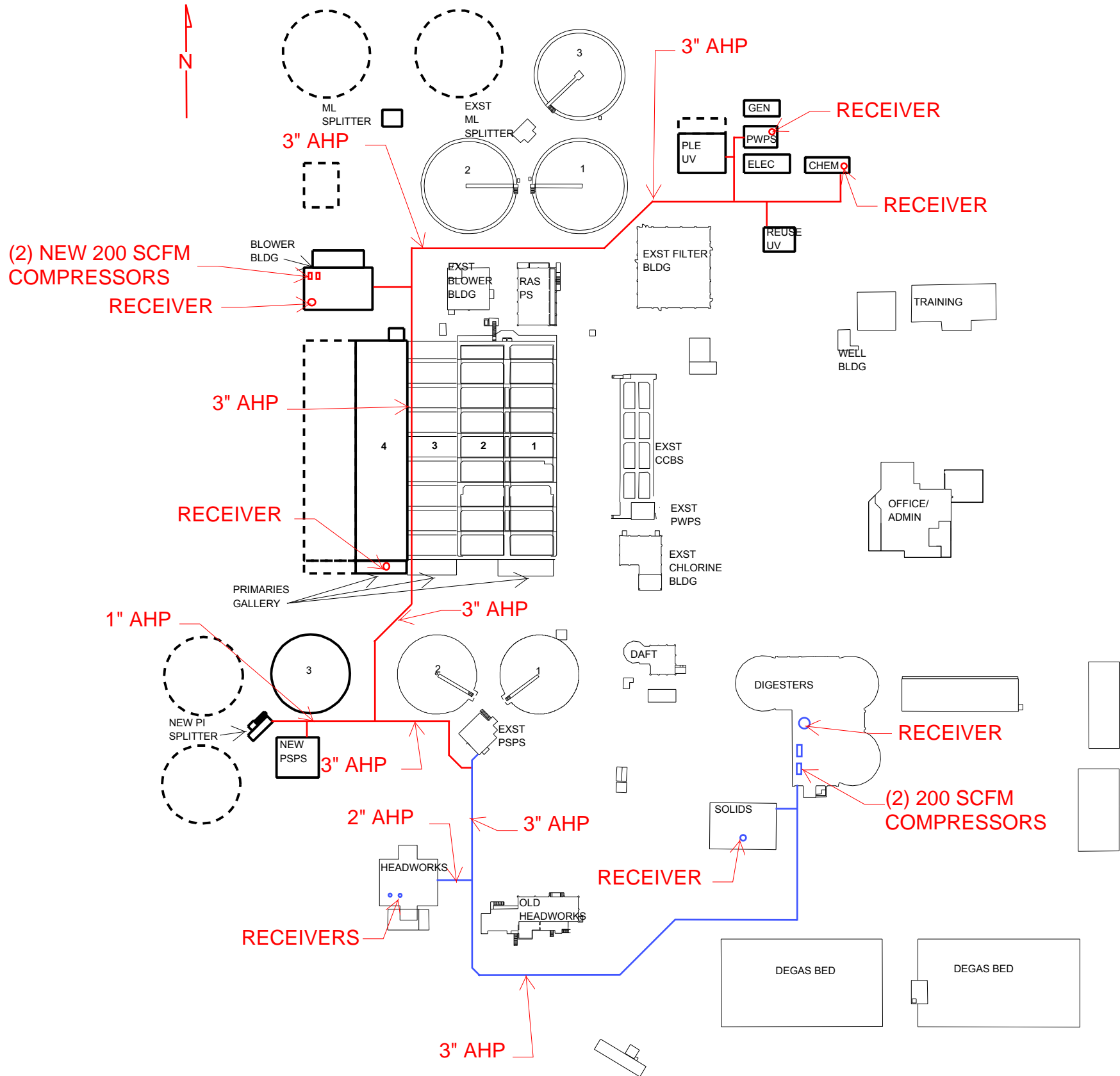


W2 (WELL WATER) SYSTEM

- EXISTING
- PROPOSED

Attachment C— Compressed Air Schematic

HIGH PRESSURE AIR
(AHP OR IA)
— EXISTING
— PROPOSED

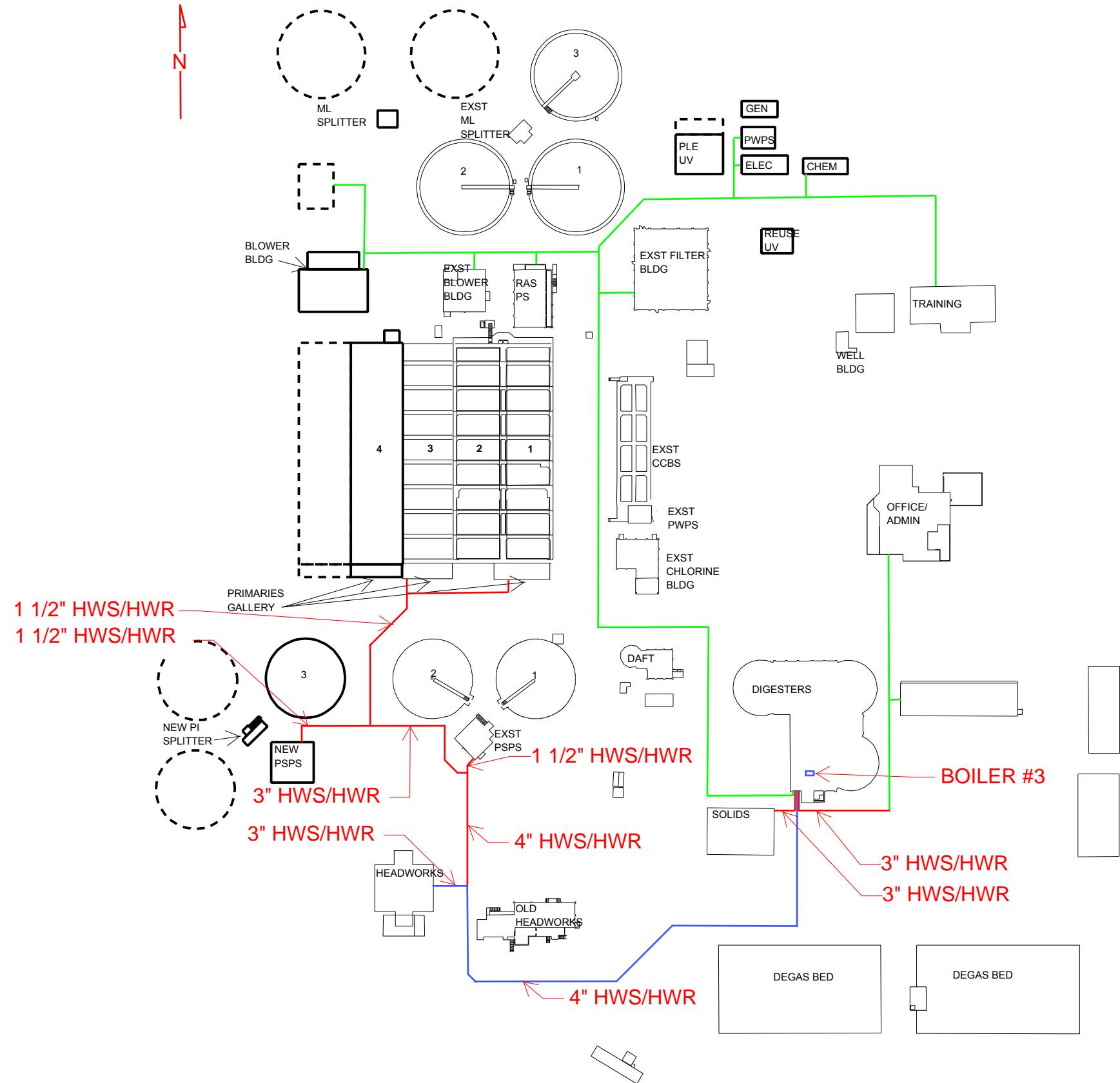


OVERALL SITE PLAN - 1"=60'

Attachment D—Hot Water Supply/Return Schematic

HOT WATER
(HWS AND HWR)

- EXISTING
- PROPOSED
- FUTURE



OVERALL SITE PLAN - 1"=60'

TM 12 – Site Civil

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DATE: October 3, 2011

PROJECT: Schematic Design Report
City of Bend WRF Secondary Expansion Project

Introduction

The purpose of this technical memorandum (TM) is to present the site civil elements and the required site utilities related to the City of Bend Water Reclamation Facility (WRF) Secondary Expansion Project. The discussion includes a description of the existing site, new and existing facilities, and design elements associated with each facility.

Project Site Description

The project site is located in Deschutes County, Oregon, on the northeastern edge of the City of Bend, near the Bend Municipal Airport. Main access to the plant is from the south with access off McGrath Road. The original Bend WRF was constructed on this site in 1981. Upgrades and expansions have been constructed between 1981 and 2008.

Existing Facilities

Existing WRF facilities include a recently constructed headworks facility, primary clarifiers, aeration basins, secondary clarifiers and return activated sludge/waste activated sludge (RAS/WAS) pump station, chlorine contact basins, reuse filter building, digesters, solids handling building, and sludge degas beds. Other existing structures include an administration/service building, a garage, maintenance shops, and a separate training/operations building.

New Facilities

The secondary expansion project generally includes the addition of a third primary clarifier, a fourth aeration basin, a fourth secondary clarifier (by approximately 2025) with mixed liquor conveyance and flow splitting improvements, a new blower building, new plant effluent ultraviolet disinfection facility, hypochlorite facility, plant water pump station, new reuse water ultraviolet disinfection facility and significant yard piping and hydraulic improvements.

Site civil work addressed topographical survey, landscape, and access and site circulation.

State and Local Codes

The civil design work on this project will be governed by state and local codes including the Oregon Department of Environmental Quality (DEQ) and City of Bend Fire Codes.

The City of Bend Fire Department follows the Oregon Fire Code, Oregon Revised Statute (ORS) 479.200, the National Fire Protection Association (NFPA), and the International Fire Code (IFC). These codes regulate the street width, slope, capacity for axle loads, and horizontal curves.

The DEQ 1200C permit guides design of the erosion control features to be implemented during construction.

Site Layout

Based on the previous Project Definition work, process and hydraulic requirements led to the selection of facilities required for expansion. New facilities were placed in close proximity to similar facilities to maximize existing roads where feasible. Following placement of proposed facilities, additional site access was examined. Roadway access was limited to providing access to new and existing facilities, while accommodating future, anticipated facilities on the site. For site layout and yard piping drawings, refer to Schematic Design Package Drawings 5-C-100 and 5-CY-100.

Base Mapping

An extensive site survey of the areas to be expanded has been completed. Natural and manmade features were surveyed in areas with proposed improvements, and for piping and road connections from existing infrastructure to the proposed improvements.

Topographic Survey

The topographical survey was conducted in two phases. Phase 1 included the originally-scoped expansion areas for the primary clarifier (to the south of the existing primary clarifiers), the existing aeration basins, secondary clarifier and mixed liquor (ML) splitter box, the existing blower building, RAS pump station, and existing chlorination area.

With the final Project Definition layout locations for major improvements chosen (including facility decisions made during Schematic Design), Phase 2 of the topographical survey was conducted. The Phase 2 survey included the new primary clarifier (to the west), the new secondary clarifier (SC) splitter structure and SC 5, the new plant effluent ultraviolet disinfection (UV) facility, the new reuse water UV facility, the new plant water pump station area, and new hypochlorite facility and roadway access.

Horizontal and Vertical Control

Existing survey control information for the City of Bend WRF was received from David Evans and Associates (DEA) on August 5, 2009, via email in a .txt file format.

Upon review of the horizontal coordinates provided by DEA, it appeared they were on the “Central Oregon Coordinate System” (COCS), which was verified by importing the

coordinate file into the geographic positioning system (GPS) calibration template for the COCS.

The COCS is based on the following data:

Horizontal:

Datum:	NAD 83 (adjustment 1991)
Projection:	Transverse Mercator
Zone:	Central Oregon LCS
Central Meridian:	W 121° 17' 00.00"
Latitude of Origin:	N 43° 00' 00.00"
Origin Northing:	0.00 feet
Origin Easting:	3,300,000.00 feet
Scale Along Meridian:	1.0001600
Linear Units:	International Foot

Vertical:

Datum:	NGVD 29
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In cross checking the vertical component of the coordinates provided by DEA and benchmarks noted on the base drawing (bd56base.dwg), it was found that the elevations provided are approximately 0.15 foot lower than published benchmarks on the WRF site. For this topographical survey, the elevation that is stamped on the 2.5-inch diameter benchmark located on a concrete block west of the south end of the digester building, in a landscape block planter will be held. The elevation of this benchmark is 3,363.00 feet. The NGVD 29 elevation of this benchmark was confirmed by static GPS observation, which was submitted to the National Geodetic Survey (NGS) Online Positioning User Service (OPUS) for processing. The OPUS NAVD 88 elevation was then converted to a NGVD 29 elevation through NGS's VERTCON (North American Vertical Datum Conversion) program. Differential levels were also run (holding the 3363 benchmark) to three other existing benchmarks on the WRF site, each falling well within vertical tolerances. Referenced as-built/design drawings do not explicitly state using NGVD 1929. However, based on the recent WHPacific topographical survey (using the NGVD 29 datum) of existing facilities such as the headworks finish floor, primary and secondary facilities (top of wall and bottom of weir of clarifiers), the previous design/as-built drawing elevations are consistent with NGVD 29 datum. The secondary expansion will use the same vertical datum of NGVD 1929.

The horizontal (COCS) position of DEA's existing survey control is recommended for continued use and will be used on this project.

Survey Topographical Map

The scope of work for the initial topographical survey, Phase 1, included the following areas:

- New Primary Clarifier 3 (PC 3) south of existing Primary Clarifier 1 (PC 1).
- New Aeration Basin 4 (AB 4) west of existing Aeration Basin 3 (AB 3), and the area south of AB 3.

- New blower building and new RAS pump station between existing AB 3 and Secondary Clarifier 2 (SC 2).
- New Secondary Clarifier 4 (SC 4) west of existing Secondary Clarifier 3 (SC 3), and the new secondary clarifier splitter structure northwest of SC 2.
- Existing chlorine contact basin/chlorine building north and east sides, and splitter structure.

The scope of the Phase 2 topographical survey included the following areas. This scope was completed during Schematic Design:

- Survey control for vertical and horizontal in the proposed areas, using the existing COCS horizontal and vertical datum based upon the benchmark stamped 3363. Complete digital differential leveling through additional survey control.
- Survey finish floor inside the solids handling building, one shot on main floor and outside the building, three shots for surrounding ground, west side.
- Pick up natural and manmade features, including trees over 10 inches diameter, and existing located buried utilities. Proposed improvements will generally be south of the diagonal gravel construction access road.
- Verify the power poles north of the disinfection facility location.
- Check the field work and complete a topographical base map for the new areas surveyed.
- Include the new work in the existing base map file, using the same control.
- Send the base mapping for review and comment. Make any changes.
- WHP & CH2M HILL engineering staff coordinated with City staff onsite to identify critical process piping tie in points that needed to be surveyed. City staff potholed critical buried tie in points and the survey crew obtained top of pipe elevations, pipe type, top of pipe inside where possible. These tie in points include:
 - 42-inch primary influent (PI) west out of headworks, location to tie pipe
 - 30-inch PI into existing primary splitter structure and adjacent dry utility duct bank
 - Cross pipe (24-inch x 42-inch primary effluent [PE] tee) between PC 1 and PC 2 at existing tee, which is location to tie upsized 42-inch PE, may topo/tie 30-inch north due to vactor truck inaccessibility
 - One existing 30-inch PE buried stubs to south, south of existing aeration basin
 - Existing 42-inch PE and 18-inch RAS piping in pipe gallery extending east and west at the south end of the AB 3
 - Invert of existing mixed liquor splitter box between secondary clarifiers
 - 42-inch SE south of SC 1 at 90 degree bend

- 24-inch SE to 45 degree bend at NE side SC 2, this bend is currently made with Fernco-Type adapter
- Proposed connection from 30-inch SE to 42-inch at northwest end existing CCB, and from CCB to pump station
- Electrical duct banks north and east of RAS pump station (assume 6 potholes)

Potholed utilities in Phase 2 were added to the base map.

Site Vehicular Circulation Evaluation

Introduction

The secondary expansion at the Bend WRF will require construction of new roads to allow for access to existing, proposed, and future facilities. Several existing paved and dirt roads of varying width exist throughout the site to provide access for maintenance vehicles. Some of the existing roads are narrow and contain small radii curves, which inhibit movement of emergency and large service vehicles.

Proposed new roads will be 20 feet in width per City of Bend requirements for fire access, except at connection to existing roads or where physical space is limited. All proposed roads will have a minimum separation from adjacent buildings of 5 feet. The City of Bend reviewed the preliminary site layout and road configuration in Project Development and provided feedback to develop a more “grid-like” road network and avoid curving roads. This information has been incorporated into the current site circulation plan. Existing access routes were maintained and new roads were conceptually placed to provide access to existing, proposed, and future facilities. The overall site plan shows proposed and future roads for full buildout visualization.

Design Methodology

The modeling software AutoTURN was used to analyze site circulation. Design vehicles are listed below:

- Fire Truck—City of Bend type fire truck with 29.33-foot total length, 14.6-foot wheelbase, 8-foot width, and dual rear axles.
- Chemical Delivery Vehicle—double tanker truck with 59-foot total width. This is the largest vehicle that may carry chemicals (such as hypochlorite) to the site.
- City of Bend Vector Truck—36.33-foot total length and 20.25-foot wheelbase.

These vehicle-specific length and wheelbase data are taken from recent measurements of City of Bend vehicles and are the largest vehicles expected to use the road system. The fire truck and the vector truck can travel all new proposed roads. The chemical delivery vehicle will access the hypochlorite facility from the northeast entry road.

West Site Access

Given the locations of proposed and future facilities and conceptual road placement, the fire truck vehicle path was used to check for turning clearances and general site circulation along the west side and the entire site. The west circulation road is anticipated to be

constructed at a later date. Current proposed roads will generally end along the west side and connect to the existing dirt road to provide access north and south. It is anticipated that the future western access will be placed at the existing lower ground level and will contain a series of earthen ramps up to the existing and proposed facilities.

Loop Road

A plant effluent disinfection facility is proposed near the northeast corner of the site. A loop road is proposed for use by chemical delivery vehicles, which will provide hypochlorite for reuse water and plant water. The planned chemical delivery route is for the chemical delivery truck to drive from east to west to the unloading area on the south side of the hypochlorite facility, unload, and continue clockwise through and off the site following a turnaround loop. With this route there is no need to backup to turn around. A double tanker was the chemical delivery design vehicle used to verify turning movements and general site circulation.

Site Grading and Drainage

The Schematic Design grading plan as well as grade elevations listed in this TM are based on the NGVD 1929 vertical datum. Finish grade contours are provided at 1-foot contour intervals. Maximum cut and fill slopes are 2:1.

Site grading will provide adequate drainage away from facilities and transversable grades for maintenance and delivery vehicles. Maximum cross slopes of 2 percent and minimum longitudinal slope of 0.5 percent will be applied to all roads. New roads will match existing grades at the project limits. Stormwater within the process areas will be routed by surface flow to the perimeters of the construction limits, then follow existing surface drainage paths offsite to surrounding native ground for infiltration.

Some water quality measures, such as infiltration basins at the perimeter of the WRF facilities area, may be added for treatment of a 2 year storm event in the event that stormwater is retained due to natural or manmade drainage barriers. There will be no new underground injection control facilities.

The City of Bend Drainage and Grading Plan, and DEQ stormwater guidelines will be applied to the stormwater design elements for the site work, grading, and drainage.

Primary Clarifiers

The new PC 3 and future PC 4 will need to be at the same elevation as existing PC 1 and PC 2. The walkways will need to be accessible for access and maintenance. Fill should be provided around the clarifiers, up to the existing walk at elevation (El.) 3359.0. The top of walls will be at El. 3363.0. Ground in the area west of the existing PCs is approximately El. 3345.0, so 14 feet of fill will be needed in the area around new PC 3. On the west side of PC 3, grade will slope off to catch existing ground at a 2:1 slope, similar to existing PC 2. Appropriate rails will be required for the walkway around PC 3. In the future, when PC 4 is built, grade around it will need to be raised to El. 3359 and slope to existing ground on the west side. The splitter structure south west of PC 3 will have a finish floor similar to the new primary sludge pump station and will abut the toe of the PC 3 slope. The grading around

the new splitter structure and south side of the new pump station is expected to be similar to the grading around the existing splitter structure and pump station.

Aeration Basins

The new AB 4 and future AB 5 will be at the same elevation as the existing ABs. The top of the existing AB 3 concrete wall is at El. 3360.3; at the south end, grade slopes from El. 3358.0 down to El. 3350.0; and the west (low) side ground is at El. 3343.0 feet. The north end slopes from El. 3350.0 down to El. 3343.0 feet on the west. Similar grading around new AB 4 is expected, with a rail around the exposed edges. The north end grading will need to accommodate the new blower building, and the south end will need to accommodate the pipe gallery extension and access. The road at the south end will ramp down to the lower elevation road to the west.

Blower Building

The new blower building west of the existing blower building will be set at El. 3350.2 to match the grade of the existing blower building. Grading contours will be checked to ensure that the access road ramp from the south side of the secondary clarifiers does not encroach on the building perimeter. It may be necessary to split the grade between the existing blower building and the lower elevation road to accommodate the access road, and allow grades around the building to catch existing grade without filling around the power poles or over the large underground power line. Discussion will take place with Central Electric Cooperative to determine the likelihood of a second feed to the WRF. This would potentially allow for relocation of existing underground power and poles in this area. At that time, grading around the proposed blower building will be adjusted. Relocation of underground power and poles will allow for a better foundation for the blower building.

Future RAS Pump Station (Approximately 2025)

The future RAS pump station proposed west of SC 2 and west of the access road has similar considerations to the elevation of the blower building. The future RAS pump station building needs to be high enough to allow convenient access off the proposed road, deep enough to accommodate pump station function, and cost effective considering earthwork. Grading design included in the secondary expansion will accommodate these future grade elevations, but defer the actual fill until the time of construction.

Future Secondary Clarifier 4 (Approximately 2025)

When constructed, the new SC 4 will need to be at the same elevation as existing SC 1, SC 2, and SC 3. The walkway will need to be accessible for access and maintenance. Fill will need to be provided around the clarifier, up to the existing walk El. 3352.2. The top of walls will be El. 3355.6. Ground between the new SC and the existing SCs and splitter will need to be El. 3352.0 to accommodate access. Ground on the west and north sides can slope at 2:1 to catch existing grade, similar to the north and west sides of SC 2, with a rail. Plant water will be extended to the new SC, similar to the existing SCs. Grading design included in the secondary expansion will accommodate these future grade elevations, but defer the actual fill until the time of construction.

Secondary Clarifier Splitter Structure

It is expected that the ground around the SC splitter structure will be raised to be slightly lower than the SC walkways, given the proximity to the SCs. This will reduce the stairs needed to access the splitter, and prevent the “tower” look.

Reuse Water UV Facility

The ground around the new reuse water UV building, shown east of the existing filter building, will match into surrounding surfaces to promote drainage and allow access. This area is relatively flat.

Plant Effluent Disinfection (UV) Facility and Plant Water Pump Station Area

The new plant effluent disinfection facility area is located in a relatively flat area, and surrounding ground will be graded to promote drainage and allow access.

Yard Piping

Yard piping plans include all process piping, service utilities, and gravity piping. Stub outs will be placed during this expansion for future facility connections. Dry utility conduits/sleeves will also be placed to serve power, communication, etc. Construction practices will be specified to protect existing piping during construction. Yard piping and site electrical work are described in *TM 9 – Plant Hydraulic Improvements and Yard Piping* and *TM 18 – Electrical Design Criteria*.

Plant Water, Potable Water, Compressed Air

Refer to *TM 11 – Plant Water, Potable Water, Compressed Air* for plant water, potable water, and compressed air lines.

Site Access and Security

The existing plant perimeter is secured with locked chain link fence. A similar type of chain link fence with similar dimensions will be installed with lockable gates to allow use of the existing access points and road system. An automatic gate at the approach to the chemical facility will allow automated access for hypochlorite delivery trucks, if deemed necessary for delivery of hypochlorite for reuse water. The new fence and gate locations are shown on the overall site plan.

Erosion Control

The site is surrounded by relatively flat, permeable soils. The nearest significant natural surface water body is the Deschutes River, which is about 2.5 miles away. There are no tributaries that carry water from the site to the river. The project team will work to prepare documentation for 1200C permitting, and design appropriate erosion control measures so that site work is properly completed during construction. An erosion control plan showing the areas to be disturbed by the new construction, along with silt fencing at downhill construction limits, biobags and hay bales in channelizing areas, sedimentation basins with overflow to downstream sheet drainage, and infiltration in native areas will be completed. The erosion control plan meeting City of Bend and DEQ requirements, along with the 1200C

application, may be used by the City to apply for a 1200C permit, and obtain a City of Bend grading permit. The consultant team is not currently scoped to manage the 1200C permitting process, and will only provide the complete application and required permit drawings.

Site Landscape

Any landscaping will generally match the density and type of the existing landscaping around process structures. The City should define any self-performed landscaping and irrigation that it intends to provide following construction and the portion of contractor-performed landscaping and irrigation. This will be required to determine and prepare final design approach and package.

TM 13 – Architectural Design Criteria

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DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum details the architectural approach to new facilities at the Bend Water Reclamation Facility (WRF). The concepts for this project are to:

- Present an architectural image of quality and good design.
- Provide architectural exterior treatment that unifies the existing and proposed campus of buildings onsite.
- Use durable, low-maintenance, corrosion-resistant construction materials.
- Provide handicapped access to employees and visitors from defined public areas.
- Consider the implementation of sustainable design features to reduce energy use and negative environmental impacts.

Building Types

The primary building type will consist of insulated pre-cast concrete panels mounted on steel frames. Two types of roof finish systems will be used: the first being a single-ply roofing membrane over rigid insulation, and the second being a sloped standing seam metal roof.

Translucent wall panels will be used within the pre-cast concrete wall panels to provide daylight. Translucent skylights will provide daylighting through the roof and will be removable where access for equipment is required. See the oblique view of the new blower building (Figure 1) and the new primary sludge pump station (Figure 2) as examples of the features recommended for new buildings on the site. Doors, door frames, and door hardware will be provided as listed in Table 2. The buildings incorporating these features will be as follows:

- Blower building

- Primary sludge pump station
- Plant water pump station
- Electrical building
- Hypochlorite facility

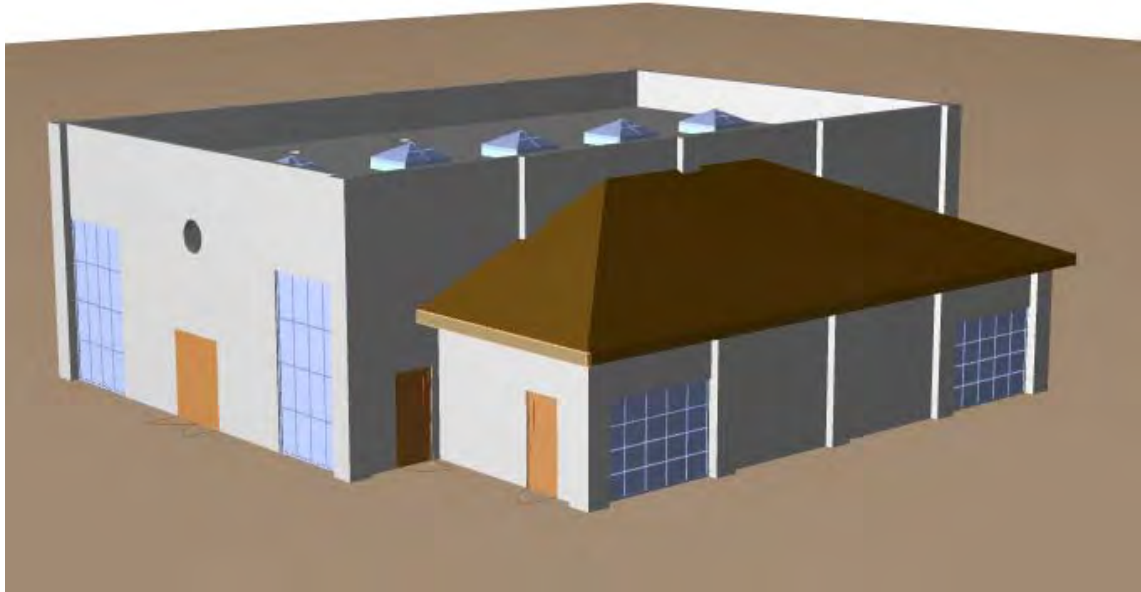


FIGURE 1
Oblique View of New Blower Building



FIGURE 2
Oblique View of Primary Sludge Pump Station

A secondary building type will be a shade canopy, constructed using steel columns, purlins, and an un-insulated metal roof. This building type will apply to the following locations:

- Reuse disinfection facility
- Plant effluent disinfection facility

Building Design Criteria

All facilities will be designed in accordance with all applicable building and local codes adopted by the State of Oregon. The 2010 editions of the Oregon Structural Specialty Code (OSSC), Oregon Fire Code, Oregon Mechanical Code, and the 2008 editions of the Oregon Plumbing Specialty Code and Oregon Electrical Code are the current applicable codes for Oregon; these codes are based on the model codes identified in Table 1.

TABLE 1
Oregon Structural Specialty Code, Adopted Model Codes

Facility	Code	Year
Building	International Building Code	2009
Plumbing	Uniform Plumbing Code, Chapters 2 through 11, 13, 14, 15 and 16; and Appendices A, B, D, E, J, and I.	2006
	National Fire Protection Association (NFPA) 99C, Medical Gas and Vacuum Systems Standard.	2002
	Oregon amendments.	2007
Mechanical	International Mechanical Code	2009
Electrical	National Electrical Code	2008
Energy	International Energy Conservation Code	2009
Fire	International Fire Code	2009
Accessibility	American National Standard International Code Council (ICC)/American National Standards Institute (ANSI) A117.1-98, Accessible and Usable Buildings and Facilities; Americans with Disability Act (ADA) Title II/Current Edition.	

Exterior Building Components and Treatment

Roof Type 1:	Single-ply membrane sloped to interior drains.
Roof Type 2:	Standing seam metal roof with metal gutters and downspouts.
Walls:	Pre-cast concrete panels.
Doors:	See Table 2.
Door Hardware:	Mortise locksets with lever handles.
Translucent Wall Panels:	White face sheets and factory finished aluminum frame.
Translucent Skylights:	Removable type with white face sheets and factory finished aluminum frame.
Colors:	To match existing.

TABLE 2
Doors and Door Hardware
City of Bend Water Reclamation Facility

Facility	Door Material	Door Hardware Material	Justification
Blower Building			
Exterior personnel door	Anodized Aluminum	Stainless Steel	Non-Corrosive area.
Exterior equipment access doors	Anodized Aluminum	Stainless Steel	Consistent with existing door materials.
Oversized bi-fold equipment access door	Factory finished steel	Manufacturer's Standard	Low maintenance. Client preference. Avoids overhead conflicts.
Primary Sludge Pump Station			
Exterior personnel doors	Anodized Aluminum	Stainless Steel	Non-Corrosive area.
Exterior equipment access doors	Anodized Aluminum	Stainless Steel	Consistent with existing door materials.
Interior doors	Anodized Aluminum	Stainless Steel	Low maintenance.
Plant Water Pump Station			
Exterior personnel doors	Anodized Aluminum	Stainless Steel	Non-Corrosive area.
Exterior equipment access doors	Anodized Aluminum	Stainless Steel	Consistent with existing door materials.
Interior Doors	Anodized Aluminum	Stainless Steel	Low maintenance.
Electrical Building			
Exterior Personnel Doors	Anodized Aluminum	Stainless Steel	Non-Corrosive area. Consistent with existing door materials. Low maintenance.
Hypochlorite Facility			
Exterior Personnel Doors	Fiberglass Reinforced Plastic (FRP)	Stainless Steel	Corrosive area. Low maintenance. High durability.
Reuse Building			
Exterior Personnel Doors	Anodized Aluminum	Stainless Steel	Non-Corrosive area.
Exterior Equipment Doors	Anodized Aluminum	Stainless Steel	Consistent with existing door materials.
Interior Doors	Anodized Aluminum	Stainless Steel	Low maintenance.

Code Analysis

Once the project team has further developed building plans, a code analysis will be performed for each existing and proposed building included in the project. The code search for each structure will be based on building layouts and existing or proposed construction materials and will be updated throughout the design process.

Required process buildings will be designed following OSSC 2010 criteria:

- Use group classification: F-2
- Type of construction: IIB
- Largest floor area allowable: 23,000 square feet
- Number of stories allowable: 3 (Height: 55 feet 0 inch)
- Allowable occupant load (industrial type, per 1004.1.2): 100 square feet/occupant
- Fire suppression system: none

TM 14 – Structural Design Criteria

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DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum details the structural approach to facilities at the Bend Water Reclamation Facility (WRF). The new structures will be designed to match materials and types of construction used on the existing facilities.

The existing structures at the facility primarily follow two styles of construction:

- **Occupied Structures:** Structures intended for human occupancy are typically steel frame buildings with pre-cast concrete cladding.
- **Water Holding Structures:** New and existing water holding structures are cast-in-place concrete.

Design Criteria

The design criteria are summarized in Table 1.

TABLE 1
Structural Design Criteria
City of Bend Water Reclamation Facility

Item	Criteria
Dead Loads	Weight of all permanent loads, permanent equipment, and soil on buried structures
Live Loads	
People-only areas (general floor loading)	100 pounds per square foot
Process Slabs	200 pounds per square foot
Electrical Room	300 pounds per square foot
Mechanical Room	200 pounds per square foot
Corridors/Exits/Stairs	100 pounds per square foot

TABLE 1
Structural Design Criteria
City of Bend Water Reclamation Facility

Item	Criteria
Walkways and Elevated Platforms	60 pounds per square foot
Light Storage	125 pounds per square foot
Heavy Storage	250 pounds per square foot
Mezzanine Storage	125 pounds per square foot
Vehicular Access	AASHTO HS-20
Roof Loads (Can not be reduced)	20 pounds per square foot
Snow Loads	25 pounds per square foot ground snow load 25 pounds per square foot minimum roof snow load
Wind Loads	
Wind Speed	85 mph (3 second gust)
Exposure Category	C
Occupancy Category	III (wastewater facility per IBC Table 1604.5)
Importance Factor	1.15
Seismic Design Criteria	
Site Class	C
Occupancy Category	III (wastewater facility per IBC Table 1604.5)
S_s	0.381g
S_1	0.157g
S_{DS}	0.305g
S_{D1}	0.172g
Importance Factor	1.25
Seismic Design Category	D
Soil Loads	In accordance with the recommendations provided with the final geotechnical report

AASHTO = American Association of State Highway and Transportation Officials; g = acceleration due to gravity; IBC = International Building Code; mph = miles per hour

Codes and Standards

The facility will be designed in accordance with applicable building and local codes adopted by the State of Oregon. The applicable codes are shown in Table 2.

TABLE 2
 Applicable Building and Local Codes for the State of Oregon
City of Bend Water Reclamation Facility

Code	Year
Oregon Structural Specialty Code (OSSC)	2010
International Building Code (IBC)	2009

Special Inspection, Observation, and Testing

Special inspection, observation, and testing will be required per the OSSC. The special inspection, observation, and testing plan will be included with the contract documents.

Design Approach

Materials

Concrete

The water holding facilities will be designed per ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures while the non-water holding facilities will conform to ACI 318-08 Building Code Requirements for Structural Concrete.

The cast-in-place concrete will be normal weight concrete with a 28-day compressive strength, $f'_c = 4,500$ pounds per square inch (psi). The pre-cast concrete will have a 28 day compressive strength, $f'_c = 5,000$ psi.

The cement will be Type I/II cement.

The reinforcing steel will conform to A615, Grade 60.

Structural Steel

The steel will be designed in accordance with the AISC 360-05 – Specifications for Structural Steel Buildings.

Structural steel wide flange shapes will conform to ASTM A992. Steel plates, angles, and channels will conform to ASTM A36 unless shown otherwise on the drawings. Square or rectangular steel tubing will conform to ASTM A500, Grade B, and steel pipe will conform to ASTM A53, Grade B.

All connection bolts will be high-strength bolts conforming to ASTM A325N or slip-critical. Unless otherwise shown on the drawings, bolts indicated as machine bolts or anchor bolts will conform to ASTM A307 for carbon steel, A193 for stainless steel, and A153 for galvanized steel.

All welds will be performed by American Welding Society (AWS) certified welders and will conform to AWS D1.1, latest edition.

Stainless steel, Type 316, will be used for bolts, fasteners, and so on, where corrosion concerns dictate; as indicated in the specifications and on the drawings.

Miscellaneous Materials

Design guidelines for miscellaneous materials will be as follows:

- International Code Council Evaluation Service (ICC-ES) Reports for specific products such as post-installed concrete anchors.
- Aluminum design per the Aluminum Association *Specifications for Aluminum Structures*
- Open web metal (steel) roof truss design and specifications per the Steel Joist Institute Standard Specifications and Load Tables
- Metal (steel) deck design and specifications per the American Iron and Steel Institute (AISI) Specifications for the Design of Light Gauge, Cold-Formed Steel Structural Members
- Metal grating per the National Association of Architectural Metal Manufacturers, *Metal Grating Manual* and *Heavy Duty Metal Grating Manual*
- A manufactured-aluminum rail system for handrail/guardrail.

Structural Systems

Primary Clarifier

The clarifier will be designed as a conventionally reinforced flat-bottom ground supported circular tank with a reinforced non-sliding base.

Blower Building

Roof System:	Steel beams with metal (steel) roof deck above.
Framing:	Structural steel framing supporting pre-cast architectural insulated concrete panels.
Building Foundation:	Steel columns supported on concrete footings.
Equipment Foundations:	Isolated footings will be provided for large equipment, such as the blowers. Smaller equipment will be placed on concrete equipment pads bearing on the concrete floor slab.
Floor System:	Reinforced concrete slab on grade.
Lateral System:	The metal deck will serve as a diaphragm to transfer loads to the braced steel frames.

Primary Sludge Pump Station

Roof System:	Steel beams with metal (steel) roof deck above.
Framing:	Structural steel framing supporting pre-cast architectural insulated concrete panels.
Building Foundation:	Steel columns supported on concrete footings.
Equipment Foundations:	Equipment will be placed on concrete equipment pads bearing on the concrete floor slab.
Floor System:	Reinforced concrete slab on grade.
Lateral System:	The metal deck will serve as a diaphragm to transfer loads to the braced steel frames.

Aeration Basin

The new aeration basin will be designed as a conventionally reinforced flat-bottom ground supported rectangular tank with a reinforced non-sliding base. Additionally, the basin will likely utilize one of the existing basin's walls. The original basin appears to be designed with the same structural system.

The new basin will be designed for hydraulic and hydrodynamic loading conditions.

New walls installed in the existing basins will be designed to support hydraulic loading and hydrodynamic loading as required. Existing walls, unless required by IBC chapter 34 will not be designed for hydrodynamic loading. Additionally, minor walls, such as baffle walls, where failure will not impact the structural integrity of the structure will not be designed for hydrodynamic effects.

Hypochlorite Facility

Roof System:	Steel beams with metal (steel) roof deck above.
Framing:	Structural steel framing supporting pre-cast architectural insulated concrete panels.
Building Foundation:	Steel columns supported on concrete footings.
Equipment Foundations:	Concrete tank pads will be provided, and designed for seismic anchorage. Smaller equipment will be placed on concrete equipment pads bearing on the concrete floor slab.
Floor System:	Reinforced concrete slab on grade (containment slab).
Lateral System:	The metal deck will serve as a diaphragm to transfer loads to the braced steel frames.

Plant Effluent Disinfection Facility

Roof System:	Steel beams with metal (steel) roof deck above.
Framing:	Structural steel framing supporting pre-cast architectural insulated concrete panels.
Building Foundation:	Steel columns supported on concrete footings.
Equipment Foundations:	Isolated footings will be provided for large equipment. Smaller equipment will be placed on concrete equipment pads bearing on the concrete floor slab.
Floor System:	Reinforced concrete slab on grade.
Lateral System:	The metal deck will serve as a diaphragm to transfer loads to the braced steel frames.

Plant Water Pump Station

Roof System:	Steel beams with metal (steel) roof deck above.
Framing:	Structural steel framing supporting pre-cast architectural insulated concrete panels above cast-in-place concrete basin walls.
Building Foundation:	Structural steel framing supported on concrete basin walls. The concrete basin will be founded on a cast-in-place slab.
Equipment Foundations:	Pumps will sit on a concrete slab supported by basin and divider walls. Smaller equipment will be placed on concrete equipment pads bearing on the concrete floor slab.
Floor System:	Elevated reinforced concrete slab for the upper story. Reinforced slab on grade for the water holding basin.
Lateral System:	The metal deck will serve as a diaphragm to transfer loads to the braced steel frames. The braced steel frames will transfer the load to the concrete basin shear walls..

Reuse Disinfection Facility

Roof System:	Steel frames with metal (steel) roof deck above.
Vertical System:	Steel frame columns will provide vertical load transfer from the roof to the ground.
Foundation and Floor System:	Cast-in-place concrete slab and spill containment area.
Lateral System:	The structure has minimal mass, since it will be designed as an open structure. The lateral loads will be transferred through the metal deck and beam framing to the columns, which will be designed as cantilever elements.

Pipe Supports:

Pipe support design will be limited to pipes 30 inches in diameter or larger. Supports for smaller piping and conduit will be submitted as deferred submittals.

Outstanding Issues

1. The condition of the existing aeration basin water stops on AB 3 has not been confirmed. Inspection of water stops is recommended during Design Development. If the water stops are not in place or are not adequate, modifications to the design may be required to provide a water-tight structure.
2. Voids may be present in the soils at the site. The current design assumes the voids, if present, will be mitigated and standard foundation systems will be acceptable. Depending on the geotechnical recommendations, the foundation system may require modification.
3. The method of resisting global sliding for the aeration basins will need to be addressed. Selection of final grading influences the selection of resisting mechanism(s).

TM 15 – Geotechnical Conditions

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DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This memorandum summarizes a geophysical survey performed in May 2011 and supplemental geotechnical explorations performed in June 2011 to determine subsurface conditions in the vicinity of the proposed structures at the Bend Water Reclamation Facility (WRF) as shown in the June 2011 Schematic Design Drawings. These new facilities and boring locations are shown in Figure 1 and include the new locations for the new Primary Clarifier 3, the new blower building, and the new plant effluent disinfection facilities. The proposed secondary clarifier and chlorine contact basin have been deleted from this phase, while new Aeration Basin 4 is unchanged.

This memorandum serves as an addendum to the Geotechnical Data Report and Geotechnical Design Report dated November and December 2009, respectively. These reports were prepared by CH2MHILL during the pre-engineering and data collection phase. Additionally, *TM 3 – Geotechnical Design Criteria* dated February 15, 2011, was prepared for the Project Definition Report and precedes this memorandum.

Subsurface Explorations

Subsurface explorations for Schematic Design included a geophysical survey, performed by Siemens and Associates, from Bend, Oregon, and soil/rock borings drilled by Quality Drilling and Blasting from Bend, Oregon.

Geophysical Survey

The geophysical survey was performed to identify the soil/rock interface, zones of voided basalt and fracture zones, infilled voids, and air-filled voids. The geophysical survey was performed by laying out a series of geophones in a traverse line across the area to be surveyed. Additional traverse lines were laid out generally perpendicular to the initial line to collect information in the opposite direction. The survey collected general resistivity variations to about 30 feet below the ground surface. The resistivity variations suggested

differing densities and materials in the subsurface materials. The summary report of the procedures and findings of the geophysical survey is included as Attachment A.

Supplemental Geotechnical Exploration

Eighteen (18) borings were drilled using a track-driven, Atlas Copco D3 rig using air percussion drilling techniques; the borings were abandoned by filling with bentonite chips. The borings were designated B-1-11 through B-18-11. The air percussion drilling technique was used for its ability to efficiently drill through both fractured and intact rock formations, to provide general information about rock type, and to specifically identify volcanic cavities, voids, or soft cinder layers in the underlying formations. The drill rig operator performed the drilling at the Bend WRF in 2009, and was familiar with the rock conditions similar to those encountered at the WRF. The drilling penetration rates, soil and rock cuttings, and drilling rig operator comments were incorporated by the engineering observations recorded on the boring logs (provided as Attachment B).

No sampling is possible with this drilling method, and therefore, no laboratory testing was performed.

Findings

Geophysical Survey

The geophysical survey indicates that the depth to rock is approximately 3 to 7 feet below the ground surface with indications of smaller air-voids or soil-filled voids in many areas, and indications of larger air-voids in some areas. Findings about specific locations are summarized below:

- New Primary Clarifier 3 – The survey indicated a large (approximately 20 feet wide) void is likely present between 5 and 20 feet below the ground surface. This void is located near the center and north side of the proposed clarifier location.
- New Blower Building – The survey indicated the presence of “normally voided basalt” at depths from 4 to about 10 feet below the ground surface. Normally voided basalt is described as basalt with smaller (less than about 2 feet) air-void zones.
- New Plant Effluent (PLE) Disinfection Facility – The survey indicated the presence of “normally voided basalt” below the PLE disinfection facility at depths from about 8 to 20 feet below the ground surface and larger air-filled voids beneath and east of the new hypochlorite facility from 3 to 10 feet below ground surface.

Air Percussion Drilling

The air percussion drilling also indicated the presence of soil-filled voids, hard rock as well as weak rock, and some significant air-voids. Findings about specific locations are summarized below:

- New Primary Clarifier 3 – The drilling encountered sediment-filled voids, weak scoria rock, and air-filled voids. These were encountered generally between 35 and 45 feet below the ground surface. At Boring B-3-11 attempts to backfill the boring with

bentonite chips were unsuccessful after 17 bags were placed in the boring; air flow was also noticed coming out of the boring, indicating a large or possibly interconnected cavity. At Boring B-18-11, just south of the clarifier, a void between 12 and 15 foot depth was also encountered.

- New Blower Building – The drilling encountered sediment-filled voids between about 7 and 15 feet below the ground surface, as well as weak scoria rock between about 26 and 33 feet below the ground surface.
- New PLE Disinfection Facility – The drilling encountered intermittent voids between 17 and 21 feet below the ground surface and cinder, gravel, or weak scoria rock between about 25 and 32 feet below the ground surface.

In evaluating the data from the geophysical survey, there are some subsurface materials and voids that were encountered in the air percussion borings that were not recorded from the geophysical survey. These variations are mostly due to the limited depth at which the measurements can be performed, but also from the limited total area that can reasonably be surveyed. Although the geophysical survey information is valuable in providing continuous data along a predetermined two-dimensional section, there are general limitations to the electrical resistivity measurements: they can give an idea of general conditions, but do not always depict the true nature of the materials, and the results are subject to interpretation.

Recommendations

The 2009 Geotechnical Design Report and *TM 3 – Geotechnical Design Criteria* of the Project Definition Report recommended injection of grout into drilled holes beneath the structure foundation to fill voids and provide a stable foundation for the facilities; a process referred to as compaction grouting. The findings from the subsurface explorations in 2011 for Schematic Design support this recommendation. The recommended compaction grouting procedure, which is described in more detail in the previous reports referenced above, has also been performed for many of the existing facilities at the plant.

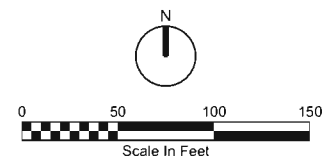
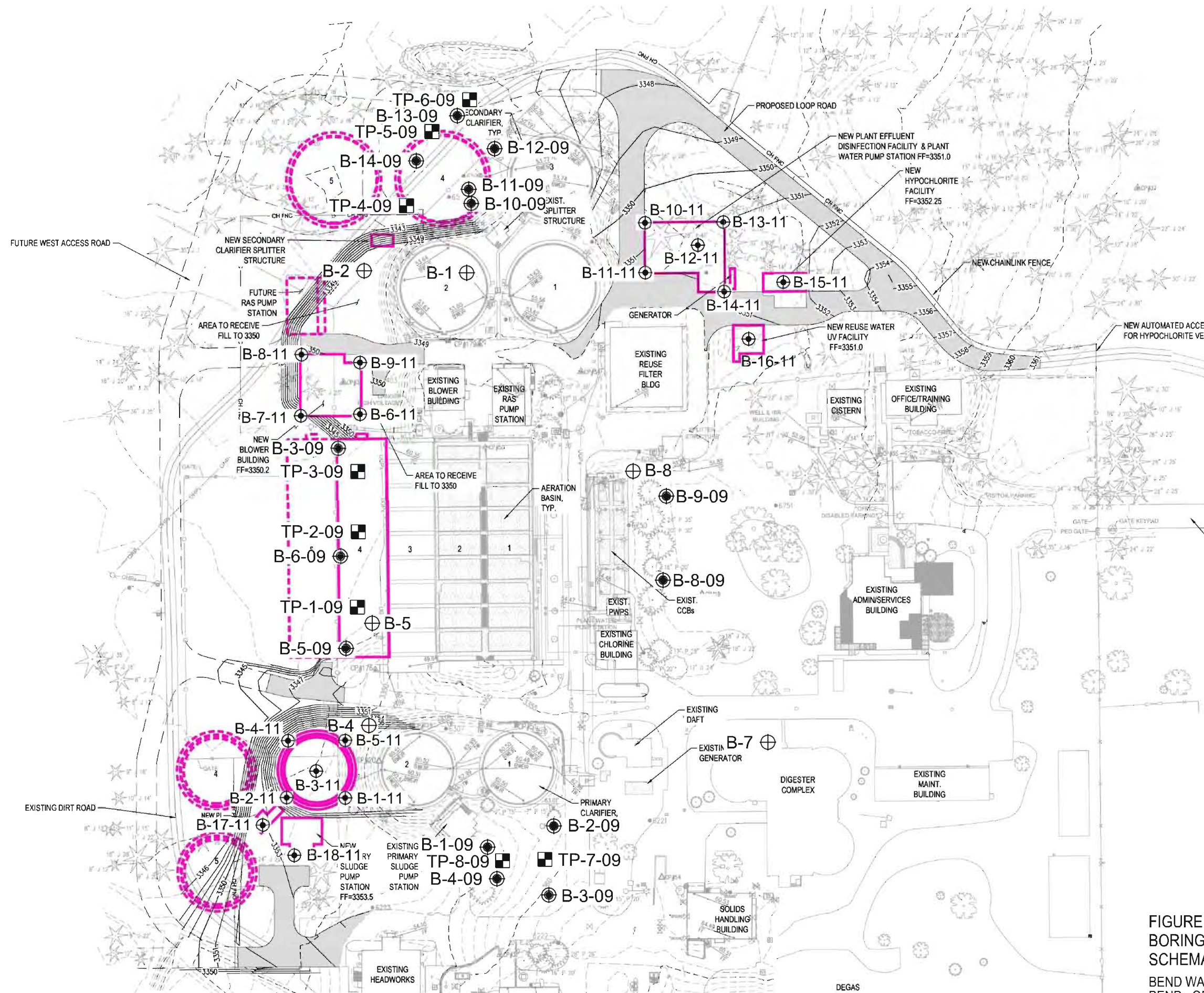
Because it is known that there is a real potential of large grout takes at the site (as was experienced at certain locations during previous foundation stabilization), compaction grouting rather than conventional grouting should be used to minimize the amount of excessive grout volumes. Compaction grouting entails using a very stiff, “low slump” mortar grout that is injected under relatively high pressures to displace and compact soils in place.

It should be noted that the compaction grouting, by its nature, and the significant void presence at the WRF site is difficult to estimate in advance. The technique should employ systematic drilling and grouting, and include the option to add holes and inject more grout as more voids are encountered during drilling.

For preliminary estimates, drilling and grouting should be performed to a minimum depth of 35 feet for the new blower building, new Aeration Basin 4, and the new disinfection facilities, and 50 feet for the primary clarifier. Spacing between drilling and grouting holes should not exceed 20 feet.

Similar ground improvement measures have been performed at the site and are generally regarded as successful with no sign of collapse or settlement of existing structures.

10:17:33 AM
6/21/2011
Geotech-FigureTM1_391657.dgn



- LEGEND:**
- ⊕ B-1 PREVIOUS BORINGS BECON, 1978
 - ⊕ B-11-09 NEW GEOTECHNICAL BORING CH2M HILL, SEPTEMBER 2009
 - TP-6-09 TEST PIT CH2M HILL, SEPTEMBER 2009
 - ⊕ B-2-11 GEOTECHNICAL BORING, CH2M HILL, 2011

- LEGEND:**
1. LOCATION OF ALL BORINGS AND TEST PITS ARE APPROXIMATE.
 2. PROPOSED FACILITIES ARE SHOWN SCHEMATICALLY BASED ON CURRENT DESIGN CONCEPTS. LOCATION AND DIMENSIONS OF PROPOSED FACILITIES ARE SUBJECT TO MINOR CHANGES DURING FINAL DESIGN.

FIGURE 1
BORING LOCATION PLAN
SCHEMATIC DESIGN REPORT TECHNICAL MEMO
BEND WATER RECLAMATION FACILITY EXPANSION
BEND, OREGON



Attachment A—Geophysical Survey

S I E M E N S & A S S O C I A T E S

CH2M HILL
C/o Brady Fuller, PE
P.O. Box 9699
Bend, Oregon 97708

June 15, 2011
Siemens Project No. 111023
City of Bend Project SW0802
CH2M HILL Project 391657

Project: City of Bend WRF Secondary Expansion Part B
Bend, Oregon

Subject: Geophysical Reconnaissance

Dear Brady,

This letter describes the results of the geophysical reconnaissance conducted to support your geotechnical exploration. This report is a continuation of similar work that we prepared as a report to CH2MHill dated September 21, 2009.

The fieldwork for this continuation was completed during the month of May 2011 in accordance with our proposal dated February 17, 2011. The results are presented in graphic fashion with this letter.

Purpose

The geophysical images are presented as a first look into the subsurface at each of the zones of interest. These data are anticipated to provide for a more effective program of direct exploration including drilling and sampling and perhaps test pit excavation. The images illustrate zones offering typical and anomalous stratigraphy and therefore targets for the drill and sample exploration. For this work, a single method was employed; earth resistivity tomography (ERT). The result illustrates continuity or heterogeneity of stratigraphy in terms of electrical contrast along



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Bend, Oregon
fax: 503-296-2271

the geophysical array.

ERT: How it works

Two-dimensional (2D) electrical resistivity tomography is a geophysical method to evaluate the subsurface electrical resistivity distribution by taking measurements along a survey line at the surface. These measurements are then interpreted to provide a description of the electrical properties of the subsurface which are in turn related to the likely distribution of geologic or cultural features known to offer

similar electrical properties. A measurement in an electrical survey involves injecting DC current into the ground through two current-carrying electrodes and measuring the resulting voltage difference at two potential electrodes. The apparent resistivity is calculated using the value of the injected current, the voltage measured, and a geometric factor related to the arrangement of the four electrodes.



The investigation depth of electrical resistivity is related to the spacing between the electrodes that inject electrical current. Therefore, sampling at different depths can be done by changing the spacing between the electrodes. Measurements are repeated along a survey line with various combinations of electrodes and spacing to produce an apparent resistivity cross-section. In this case, we used a Dipole-Dipole array with 5 foot spacing between electrode stakes. Line length varied from 28 electrodes to 56 electrodes with most surveys composed of 56 electrode spreads giving rise to depth of investigation on the order of 50 feet.

Since consecutively deeper readings are influenced by overlying strata, apparent resistivity data are inverted mathematically to generate a model of the subsurface structure and stratigraphy based on its electrical properties. Many geological/environmental or cultural factors affect or control the resistivity of the subsurface such as composition of the subsurface materials, amount of water in the

subsurface and ionic concentration of the pore fluid. Eight ERT images are presented as attachment to this letter numbered R-8 through R-15 as a continuation of similar previous work.

Survey Line Locations and Gear

Geophysical surveys were performed along routes selected by us taking into account the location of the proposed structure and numerous obstructions within these areas of interest which included existing process structures, fences and underground utilities. Topography was developed from review of topographic data available from the recent survey conducted by W&H Pacific. At the endpoints of each ERT survey, we left stakes in the ground. These stakes remain in the field as reference points to be used by the drilling team to line up on select features of the images that are targeted for additional exploration. Site plans cut from the plan sheet (provided by W&H Pacific) through each of the areas that we explored are presented along with this letter to describe the approximate location of each survey line.



ERT data were recorded using a Super Sting R-8 manufactured by Advanced Geosciences, Inc. Austin, Texas. ERT processing was done using the latest version of RES2DINV software by Geotomo Software, Malaysia.

Discussion of Results

It is well known that the geology in the area of the City of Bend WRF is composed of an irregular series of basalt layers mostly concealed at the surface by windblown silt and pumicite. The character of the rock can vary widely and often includes anomaly such as air-filled lava tube caves and rugged undulations at the surface and at depth where interbeds of cindery ash separate alternating layers of basalt. In our interpretations, we have highlighted specific locations on the site plans where the interpretation illustrates high resistivity anomaly, suggesting air-filled voids. In the

area of the disinfection facilities, the anomaly is similar to those that we associate with lava tube caves.

Although it is not possible to know the true nature of the conditions illustrated by the electrical contrasts, some generalities are known. These include the following:

- Lower resistivity (50 to 400 Ohm-m) is indicative of finer textured soils – dominated by the common silty sand of the area possibly influenced by area irrigation in the shallow horizons;
- Higher resistivity (500 Ohm-m and greater) is characteristic of rock, air and unsaturated, lightly (normally) voided structure – medium resistivity in the 5000 to 10,000 Ohm-m range likely indicates more than average degree of fracturing and jointing rather than large air void such as an air-filled lava tube cave;
- High resistivity Anomaly (10,000 Ohm-m and greater) is characteristic of air-filled voids. The true resistivity of a void is infinity since air is non-conductive; however, in reality, the measure current finds a path around the void and the interpreted resistivity is a function of the tortuosity of that path. Very high resistivity is indicated if the survey line crosses a large air void orthogonally and a somewhat lower result will be interpreted from other approach angles as well as the size of the void.
- Rapidly changing or fragmented resistivity contrasts likely provide an indication of heterogeneity caused by voided fills and/or boulder and cobble content within fill or even native soils.

Some of the high resistivity anomaly can be associated with surface features (conductive fences) that are crossed by the ERT lines. Typically, a conductive feature can be in the vicinity of the ERT line without a problem so long as the line is not parallel the feature. We laid out the surveys to satisfy this criterion. For this reason, it is our opinion that the anomaly association with the fences is likely to be coincidence and the high resistivity indicated is a result of geologic, rather than cultural feature.

We scaled each ERT profile with the same resistivity range illustrated by a color palette. Due to high resistivity anomaly discovered in this round of geophysics, we have scaled the interpretations

differently than those presented in 2009. As a result, caution to scale must be applied when comparing the two data sets.

In most profiles, the full resistivity range encountered in the project is indicated (the exception is the Blower Building Area) and hence all colors are represented. To more completely classify the high resistivity anomaly, we present the value of the highest resistivity on the interpretive profiles. The common scale technique is useful in helping to correlate stratigraphy changes across the project in terms of electrical resistivity.

This report presents our professional opinion based upon geophysical measurement and interpretation presented as an endeavor to conform to the standard of practice currently employed by area geoprofessionals conducting similar work in Bend, Oregon at this time – we make no other warranty express or implied.

We appreciate the opportunity to conduct this exploration and look forward to you completing a successful project and standby to assist your exploration crew with interpretation and boring placement as necessary.

We would be delighted to expand any of the topics as necessary. If you have questions, just ask.

Respectfully submitted,
Siemens & Associates

J. Andrew Siemens, P.E., G.E.

Renews 6/30/2012

Addressee: 2 hard copy, 1 pdf

Enclosures: ERT Profiles R-8 through R-15

Renews 6-30-2012

Key:

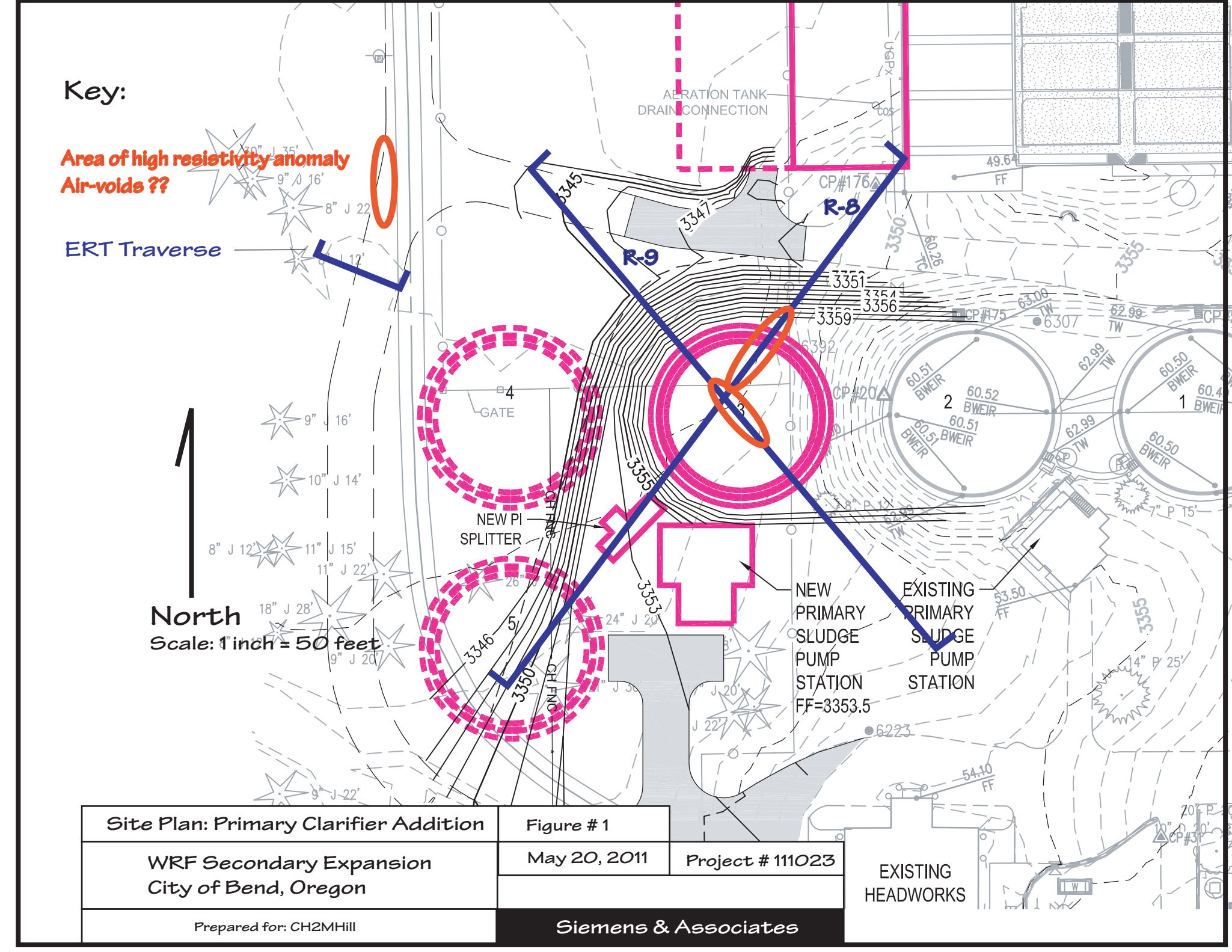
Area of high resistivity anomaly
Air-voids ??

ERT Traverse

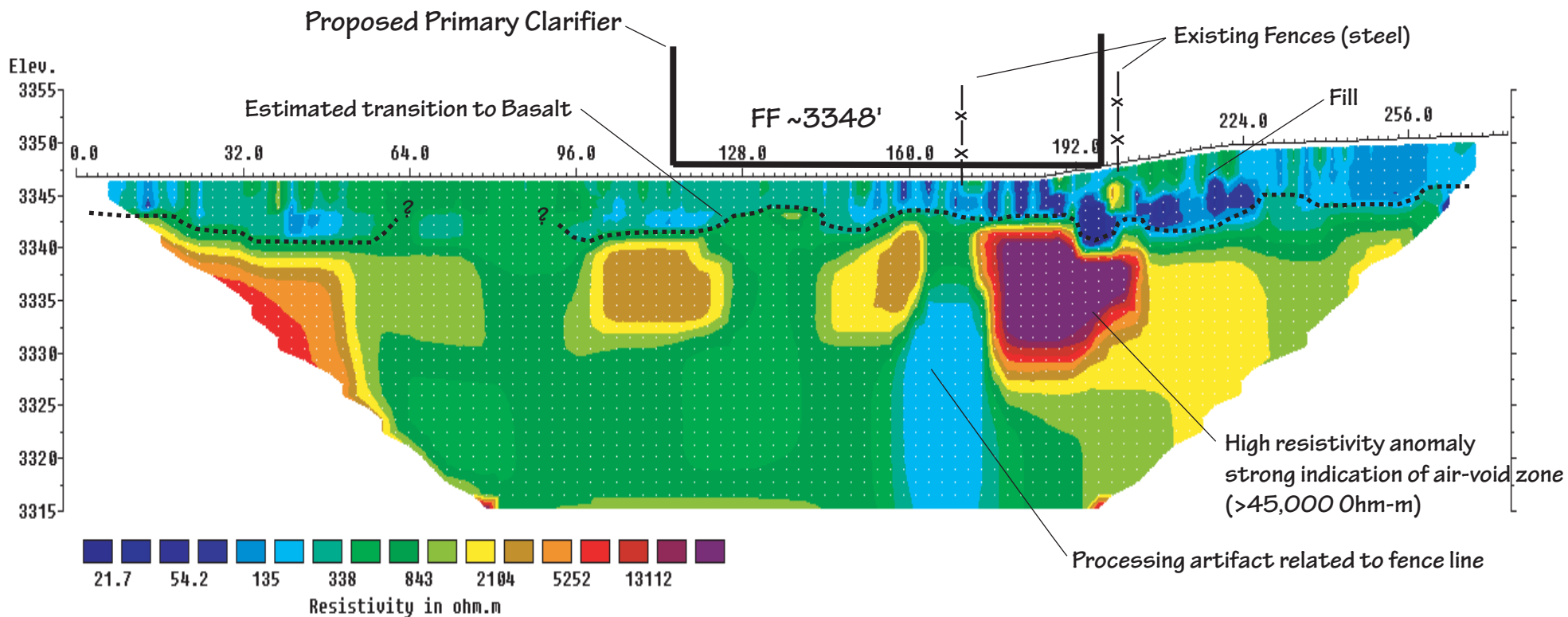
North

Scale: 1" = 50 feet

Site Plan: Primary Clarifier Addition	Figure # 1		
WRF Secondary Expansion City of Bend, Oregon	May 20, 2011	Project # 111023	
Prepared for: CH2MHill	Siemens & Associates		

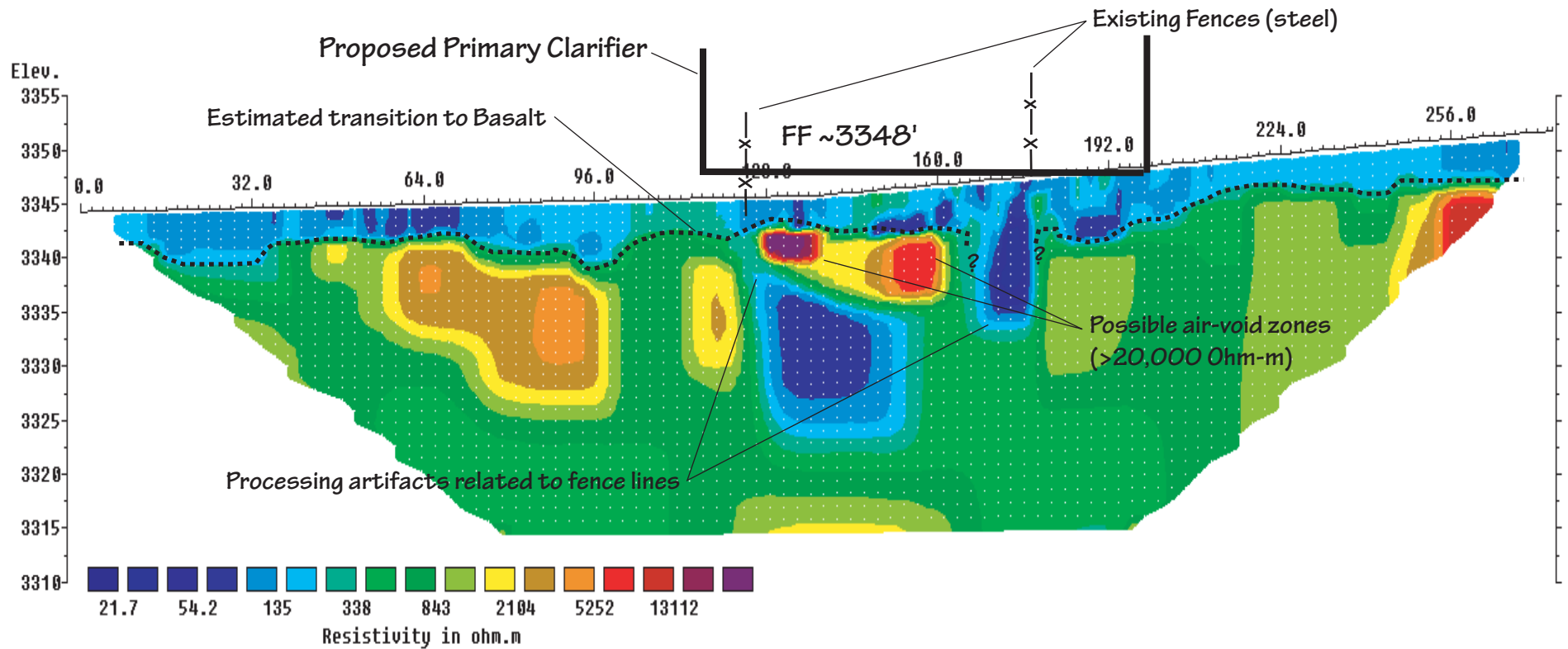


Electrical Resistivity tomography: R-8 (56 electrodes on 5 foot spacing, Dipole -Dipole Array)




n.t.s
vertical exaggeration 1.5

Electrical Resistivity tomography: R-9 (56 electrodes on 5 foot spacing, Dipole -Dipole Array)



n.t.s
vertical exaggeration 1.5


North
 Scale: 1 inch = 50 feet

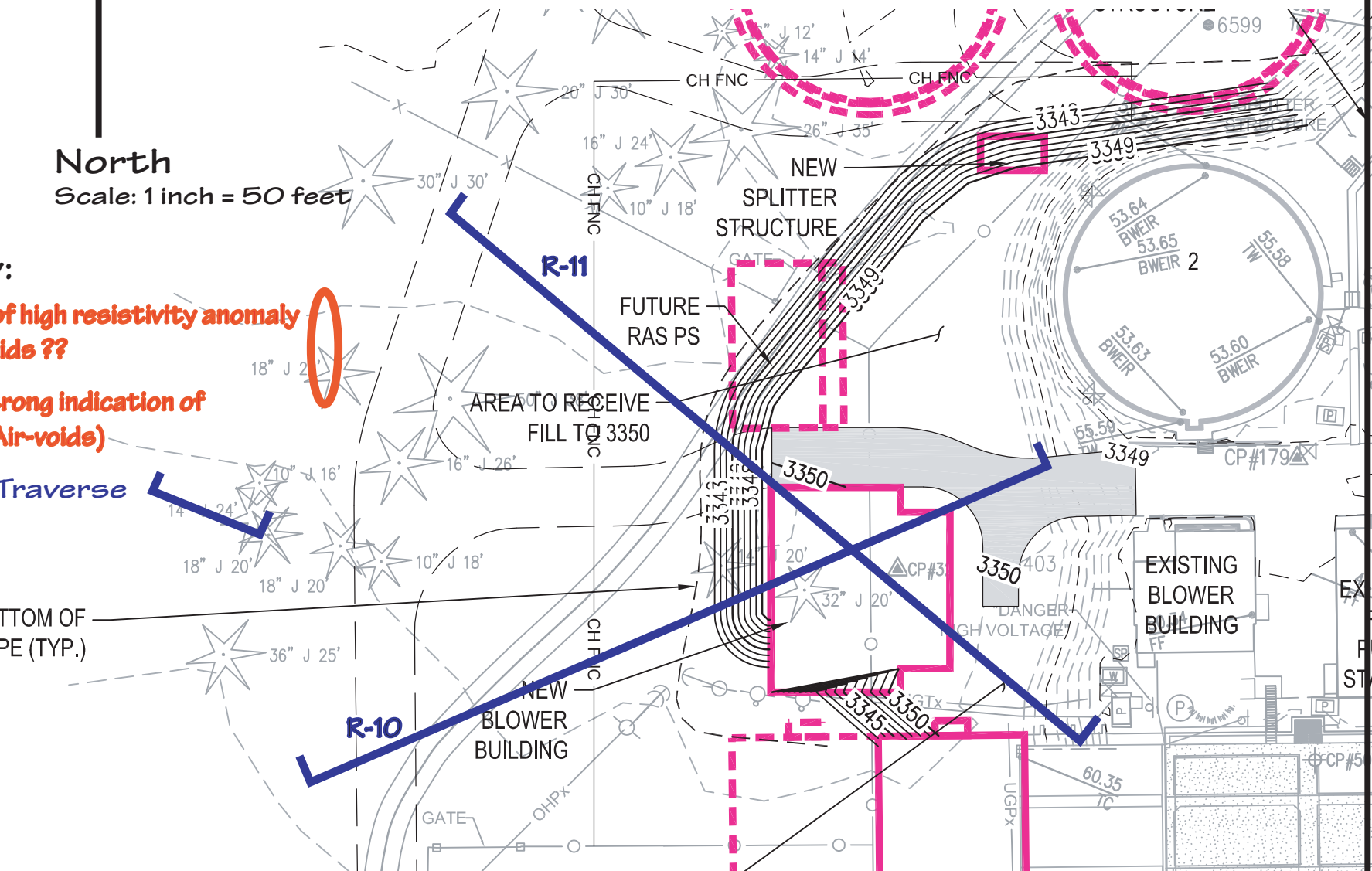
Key:

Area of high resistivity anomaly
Air-voids ??

(No strong indication of large Air-voids)

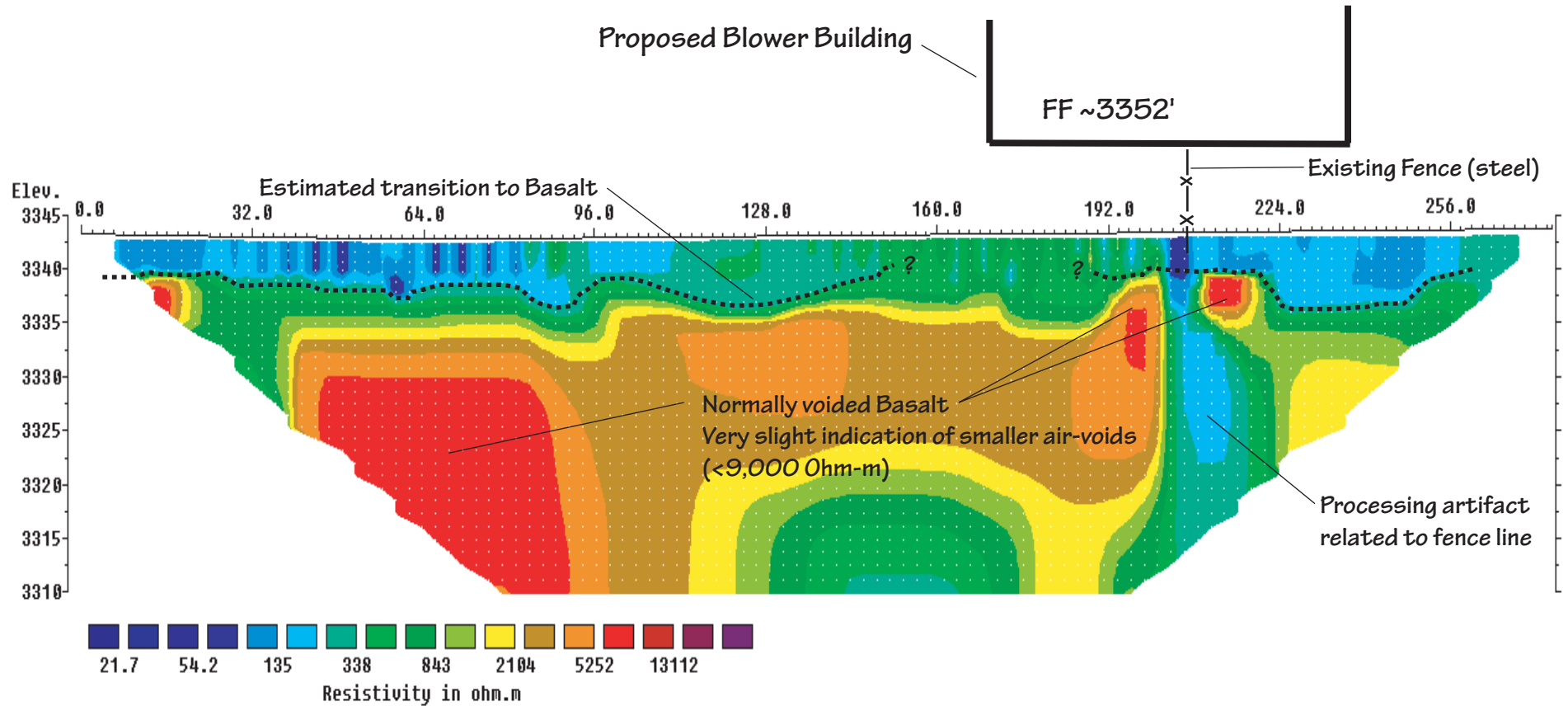
ERT Traverse

PROPOSED BOTTOM OF
 SLOPE (TYP.)



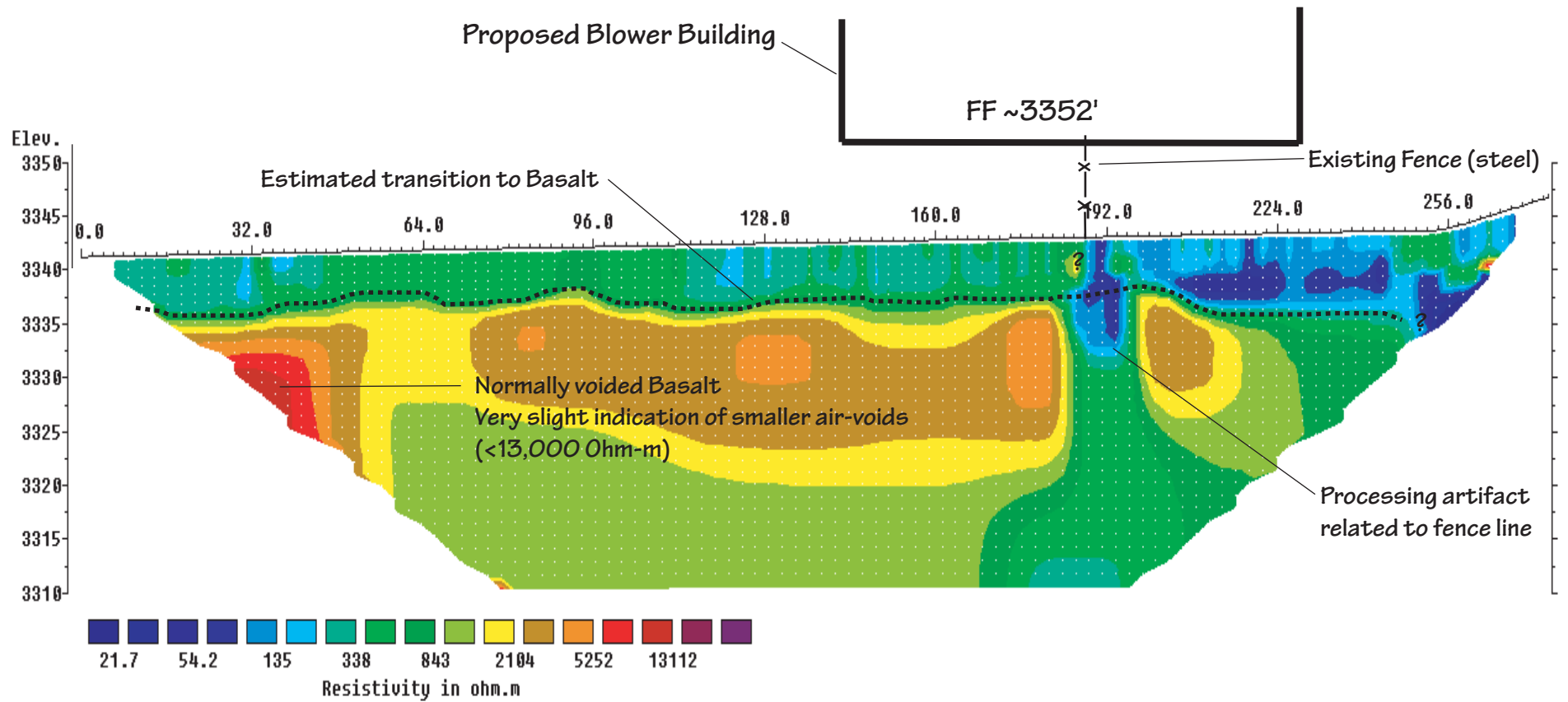
Site Plan: Blower Building	Figure # 2	
WRF Secondary Expansion City of Bend, Oregon	May 22, 2011	Project # 111023
	Siemens & Associates	
Prepared for: CH2MHill		

Electrical Resistivity Tomography: R-10 (56 electrodes on 5 foot spacing, Dipole -Dipole Array)

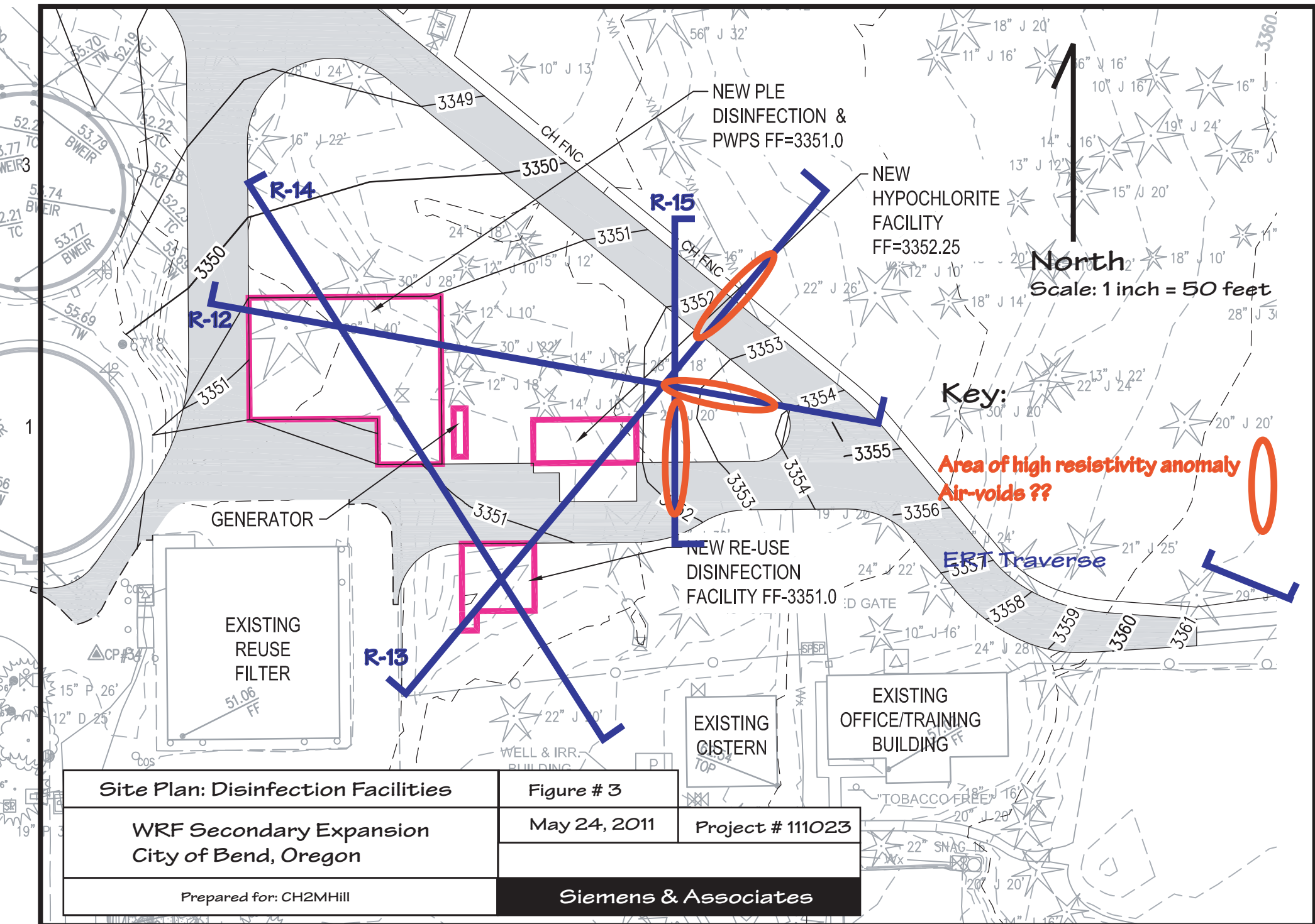


n.t.s
vertical exaggeration 1.5

Electrical Resistivity Tomography: R-11 (56 electrodes on 5 foot spacing, Dipole -Dipole Array)

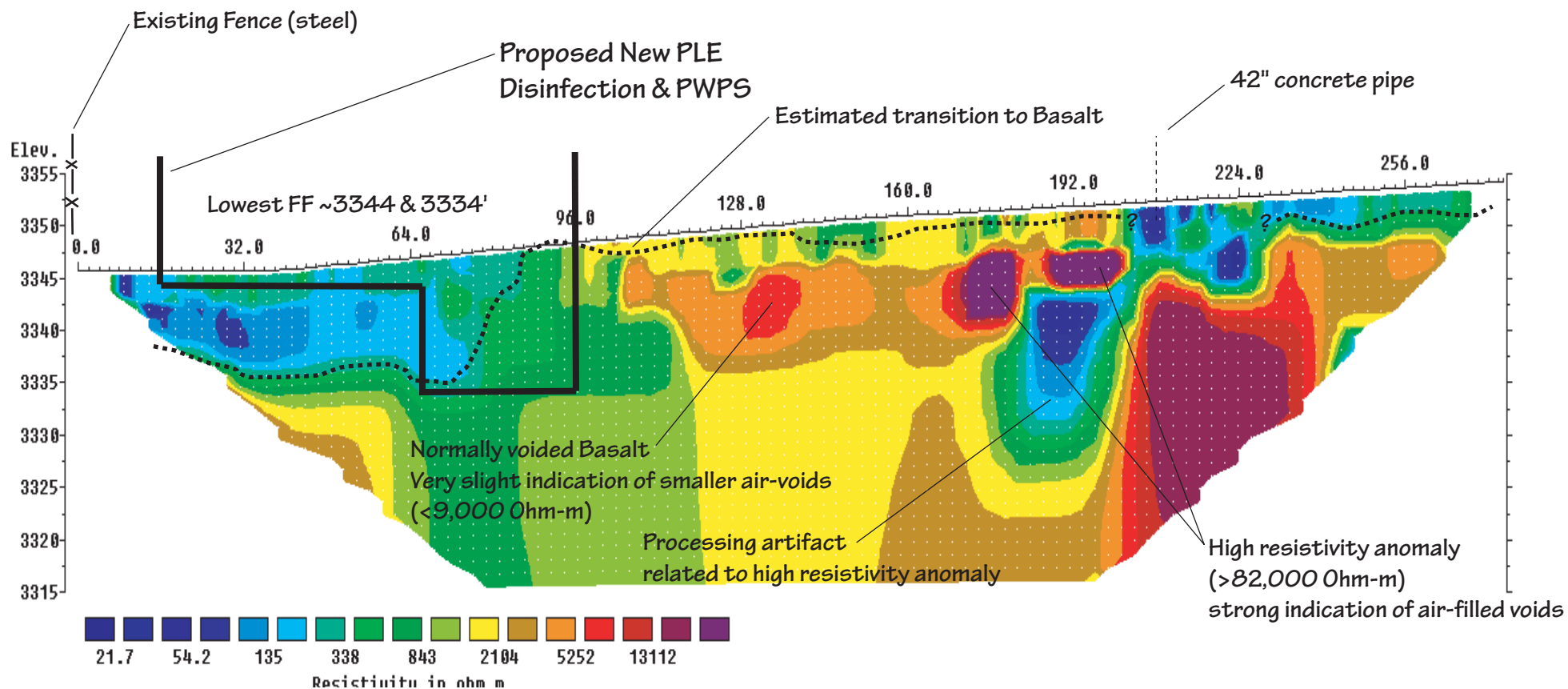


n.t.s
vertical exaggaration 1.5



Site Plan: Disinfection Facilities	Figure # 3	
WRF Secondary Expansion City of Bend, Oregon	May 24, 2011	Project # 111023
	Prepared for: CH2MHill	
		Siemens & Associates

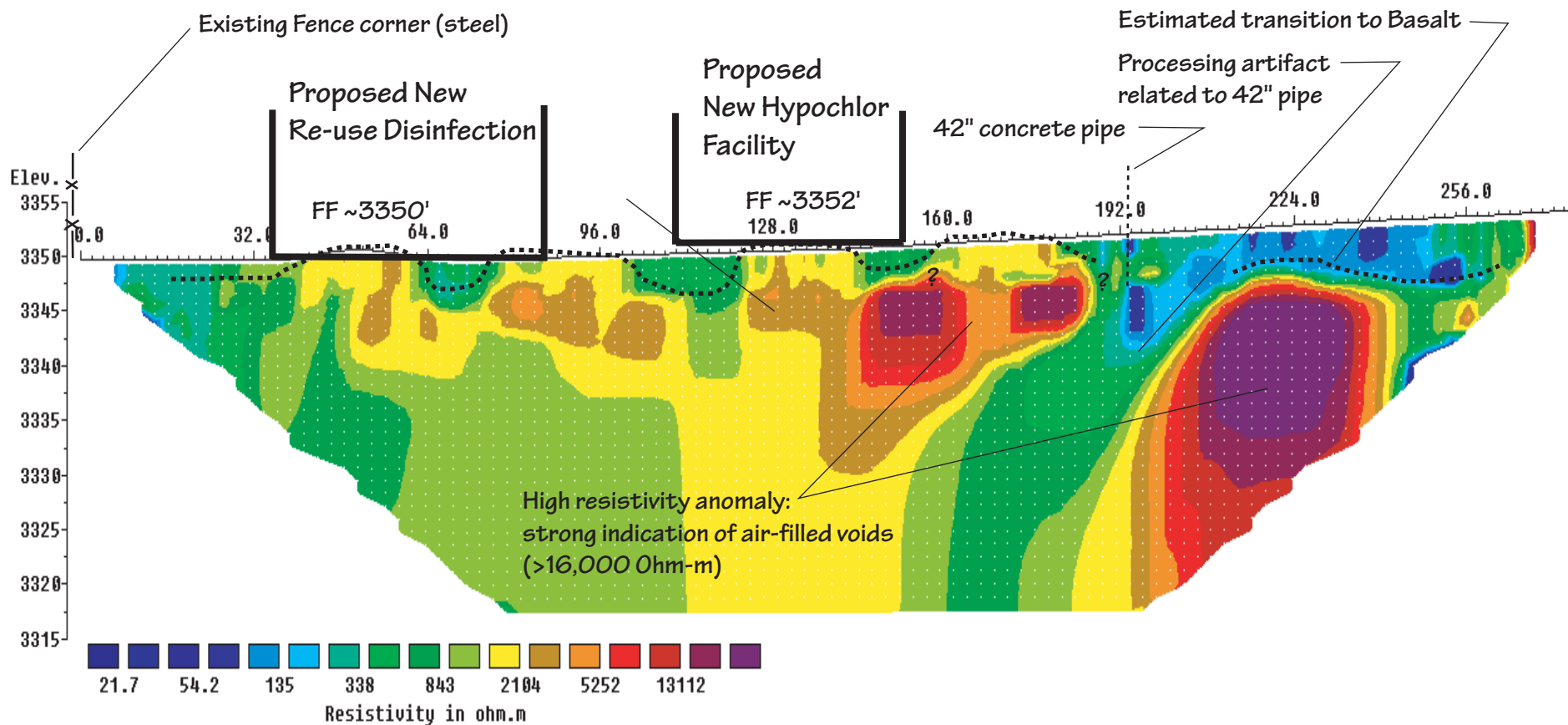
Electrical Resistivity Tomography: R-12 (56 electrodes on 5 foot spacing, Dipole-Dipole Array)



n.t.s
 vertical exaggeration 1.5

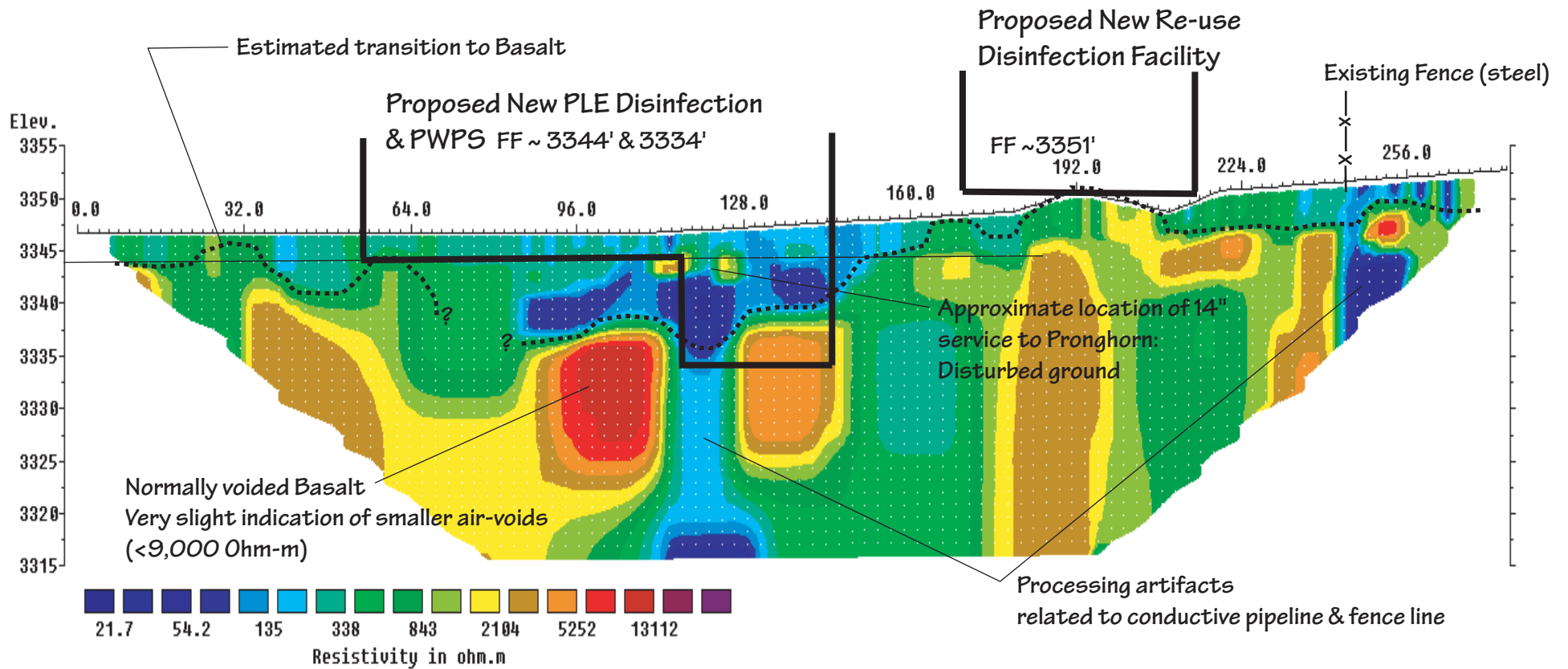
Electrical Resistivity Tomography: R-13

(56 electrodes on 5 foot spacing, Dipole-Dipole Array)



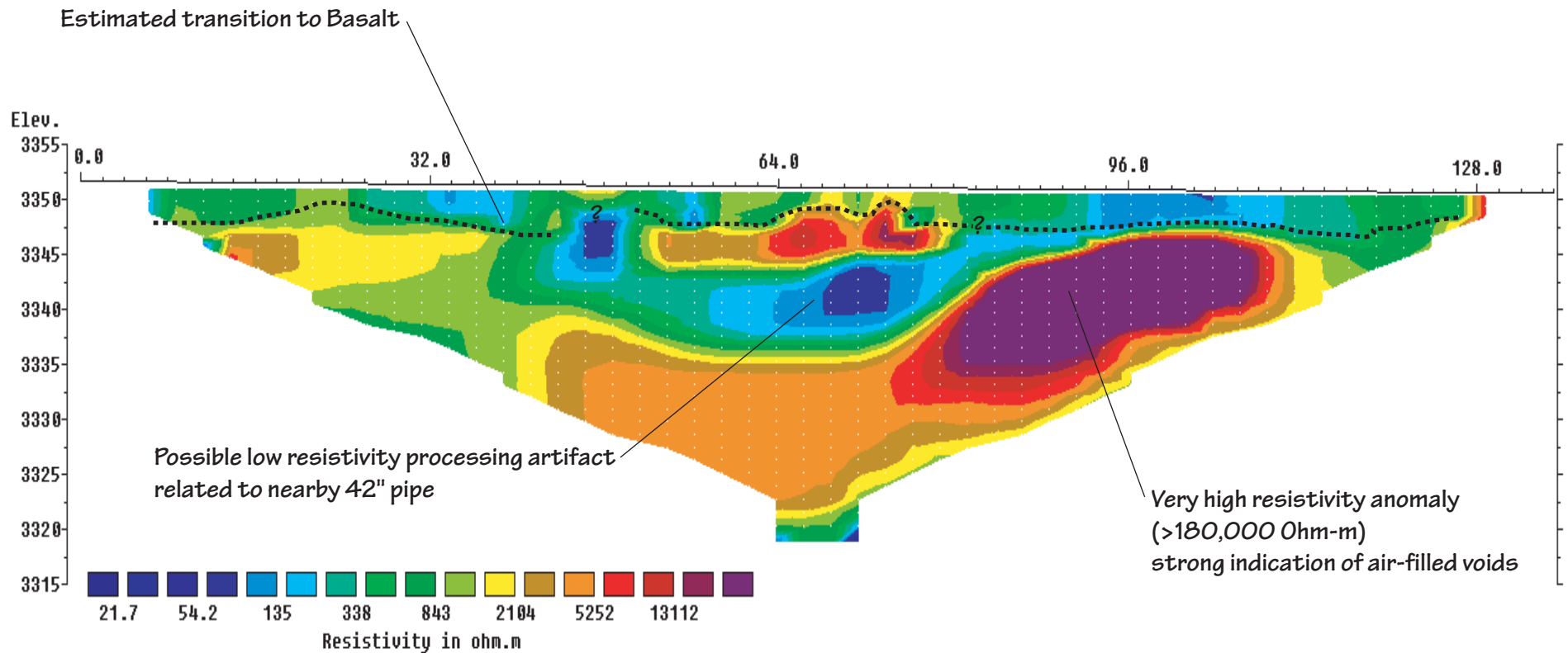
n.t.s
vertical exaggeration 1.5

Electrical Resistivity Tomography: R-14 (56 electrodes on 5 foot spacing, Dipole -Dipole Array)



n.t.s
vertical exaggeration 1.5

Electrical Resistivity Tomography: R-15 (28 electrodes on 5 foot spacing, Dipole -Dipole Array)



n.t.s
vertical exaggaration 1.5

Attachment B—Boring Logs



PROJECT NUMBER:
391657.A3.SD.GE

BORING NUMBER:
B-2-11 SHEET 2 OF 2

ROCK CORE LOG

PROJECT : Bend WRF Secondary Expansion

LOCATION :

ELEVATION :

DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion

ORIENTATION : Vertical

WATER LEVELS : ---

START : 6/3/2011

END : 6/3/2011

LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35				[Symbolic Log Pattern]			
				[Symbolic Log Pattern]	Scoria 36.0-40.0' - red purple	2 bags of bentonite	
40				[Symbolic Log Pattern]	Basalt/gravel 40.0-45.0' - gray, hard	void	
45				[Symbolic Log Pattern]	Bottom of Hole at 45.0 ft bgs - 6/3/2011	8 sec/ft end 45.0' - 5:50 p.m.	
50				[Symbolic Log Pattern]			
55				[Symbolic Log Pattern]			
60				[Symbolic Log Pattern]			



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-3-11	SHEET 1 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
5					Silty Sand (SM) 0.0-3.0' - brown	10 sec/ft	
					3' - dry		Basalt 3.0-12.0' - gray, hard
15					Air Void 12.0-13.0' - air void	12 sec/ft	
					13' - dry		Basalt 13.0-36.0' - gray, hard
30							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-3-11
SHEET 2 OF 2	
<h1>ROCK CORE LOG</h1>	

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	R Q D (%)	FRACTURES PER FOOT	DISCONTINUITIES	SYMBOLIC LOG	LITHOLOGY	COMMENTS
				DESCRIPTION		ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
				DEPTH, TYPE, MOISTURE			
35					(Symbolic log pattern)		
40					(Symbolic log pattern)	Soil Void 36.0-45.0' - softer soil, reddish?	
45					(Symbolic log pattern)	Soil Void With Air 45.0-50.0' - soft	add 5th rod at 12' long (air was venting out hole during rod change)
50					(Symbolic log pattern)	Rock 50.0-53.0' - moderately hard rock, medium hardness	rock resumes at 50.0'
55					(Symbolic log pattern)	Bottom of Hole at 53.0 ft bgs - 6/3/2011	end 4:28 p.m. 17 bags of bentonite, def. flow of air out of holes during the fill, never filled hole completely, made it 12' depth with 17 bags of bentonite, hole remains
60					(Symbolic log pattern)		



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-4-11
SHEET 2 OF 2	
<h2 style="margin: 0;">ROCK CORE LOG</h2>	

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical
WATER LEVELS : ---	START : 6/3/2011
	END : 6/3/2011
	LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35					Scoria 31.0-35.0' - reddish, softer soil, void	3 bags of bentonite	
			35' - dry		Basalt 35.0-45.0' - gray, hard		
45					Bottom of Hole at 45.0 ft bgs - 6/3/2011	end 3:22 p.m.	
55							
60							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-5-11	SHEET 1 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
					0' - moist Silty Sand (SM) 0.0-3.0' - brown	added water	
5					3' - dry Basalt 3.0-7.0' - gray, hard	10 sec/ft	
					Dirt 7.0-9.0' - black, soft	3-5 sec/ft	
10					Basalt 9.0-20.0' - gray, hard, small air voids (1-2 inches)	bouncy 12 sec/ft	
15							
20							
25					Basalt 20.5-34.0' - gray, hard, solid		
30							



CH2MHILL

PROJECT NUMBER:
391657.A3.SD.GE

BORING NUMBER:
B-5-11 SHEET 2 OF 2

ROCK CORE LOG

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	R Q D (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS
			DESCRIPTION				
			DEPTH, TYPE, MOISTURE	ROCK TYPE, COLOR, HARDNESS		CORING RATE AND SMOOTHNESS, ROD DROPS	
35				37' - dry	<p>Scoria 34.0-37.0' - reddish/purple, void</p> <p>Basalt 37.0-45.0' - gray, hard</p>	10 sec/ft 3 bags of bentonite fill	
45					Bottom of Hole at 45.0 ft bgs - 6/3/2011	end 45.0' - 2:27 p.m.	
50							
55							
60							



**PROJECT NUMBER:
391657.A3.SD.GE**

**BORING NUMBER:
B-6-11** SHEET 2 OF 2

ROCK CORE LOG

PROJECT : Bend WRF Secondary Expansion

LOCATION :

ELEVATION :

DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion

ORIENTATION : Vertical

WATER LEVELS : ---

START : 6/3/2011

END : 6/3/2011

LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35						rock end at 30.0' - 1:06 p.m. 2 bags of bentonite	
40							
45							
50							
55							
60							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-7-11
SHEET 1 OF 2	
<h2 style="margin: 0;">ROCK CORE LOG</h2>	

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical
WATER LEVELS : ---	START : 6/3/2011
	END : 6/3/2011
	LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
				Silty Sand (SM) 0.0-3.0' - brown, soft		
5				---	Basalt 3.0-7.0' - gray, hard	10 sec/ft	
10				---	Soft Rock And Sand 7.0-13.0' - gray	3-5 sec/ft	
15				---	Rock/basalt 13.0-30.0' - gray, hard	10 sec/ft	
20				---		10-12 sec/ft	
25				---			
30				---			
					Bottom of Hole at 30.0 ft bgs - 6/3/2011		



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-7-11	SHEET 2 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES			SYMBOLIC LOG	LITHOLOGY	COMMENTS
		R Q D (%)	FRACTURES PER FOOT	DESCRIPTION		ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
				DEPTH, TYPE, MOISTURE			
							end 1:57 p.m. bentonite fill "volclay #200"
35							
40							
45							
50							
55							
60							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-8-11	SHEET 1 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS
		R Q D (%)	FRACTURES PER FOOT			
		DEPTH, TYPE, MOISTURE				
					Silty Sand (SM) 0.0-4.0' - brown	add water
5			4' - dry		Rock/basalt 4.0-7.0' - gray, solid, hard rock	
10					Void 7.0-12.0' - dirt, soft	"fell out"
15			12' - dry		Rock 12.0-15.0' - soft, rock and dirt	3-5 sec/ft
20			15' - dry		Rock 15.0-30.0' - gray, hard	10 sec/ft
25						
30					Bottom of Hole at 30.0 ft bgs - 6/3/2011	



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-8-11	SHEET 2 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical

WATER LEVELS : ---	START : 6/3/2011	END : 6/3/2011	LOGGER : L. English
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DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35							
40							
45							
50							
55							
60						end at 30.0' - 1:40 p.m. 3 bags of bentonite	



PROJECT NUMBER:
391657.A3.SD.GE

BORING NUMBER:
B-9-11 SHEET 1 OF 2

ROCK CORE LOG

PROJECT : Bend WRF Secondary Expansion

LOCATION :

ELEVATION :

DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion

ORIENTATION : Vertical

WATER LEVELS : ---

START : 6/3/2011

END : 6/3/2011

LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	R Q D (%)	FRACTURES PER FOOT	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS
				DESCRIPTION	DEPTH, TYPE, MOISTURE		ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
0					0' - slightly moist		Silty Sand (SM) 0.0-11.0'	added water
11							Basalt 11.0-20.0' - gray, rock with 1/2" voids	"bouncy drilling", "bad hole", "lost air"
20							Gravel 20.0-22.0' - soft, void	pulled drill out at 20.0', added water, re-drill
22							Rock 22.0-26.0'	
26							Soft Rock 26.0-33.0' - void	



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-9-11
SHEET 2 OF 2	
<h2 style="margin: 0;">ROCK CORE LOG</h2>	

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES			SYMBOLIC LOG	LITHOLOGY	COMMENTS
		R Q D (%)	FRACTURES PER FOOT	DESCRIPTION		ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
				DEPTH, TYPE, MOISTURE			
35							
40							
45							
50							
55							
60							
					Bottom of Hole at 33.0 ft bgs - 6/3/2011	end 33.0' - 12:51 p.m. 2 bags of bentonite	



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-10-11
SHEET 1 OF 2	
<h1 style="margin: 0;">ROCK CORE LOG</h1>	

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	R Q D (%)	FRACTURES PER FOOT	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS
				DESCRIPTION			ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
				DEPTH, TYPE, MOISTURE				
				0' - moist			Silty Sand (SM) 0.0-7.0' - brown	
				1' - dry			Rock 1.0-7.0' - gray, hard	
5								
							Dirt/rock/gravel 7.0-10.0'	5 sec/ft, add water
10							Rock 10.0-21.0'	10 sec/ft, 12 sec/ft
15								
							Gravel 21.0-25.0' - scoria layer, reddish purple, soft	5 sec/ft, add water
25							Rock 25.0-30.0'	12 sec/ft
30							Bottom of Hole at 30.0 ft bgs - 6/3/2011	



PROJECT NUMBER:
391657.A3.SD.GE

BORING NUMBER:
B-10-11 SHEET 2 OF 2

ROCK CORE LOG

PROJECT : Bend WRF Secondary Expansion

LOCATION :

ELEVATION :

DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion

ORIENTATION : Vertical

WATER LEVELS : ---

START : 6/3/2011

END : 6/3/2011

LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35						end at 12:12 p.m. 2 bags of bentonite	
40							
45							
50							
55							
60							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-11-11
SHEET 1 OF 2	
<h1 style="margin: 0;">ROCK CORE LOG</h1>	

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS
				DEPTH, TYPE, MOISTURE		
5				0' - slightly moist	Silty Sand (SM) 0.0-7.0' - brown	
10				7' - dry	Rock/basalt gray	added water, 10-12 sec/ft
15						
20						
25				28' - dry	Gravel Scoria Voids reddish purple, soft	add water
30					Rock gray	
					Bottom of Hole at 30.0 ft bgs - 6/3/2011	



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-11-11	SHEET 2 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35						end at 30.0'	
40						2 bags of bentonite "volclay end 11:55 a.m.	
45							
50							
55							
60							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-12-11	SHEET 1 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
					Silty Sand (SM) 0.0-3.0' - brown	10:48 a.m. - start drilling	
5					Basalt 3.0-7.0' - rock at 3.0'		
10					Gravel And Soft Rock 7.0-10.0'	<3 sec/ft	
15					Basalt 10.0-24.0' - basalt at 10.0', gray, hard 10.0-12.5'		
25					Void cinder filled/soft, transitions to weak rock scoria	<5 sec/ft	
30					Bottom of Hole at 30.0 ft bgs - 6/3/2011		



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-12-11	SHEET 2 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35						11:00 a.m. - end drilling	
40						2 bags of bentonite	
45							
50							
55							
60							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-13-11
SHEET 1 OF 2	
<h2 style="margin: 0;">ROCK CORE LOG</h2>	

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES				SYMBOLIC LOG	LITHOLOGY	COMMENTS
		R Q D (%)	FRACTURES PER FOOT	DESCRIPTION			ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
				DEPTH, TYPE, MOISTURE				
5				0' - dry	Rock 0.0-12.0' - gray, fine	10 sec/ft		
10					12.0-13.0' - red scoria			
15					Rock 13.0-21.0' - rock			
20					Rock 21.0-26.0'	add water, 10-12 sec/ft		
25					Gravel 26.0-29.0' - soft			
30					Rock 29.0-30.0' - gray			



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-13-11	SHEET 2 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35					Bottom of Hole at 30.0 ft bgs - 6/3/2011	2 bags of bentonite	
40							
45							
50							
55							
60							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-14-11
SHEET 1 OF 2	
<h1 style="margin: 0;">ROCK CORE LOG</h1>	

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical
WATER LEVELS : ---	START : 6/3/2011
	END : 6/3/2011
	LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
5				0' - slightly moist	Silty Sand (SM) 0.0-1.0' - brown		
10				9.5' - dry	Rock Basalt 5.0-9.5'	5-10 sec/ft	
15					Basalt 9.5-17.0'	10 sec/ft	
20					Void 17.0-21' - intermittent voids	add water	
25					Rock Basalt 21.0-26.0'		
30					VOIDS 26.0-32.0' - chunks of scoria		



PROJECT NUMBER:
391657.A3.SD.GE

BORING NUMBER:
B-15-11 SHEET 1 OF 2

ROCK CORE LOG

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
					Silty Sand (SM) 0.0-1.0'		
					Basalt 1.0-8.0'	bedrock at 1.0', 10 sec/ft	
5						6" soil infilled	
					Sand/gravel 8.0-20.0' - softer, void	8.0-10.0' - soil infilled, < 5 sec/ft 8.0-10.0'	
10					Basalt 10.0-20.0' - 10.0-28.0' - hard basalt	add water at 10.0', 10-15 sec/ft	
15							
20					Basalt 20.0-30.0'	15 sec/ft	
25							
30					28.0-30' - 28.0-30.0' - air filled, void at 30.0'		



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-15-11
SHEET 2 OF 2	
<h1>ROCK CORE LOG</h1>	

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical
WATER LEVELS : ---	START : 6/3/2011
	END : 6/3/2011
	LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35				[Symbolic Log: Hexagonal pattern]	30.0-39.0' - back into hard basalt	15 to 20 sec/ft	
40				[Symbolic Log: Hexagonal pattern]	39-40'	30.0-39.0' - air void	
45				[Symbolic Log: Hexagonal pattern]	40.0-50.0' - 40.0-45.0' - weak, scoria rock	no hammer activity, rotary only	
50				[Symbolic Log: Hexagonal pattern]	Bottom of Hole at 45.0 ft bgs - 6/3/2011	3 bags of bentonite	
55				[Symbolic Log: Hexagonal pattern]			
60				[Symbolic Log: Hexagonal pattern]			



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-16-11	SHEET 1 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
5					Silty Sand (SM) 0.0-1.0' - brown	5-10 sec/ft	
					Basalt 1.0-5.5'		
					void		
10					dirt mixed basalt/cinder, soft	no hammer used, add water 6 sec/ft	
15					Basalt solid		
20					Basalt	10-12 sec/ft	
25					Basalt scoria, reddish		
30					Basalt		



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-16-11	SHEET 2 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical
WATER LEVELS : ---	START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
						15 sect/ft	
						3 bags of bentonite	
35							
40							
45							
50							
55							
60							
					Bottom of Hole at 32.0 ft bgs - 6/3/2011		



PROJECT NUMBER:
391657.A3.SD.GE

BORING NUMBER:
B-17-11

SHEET 1 OF 2

ROCK CORE LOG

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	R Q D (%)	FRACTURES PER FOOT	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS
				DESCRIPTION			ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
				DEPTH, TYPE, MOISTURE				
							Silty Sand (SM) 0.0-4.0' - brown	
5				4' - dry			Basalt 4.0-8.0' - gray, hard	
10				10' - dry			Sand/gravel 8.0-12.0' - soft	8 sec/ft 3 sec/ft
15				12' - dry			Basalt 12.0-30.0' - gray, hard	10 sec/ft
20								
25								
30								
							Bottom of Hole at 30.0 ft bgs - 6/3/2011	



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-17-11	SHEET 2 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion	LOCATION :
ELEVATION :	DRILLING CONTRACTOR : Quality Drilling
CORING METHOD AND EQUIPMENT : Air Percussion	ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35						end 30 feet with basalt - 6:18 p.m. 2 bags of bentonite	
40							
45							
50							
55							
60							



PROJECT NUMBER: 391657.A3.SD.GE	BORING NUMBER: B-18-11	SHEET 1 OF 2
ROCK CORE LOG		

PROJECT : Bend WRF Secondary Expansion LOCATION :

ELEVATION : DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion ORIENTATION : Vertical

WATER LEVELS : --- START : 6/3/2011 END : 6/3/2011 LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
5				. . .	Silty Sand (SM) 0.0-5.0'	add water	
10				/ / /	Basalt 5.0-12.0'	10 sec/ft	
15				. . .	Soft Soil Void 12.0-15.0'		
20				/ / /	Basalt 15.0-30.0' - gray, hard	10 sec/ft	
25				/ / /			
30				/ / /			
					Bottom of Hole at 30.0 ft bgs - 6/3/2011		



PROJECT NUMBER:
391657.A3.SD.GE

BORING NUMBER:
B-18-11 SHEET 2 OF 2

ROCK CORE LOG

PROJECT : Bend WRF Secondary Expansion

LOCATION :

ELEVATION :

DRILLING CONTRACTOR : Quality Drilling

CORING METHOD AND EQUIPMENT : Air Percussion

ORIENTATION : Vertical

WATER LEVELS : ---

START : 6/3/2011

END : 6/3/2011

LOGGER : L. English

DEPTH BELOW SURFACE (ft)	CORE RUN LENGTH AND RECOVERY (%)	DISCONTINUITIES		SYMBOLIC LOG	LITHOLOGY	COMMENTS	
		R Q D (%)	FRACTURES PER FOOT		DESCRIPTION	ROCK TYPE, COLOR, HARDNESS	CORING RATE AND SMOOTHNESS, ROD DROPS
					DEPTH, TYPE, MOISTURE		
35						End 30.0' - 6:27 p.m. 2 bags of bentonite end day 6:40 p.m., leave site 6:50	
40							
45							
50							
55							
60							

TM 16 – Mechanical Design Criteria

PREPARED FOR: Jim Wodrich, P.E./City of Bend

PREPARED BY: Jason Krumsick/CH2M HILL

REVIEWED BY: Dave Green, P.E./CH2M HILL
Brady Fuller, P.E./CH2M HILL
Jim Griffiths, P.E./CH2M HILL

DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum details the mechanical approach to new facilities at the Bend Water Reclamation Facility (WRF).

Design Criteria

Codes and Standards

Mechanical system design will conform to the applicable U.S. codes and standards. The codes and standards of the following organizations will govern:

- American Society of Mechanical Engineers (ASME)
- American National Standards Institute (ANSI)
- American Water Works Association (AWWA)
- American Welding Society (AWS)
- Hydraulic Institute Standards (HIS)
- National Fire Protection Association (NFPA)
- Occupational Safety and Health Administration (OSHA)

Plant Hydraulics

Open channel flow through the plant components will be analyzed with CH2M HILL HYDRO software. The result will be used to develop the plant hydraulic profile. See Schematic Design *TM 9 – Plant Hydraulics*.

Pumped System Hydraulics

Pumped system hydraulics will be performed using Applied Fluid Technologies (AFT) Fathom software.

Pumping of wastewater with solids concentration of less than 2 percent will be analyzed using the Newtonian Fluid Model.

Sludge system hydraulics, solids concentration of 2 percent or greater, will be analyzed using the Non-Newtonian Bingham Laminar Plastic Model built into Fathom software.

Equipment Selection

Process equipment will be selected for the chosen plant process alternative to meet the performance requirements of that alternative. Input from plant operations and maintenance personnel will be solicited throughout the design for preferred manufacturers or equipment vendors. Final process equipment selections will be made based on equipment performance requirements, reliability, cost, efficiency, CH2M HILL experience, and City of Bend preferences. The equipment list associated with the proposed unit process upgrades is included as Attachment A to *TM 2 – Process and Facilities Overview and Recommendations*.

The process mechanical engineer(s) will be responsible for compiling the equipment specifications, which will include at least two named manufacturers for each piece of equipment, unless there are overriding reasons to procure equipment from a sole-source to match existing equipment or to obtain a performance guarantee.

Where applicable, double mechanical seals will be specified on pumps. Flow measurement and pressure measurement instruments will be provided on pumping systems to improve startup, performance monitoring, trending, and maintenance.

Piping Selection

A preliminary pipe schedule is included as Attachment B to *TM 2 – Process and Facilities Overview*.

Wastewater and sludge system piping will generally be cement-lined ductile iron (CLDI) pipe; welded steel pipe or high-density polyethylene (HDPE) pipe will be used for process piping 30-inch and above as CLDI is not cost effective in these sizes. For exposed piping installation, CLDI pipe joints shall be grooved joint or flanged, and, for buried installation, CLDI pipe joints will be restrained joints. Welded steel and HDPE pipe joints will be welded or flanged.

Process air system piping will be carbon steel or stainless steel. Steel and stainless steel pipe shall be provided with flanged joints connections to valves and other equipment.

Piping materials and joint types for pressurized systems will be selected to provide thrust restraint of all joints exposed or buried.

Valve Selection

Manually operated and power-operated valve schedules will be developed and updated as design progresses.

Valve selection will generally be as follows:

- For raw sewage and sludge systems, plug valves and ball valves will be used except where flow control is required. Flow control valves for sludge systems will be V-port type ball valves or eccentric plug control valves.

- For process air system, final effluent, and plant water systems, valves 3 inches and larger will be butterfly valves. Valves 2½ inches and smaller will be ball valves.
- In chemical systems, non-metallic diaphragm valves will be used, except in hypochlorite systems that will use a vented PVC ball valve.
- Check valves for pumped systems will use actuated valves with flow and pressure elements to monitor system operation where applicable. Passive systems such as swing check valves and ball valves will be used when appropriate backup systems are not sufficient. Check valves in chemical systems will be non-metallic ball-check valves.
- The default actuator type for power-operated valves will be pneumatic actuators. The plant's existing high pressure air system will be analyzed and expanded as necessary to provide the additional pneumatic air capacity required.
- New valves, installed as part of these proposed WRF upgrades will utilize pneumatic actuators where possible. Existing electric-actuated valves will not typically be replaced with pneumatic actuators unless work is being conducted on that particular valve. The City of Bend intends to retrofit many of their existing electric actuators over time, and air supply lines will be routed and sized to accommodate these future retrofits.

Gate Selection

Gate schedules will be developed and updated as the design progresses.

Fabricated stainless steel or aluminum slide gates will be used in low head and, if required, modulating gate applications. Stainless steel or aluminum materials will be selected based on corrosion evaluation recommendations.

Cast iron slide gates (sluice gates) will be used in higher head and where lower leakage rates than provided with fabricated slide gates are required.

Gates will be either manually actuated or powered by electric 460 volt (V), three-phase actuators, where deemed necessary. A portable electric drill operator will be provided to allow powered operation of gates provided with manual actuators.

Code Issues

Mechanical and supporting electrical equipment will be designed in accordance with NFPA 820, 2003 Standard for Fire Protection in Wastewater Treatment and Collection Facilities. The incorporation of NFPA 820 requirements is a task that will be coordinated by the process mechanical engineer(s) with all other involved discipline engineers including electrical, building mechanical and instrumentation and control.

Reliability/Redundancy

The U.S. Environmental Protection Agency (EPA) requires that wastewater facilities meet the requirements for reliability and redundancy in their treatment components and associated equipment. The reliability standards establish minimum levels of reliability for three classes of wastewater works. Oregon Department of Environmental Quality (DEQ) has also established minimum standards governing the reliability of mechanical, electrical, and fluid systems used in wastewater systems. The standards are intended to protect the

environment, particularly receiving waters, against unacceptable degradation resulting from power failure, flood, peak loads, equipment failure, and maintenance shutdowns. The standards are divided into three, decreasingly stringent, classes of reliability: I, II, and III.

DEQ has determined that reliability Class II is appropriate for the Bend WRF treatment facilities. These requirements provide the basis for process mechanical equipment included in the schematic design.

Design Approach

Drawing Guidelines

At a minimum, provide the following information on the layout drawings:

- Dimensioning: Locate equipment and piping centerlines as required, using a minimum of two dimensions. Dimension from interior wall surfaces or from exterior wall surfaces.
- Pipe elevations: When indicating pipe elevations, use the following conventions:
 - Centerline for pressure pipes except when two or more pipes rest on a common support.
 - Invert elevation (IE) for gravity-flow pipes (including gravity-flow pipes through walls) except when two or more pipes rest on a common support.
 - Bottom-of-line (BOL) elevation when two or more pipes rest on a common support.
 - Equipment elevations: Be aware of differences in equipment dimensions among manufacturers. Ensure that a satisfactory installation will result for any probable equipment. A pump, for example, should normally be set by indicating inlet or outlet piping elevations.
- Show any piping reducers/increasers required to connect piping to equipment, valves, etc.
- Properly reference design details (*to be developed in Final design*). Create custom details only when absolutely necessary.
- Ensure that drawing notes are clear and concise and that terms on the drawings agree exactly with the terms used in the general abbreviation sheets and/or the specifications.

Layout and Access

Certain conventions should be followed to make the Bend WRF optimally functional, operable, and maintainable. When developing layouts, observe the guidelines outlined below.

Equipment

- Typically, one type of equipment will be chosen as the basis of design. This make or model is referred to as the “design standard.” Layout should be based on this selection.

Where other manufacturer's products are also suitable, the layout should be checked to ensure that the arrangement does not preclude the use of these alternatives.

- Required space for equipment removal/replacement/maintenance will be provided in the layout on the drawings.
- Mount equipment and panels on equipment pads to protect them from wash down and flooding.
- The minimum clearance on sides around rotating equipment over 10 horsepower (hp) should be 4 feet.
- Leave at least 4 feet of clearance between the outermost extremities of adjacent pieces of equipment or between a wall and a piece of equipment.
- Clearance in front of any other equipment face or panel requiring maintenance should be 4 feet.
- Pressure vessels should be at least 2 feet from the back wall and 3 feet apart. Sufficient space in front of the vessel should be provided for the face piping plus 4 feet.
- For pumps, compressors, and other rotating equipment where parallel units are provided, the orientation of the drive and the rotation should be identical.
- Pumps used for sludge pumping should be arranged to minimize the distance and number of bends through which the liquid must be conveyed to the pump suction.
- Provide adequate headroom for removal of vertical turbine pumps, and/or specify shafts, shaft enclosure tubes (where applicable), and columns in specific length sections that are removable.
- Provide ladders and/or hatches to access and remove equipment.
- Motorized hoists, monorails, or cranes should be provided where equipment component weights exceed 2,000 pounds (lb) and/or when frequent lifting for maintenance is necessary.
- Provide adequate lifting headroom for equipment. An allowance for sling length or lifting beams between equipment lift points and crane or hoist hook also needs to be included.
- Provide lifting eyes, in accordance with the design details, above equipment not otherwise provided with lifting means.
- Place wash down stations in logical areas to facilitate clean-up and pipe flushing.

Piping and Valves

- Locate piping so that it is not a tripping hazard, a head-banger, or a barrier to equipment access.
- Minimal piping should be located above blowers, compressors, or pumps to facilitate lifting.

- In general, lay out piping close to walls where it can be easily supported, particularly in spaces with high ceilings.
- If piping must be run close to a wall, but not supported from it, leave at least 2 feet of clearance between the outermost pipe flange and the wall.
- To permit purging of air from the pipeline while it is being filled with water, locate a manual vent valve on the highest point of every pipeline to be filled with liquid or which is to be hydrostatically tested.
- To permit water drainage, locate a manual drain valve on the lowest point of every pipeline.
- Pipe supports and seismic bracing are generally not shown on the layout drawings.
- Verify, however, that adequate space is available for installation of these supports.
- Provide flexible connections to permit easy assembly and disassembly of piping and connections to equipment.
- When laying out piping, keep the placement of anchors and expansion joints in mind. These must be located on the drawings.
- If piping reducers are required on the suction side of pumps, provide eccentric reducers that are flat on top (FOT).
- Wall penetrations should be perpendicular to the wall.
- Make an effort to keep valves within operator reach. For any valve over 6 feet 9 inches above the operating floor, provide a chain operator.
- Do not place swing check valves in vertical piping runs.
- Install an easy disassembly coupling or pipe joint within four diameters of valves.
- Provide thrust restraint for sleeve and other couplings that are not capable of internal thrust restraint.
- Allow ample space for valve and gate actuators.
- Provide adequate clearances for rising stem valves and gates.
- Install buried valves in valve vaults where practical.
- Provide sufficient straight runs for flow meters and other instrumentation and control (I&C) elements.

Pipe Insulation and Freeze Protection

- Exterior small diameter process piping, such as chemical piping, will be insulated and heat traced for freeze protection. Plumbing piping insulation and freeze protection requirements are include in *TM 17 – HVAC/Plumbing Design Criteria*.

- Insulation will be provided on air low pressure (ALP) piping on the discharge near the blowers to protect personnel from potential burn hazards.

Corrosion Control

Corrosion control measures for mechanical piping and equipment will follow the guidelines set forth in *TM 19 – Materials and Corrosion Control*.

Equipment Removal System

Provisions will be made to ensure all equipment is installed to allow means for its removal and replacement as necessary.

The primary means for removal of equipment that is mounted outdoors will be through the uses of boom trucks and cranes. The design will ensure that all outdoor equipment will be accessible with available rental boom trucks or cranes.

The facility designs for equipment mounted indoors or in shelters shall take into consideration the method of equipment removal. Where practical, access shall be provided to allow removal by forklift, dolly, or cart. Where this type of access is not available, permanent means of equipment removal shall be provided in the design. It is anticipated that the following area(s) will require permanently installed equipment removal system:

- Facility 43 - Plant Effluent Disinfection Facility – UV Equipment: Monorail with electric operated hoist and trolley
- Facility 44 - Reuse Disinfection Facility – In Vessel UV Equipment: If required, a monorail with electric operated hoist and trolley will be provided.

Outstanding Issues

The design development phase of the project is the appropriate time to incorporate input in the mechanical design from the plant operators and maintenance personnel. The following is a list of items where input will be solicited from plant staff about preferences:

- Valve manufacturers
- Pneumatic valve actuator manufacturers
- Pump manufacturers
- Pump seal designs
- Pipe system labeling and/or color coding
- Review of pipe materials selections
- Review of equipment access and equipment removal systems

TM 17 – HVAC/Plumbing Design Criteria

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DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum details the heating, ventilation, and air conditioning (HVAC)/plumbing approach to new facilities at the Bend Water Reclamation Facility (WRF).

Applicable Codes, Standards, and Regulations

Building mechanical design incorporates the codes, industry standards, and other state and federal regulations described below.

Building Codes

The applicable building codes are shown in Table 1.

TABLE 1
Applicable Building and Local Codes for the State of Oregon
City of Bend Water Reclamation Facility

Item	Code	Year
Building	Oregon Structural Specialty Code	2004
Plumbing	Oregon Plumbing Specialty Code	2008
Mechanical	Oregon Mechanical Specialty Code	2010
Fire	Oregon Fire Code	2010
Energy	Oregon Energy Efficiency Specialty Code	2010
Electrical	National Electrical Code	2008

Standards and Regulations

Applicable standards and regulations are as follows:

- Air-Conditioning and Refrigeration Institute (ARI)
- Air Moving and Conditioning Association (AMCA)
- American Conference of Governmental Industrial Hygienists (ACGIH)
- American National Standards Institute (ANSI)
- American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) design and data manuals, including the following:
 - Standard 55-2004 - Thermal Environmental Conditions for Human Occupancy
 - ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality
 - ASHRAE Standard 90.1-2007 - Energy Standard for Buildings Except Low-Rise Residential Buildings
- American Society of Mechanical Engineers (ASME)
- American Society of Plumbing Engineers (ASPE)
- Americans with Disabilities Act (ADA), Title III
- Associated Air Balance Council (AABC)
- National Environmental Balancing Bureau (NEBB)
- National Fire Protection Association (NFPA)
- Occupational Safety and Health Administration (OSHA) Standards for General Industry
- Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - Sheet metal ductwork construction manual

Heating Ventilating and Air Conditioning Systems

Outdoor Design Conditions

Table 2 summarizes climate data used for establishing HVAC design criteria. The thermal design parameters, including the winter and summer design temperatures, are referenced from the ASHRAE 2005 climatic data.

TABLE 2
Outdoor Design Criteria
City of Bend Water Reclamation Facility

Season	Outdoor Design Criteria
Winter	1°F dry bulb @ 99.6 percent (ASHRAE 2005)
Summer	93°F dry bulb / 62°F wet bulb @ 0.4 percent (ASHRAE 2005)

°F = degrees Fahrenheit.

Indoor Design Conditions

Table 3 summarizes the indoor design conditions.

TABLE 3
Indoor Design Criteria
City of Bend Water Reclamation Facility

Area	Occupied Mode	Unoccupied Mode
Existing Primary Sludge Pump Station		
Pump Room	104°F (cooling), 50°F (heating)	104°F (cooling), 50°F (heating)
New Primary Sludge Pump Station		
Pump Room	104°F (cooling), 50°F (heating)	104°F (cooling), 50°F (heating)
Electrical Room	104°F (cooling)	104°F (cooling)
Primary Effluent Gallery		
Gallery	50°F (heating)	50°F (heating)
New Blower Building		
Blower Room	104°F (cooling), 50°F (heating)	104°F (cooling), 50°F (heating)
Electrical Room	104°F (cooling)	104°F (cooling)
Existing Return Activated Sludge/Waste Activated Sludge (RAS/WAS) Pump Station		
Pump Room	104°F (cooling), 50°F (heating)	104°F (cooling), 50°F (heating)
Electrical Room	104°F (cooling), 50°F (heating)	104°F (cooling), 50°F (heating)
New Plant Water Pump Station		
Pump Room	104°F (cooling)	104°F (cooling)
Reuse Ultraviolet (UV) Building		
UV Room	104°F (cooling), 50°F (heating)	104°F (cooling), 50°F (heating)
Chemical Building		
Sodium Hypochlorite Pump Room	104°F (cooling), 50°F (heating)	104°F (cooling), 50°F (heating)
UV Electrical Building		
Electrical Room	104°F (cooling)	104°F (cooling)

TABLE 3
 Indoor Design Criteria
City of Bend Water Reclamation Facility

Solids Building		
Solids Processing	50°F (heating)	50°F (heating)

Notes: For equipment with cooling requirements lower than 104°F local panel cooling will be provided.

HVAC General Design Criteria

Table 4 describes the HVAC design intent for each building, including ventilation rate criteria, ventilation system types, heating and cooling system types, basic operating control intent, and general locations where equipment will be located. Units of measurement for ventilation rates are given in air changes per hour (ACH) or cubic feet per minute (cfm). Rates measured in standard cubic feet per minute (scfm) are adjusted for altitude by converting to actual cubic feet per minute (acfm) when performing calculations for sizing equipment.

Cooling equipment types include the following:

- 100 percent outside air filtered supply fans (SFs) for ventilation cooling.
- Indoor air handling unit (AHU) with split system mechanical direct-expansion (DX) refrigeration generated from an outdoor air-cooled R410A compressor condensing unit (ACCU) and economizer cooling.

Heating equipment types include the following:

- Duct mounted electric resistance heater.
- Electric unit heater.
- Duct mounted hot water heating coil.
- Hot water unit heater.
- Packaged air handling unit with filter section and hot water heating coil.
- Indoor AHU with split system mechanical heat pump generated from an outdoor air-cooled R410A compressor condensing unit and economizer cooling.

TABLE 4
 Descriptions of HVAC Design Intent
City of Bend Water Reclamation Facility

Building Name	Spaces	Ventilation Rate Criteria	Ventilation System Type	Heating & Cooling System Type	Operating Control	Equipment Mounting Location(s)
Existing Primary Sludge Pump Station	Pump Room	6 ACH of 100% Outside air (OSA) per NFPA 820 Table 6.2(a) Row 9 b.	Filtered supply air fan (SF) and exhaust fan (EF).	Ventilation cooling and hot water heating with electric resistance heating backup controlling to a supply air setpoint.	Continuous operation of both SF and EF. Heating via duct mounted thermostat. Monitored by EMP system.	SF: Indoor in pump room. EF: roof mounted.
New Primary Sludge Pump Station	Pump Room	6 ACH of 100% OSA per NFPA 820 Table 6.2(a) Row 9 b.	Filtered supply air fan and exhaust fan.	Ventilation cooling and hot water heating with electric resistance heating backup controlling to a supply air setpoint.	Continuous operation of both SF and EF. Heating via duct mounted thermostat. Monitored by EMP system.	SF: Indoor in pump room. EF: roof mounted.
	Electrical Room	No requirement.	Filtered supply air fan.	Ventilation cooling.	Local thermostats for cooling control and heat transfer control to pump room.	SF: Indoor in electrical room.
Primary Effluent Gallery	Gallery	No requirement.	None	Hot water unit heater.	Local thermostat on unit heater.	Unit heater in gallery.
New Blower Building	Blower Room	No requirement.	Filtered supply air fan and relief damper.	Ventilation cooling and electric resistance heating to a supply air setpoint.	Local thermostats for cooling and heating mode control. Heating control via duct mounted thermostat.	SF: Indoor in pump room.
	Electrical Room	No requirement.	Filtered supply air fan.	Ventilation cooling.	Local thermostats for cooling control and heating control.	SF: Indoor in electrical room.
Existing RAS/WAS Pump Station	Pump Room	6 ACH of 100% OSA per NFPA 820 Table 6.2(a) Row 9 b.	Heat pump AHU and exhaust fan.	AHU with economizer cooling and heat pump heating to a space temperature setpoint.	Continuous operation of both SF and EF. Heating via local thermostat. Monitored by EMP system.	AHU: Indoor in pump room. EF: roof mounted.

TABLE 4
 Descriptions of HVAC Design Intent
City of Bend Water Reclamation Facility

Building Name	Spaces	Ventilation Rate Criteria	Ventilation System Type	Heating & Cooling System Type	Operating Control	Equipment Mounting Location(s)
New Plant Water Pump Station	Pump Room	No requirement.	Filtered supply air fan and relief damper.	Ventilation cooling.	Local thermostats for cooling.	SF: Indoor in pump room.
Reuse UV Building	UV Treatment Room	No requirement.	Heat pump AHU and relief damper.	AHU with economizer cooling and heat pump heating to a space temperature setpoint.	Local thermostat for cooling and heating mode control.	AHU: Indoor in treatment room.
Chemical Building	Pump Room	No requirement as chemical quantity below exempt amounts.	Filtered supply air fan and relief damper.	Ventilation cooling and electric resistance heating to a supply air setpoint.	Local thermostat for cooling and heating mode control. Manual switch for user controlled ventilation.	SF: Indoor in pump room.
UV Electrical Building	Electrical Room	No requirement.	Filtered supply air fan and relief damper.	Ventilation cooling.	Local thermostat for cooling.	SF: Indoor in electrical room.

EMP = environmental monitoring panel..

RAS/WAS = return activated sludge/waste activated sludge

General Equipment Selection Criteria

Quality

Systems will be selected that exhibit high reliability and long service life. Process areas will be served by industrial grade heavy-duty equipment. Non-process areas will be served by commercial grade equipment.

Corrosion Protection

Protection from corrosion is a design criterion for the HVAC systems. All HVAC coils will be specified with a corrosion-resistant coating. HVAC supply ductwork will be aluminum for all process buildings. HVAC exhaust ductwork for all process building will be aluminum or stainless steel depending upon the odor and moisture levels. Paint will be applied to HVAC systems to protect materials exposed to outdoor conditions, or chemicals used in, or resulting from, the associated processes.

HVAC Materials

HVAC ductwork, diffusers, registers, and grilles will be aluminum.

Redundancy

HVAC systems will not be provided with any redundant systems or excess capacities to provide airflow or ventilation. Due to capacity limitations of Boiler 3, electric resistance heating will be provided as backup for systems that utilize hot water for heating.

Equipment Layout and Access

HVAC equipment will be located within the space served, adjacent to the space at the building exterior or on building rooftops where there is no other viable option. If equipment is located on a roof, it will have safe and easy access to equipment for service, removal, and replacement.

Energy Code Compliance

HVAC systems and equipment for all facilities shall be selected and specified to perform at levels dictated by the 2010 Oregon Energy Efficiency Specialty Code (OEESC).

NFPA 820 Requirements

Supervised Signaling

Chapter 7 of NFPA 820 requires supervised signaling and remote monitoring of NFPA 820 required ventilation and gas detection systems. Signaling systems must meet the requirements of NFPA 72. HVAC equipment associated with the required ventilation will be monitored for proper operation and provided with supervised signaling through an environmental monitoring system that is separate from both the HVAC control and plant supervisory control and data acquisition (SCADA) system.

Remote Monitoring

Chapter 7 of NFPA 820 requires remote alarm indication for ventilation failure and gas detection alarms. The environmental monitoring system shall provide an interface to the

plant SCADA system for transmission of both a system alarm and a system trouble condition for remote annunciation.

Space and Entry Alarms

Chapter 7 of NFPA 820 requires both space and entry alarms for ventilation failure and gas detection conditions. The interior alarms shall be both audible and visual. The entry alarms can be a go/no-go type warning light system. The alarms shall be active at any time that the ventilation systems are not properly functioning and upon gas detection or gas detector failure.

Hot Water Distribution Expansion

Hot water is produced in the digester complex with the existing boilers, fired primarily with digester gas. Hot water is distributed from the boiler to the new headworks facility for space heating and other uses. Excess digester gas is available on a continuous basis for use in the hot water system.

This project will extend and expand the hot water supply (HWS) and return (HWR) system to the following facilities:

- Upgraded solids building
- New and existing primary sludge pump stations
- New and existing primary effluent piping gallery (adjacent to the aeration basins)

This expansion is problematic as the connected load is already greater than the 2,069 mbh (thousand Btu per hour) capacity of Boiler 3 that provides the heating. The total connected load of the headworks and the digester facilities is estimated at about twice the boiler capacity. The heating loads of the facilities associated with this project add an additional 700 mbh of load or about 15 to 20 percent to the total load on the boiler. The current boiler system appears to handle the current loading and is likely able to handle the increased load in all but peak loading conditions. To prevent the possibility the system is overloaded during peak loading conditions by the additional connected load, the new loads shall be designed to be shed during the peak condition. Where required, the new systems will be backed up by electric resistance heating.

At the request of the City of Bend, the possibility of utilization of hot water for the administration building was considered. The HVAC systems within this facility appear to be the packaged heat pump type that does not already utilize hot water for heating purposes. Modification of these systems to accept hot water heating is an extensive process that may require modifications to the units themselves, installation of duct mounted hydronic coils and piping, and extensive modifications to the HVAC control systems within the building. Given the level of disruption to the systems and building required for this installation and the age of the systems involved, modification to accept hot water heating is not recommended. Provisions for future utilization of hot water heating at this facility will be included as part of this project.

Noise Control

Although some equipment noise is inevitable in process spaces and mechanical rooms, noise levels are considered an important mechanical design criterion. HVAC systems serving

occupied areas are designed to meet average noise criteria levels recommended by ASHRAE. For spaces not listed by ASHRAE, noise from equipment is controlled to comply with OSHA requirements.

Where efficient HVAC equipment selection does not result in acceptable noise levels and in process areas where equipment noise can escape through HVAC openings, sound attenuation devices such as acoustical louvers or duct silencers will be used to reduce noise levels.

Instrumentation and Control Strategy

All HVAC systems will be fully integrated into the plant SCADA system for control. All HVAC system will be treated as a process and provided with a process and instrumentation diagram (P&ID). Standard HVAC control methodology with third party integration will not be allowed.

Plumbing Systems

Plumbing Scope

The plumbing discipline for this project includes with some exceptions, the following services inside the building and through the building wall or slab edge:

- W1 – potable water
- W2 – potable well water
- W4 – service (plant) water
- PD – plant drain

The exceptions include:

- Where indicated, portions of W1 and W2 with process valves or instrumentation
- Process drains that are integral to the process
- Piping from building face across the site as included with yard piping design

Insulation Materials

Insulations shall be specified for the following piping:

- Small diameter W1, W2, and W4 in exposed locations. This insulation will consist of elastomeric foam with aluminum jacket (exterior) or polyvinyl chloride (PVC) jacket (interior).
- Hot water supply and return in exposed locations. This insulation will consist of fiberglass with aluminum jacket (exterior) or polyvinyl chloride (PVC) jacket (interior).
- Hot water supply and return in buried locations. The insulation will be part of the pre-insulated piping system.

Fluid Services Description

Site distribution of potable water, plant water, hot water, and compressed air is addressed in *TM 11 – Plant Water, Potable Water, Hot Water, and Compressed Air*. This technical memorandum addresses piping requirements for the following systems.

Potable Water (W1, W2)

Potable water is available from two sources. This water is utilized for all potable water uses such as restrooms, emergency showers, eyewashes, service sinks, drinking fountains, etc. Some processes may utilize potable water. Appropriate backflow prevention will be provided to protect the potable water system in these cases. In exposed exterior locations the piping will be insulated and heat traced.

Service (Plant) Water (W4)

W4 is water that is reclaimed from the treatment process effluent flow stream. Reclaimed water has been purified, filtered, and disinfected in accordance with applicable standards. It becomes W4 when it enters the service water pump system and is used for hose stations, fire protection, and for various process uses. In exposed exterior locations, the piping will be insulated and heat traced.

Hot Water Supply and Return (HWS, HWR)

Hot water is used for process and HVAC heating requirement. This water is generated within the digester building and is distributed across the site for various heating uses. A pre-insulated HDPE/PEX (high density polyethylene/cross linked polyethylene) arctic piping system will be used for buried portions of this system.

Plant Drain (PD)

Process area floor drains, hub drains, and other PDs are not considered sanitary drains as described by the International Plumbing Code (IPC). Therefore, to prevent blockages, they will not be trapped and vented as sanitary systems when the process area is continuously ventilated at 6 air changes per hour or greater. Corrosion resistant materials will be used to protect the system against corrosion from chemicals.

Equipment

Emergency Safety Equipment

- Combination emergency safety shower/eyewash units located in process areas will require a water flow alarm. Each water flow alarm device will consist of the manufacturer's standard product. Power requirements will be coordinated with the electrical supply available to each area. Remote monitoring of the emergency safety shower/eyewash units will be provided by a plant-wide process and instrumentation control system. Locations will include the sodium hypochlorite pump room.
- Potable water supply will be used directly for all emergency safety equipment. Per the ANSI Z358.1-2009 Standard for Emergency Eyewash and Shower Equipment, the maximum and minimum allowable temperature for the delivered flushing fluid is from 38°C (100 degrees Fahrenheit [°F]) maximum to 16°C (60°F) minimum. Therefore, CH2M

HILL concludes that heating of the potable water is required. Potable water to emergency safety equipment will be insulated and heat traced when exposed outdoors. An instantaneous electric water heater will be provided for each shower.

Hose Station Application

- Outdoor hoses will generally be frost-free 1.5-inch yard hydrants. Flow rate allocated to a 1-1/2-inch hose is 100 gallons per minute (gpm).
- Indoor hoses will be 1-inch diameter. Flow rate allocated to a 1-inch hose is 20 gpm.
- Hose stations will use W4 plant water.

Process Buildings Application

- Building floor drainage will be routed to a process drain system.
- Emergency safety shower/eyewash units will be strategically located at chemical use areas inside of the building, and outside at the chemical storage and unloading area. Flow and location will comply with ANSI Z358.1-2009.
- Spill containment areas will be included for chemical storage tanks as required by the building code. Drains from these containment areas will include a manual valve and be chemical-resistant. After inspection, the sump can be pumped out, or manually drained to the truck loading containment tank. A position switch will be provided on the manual drain valve to alert operators to an open valve position to prevent accidental release of chemicals to the drain system.

Fire Suppression Systems

There are no facilities identified that require automatic fire suppression sprinkler systems. All new facilities will be provided with yard hydrant coverage. Yard hydrant spacing will be 500 feet maximum or as required by the Authority Having Jurisdiction (AHJ), whichever is more stringent. A minimum of 1,500 gpm of water will be required for a duration of not less than 2 hours.

Outstanding Issues

Confirmation that W4 water is approved by the AHJ for use as a fire protection water supply per the requirements of Section 507.1 of the 2010 Oregon Fire Code.

TM 18 – Electrical Design Criteria

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PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

This technical memorandum details the electrical approach to new facilities at the Bend Water Reclamation Facility (WRF). The objective of this technical memorandum is to tailor the design approach to the specific needs of this project. This technical memorandum will discuss the following:

- Design Criteria
- Codes and Standards
- Design Approach
- Outstanding Issues

Design Criteria

The basic goals of the design criteria are:

1. Develop safe, reliable, and maintainable electrical systems.
2. Promote a consistent and uniform design approach and standardize the types and quality level of equipment specified.
3. Establish a uniform basis for specifications and drawings.
4. Provide a means of incorporating client input on items of preference and experience.

Listed and Labeled Equipment

Electrical equipment, materials, or services to be provided will have an attached label, symbol, or other identifying mark of an organization that is concerned with product evaluation, compliance with appropriate standards, and performance of the equipment. Typically, this is the Underwriters Laboratories Label or Listing (UL). In situations where a UL Label or Listing cannot be provided for equipment because of a lack of UL standards, then testing will be performed by an organization that is acceptable to the authority having jurisdiction.

Calculations

Calculations will be prepared in accordance with the project instructions. Calculations will be reviewed by a senior engineer; the engineer’s initials and the date of the review will be added to each calculation sheet.

Distribution Voltage Selection

Standard distribution systems to be used are:

- 12.47 kilovolts (kV), ungrounded delta, 3-phase, 3-wire.
- 480 volts (V), ungrounded delta, 3-phase, 3-wire.
- 480Y/277 V solidly grounded wye, 3-phase, 4-wire.
- 208Y/120 V solidly grounded, 3-phase, 4-wire.

Utilization Voltages

The equipment utilization voltages listed in Table 1 will be used.

TABLE 1
Equipment Utilization Voltages

Equipment	Utilization Voltage
Fluorescent Lighting	120 volts, single-phase
High Intensity Discharge Lighting	120 volts, single-phase
Convenience Outlets	120 volts, single-phase
Motor Control	120 volts, single-phase
Motors, less than 1/2 hp	120 volts, single-phase
Motors, 1/2 hp and larger	480 volts, three-phase

hp = horsepower

Voltage Drop

Prepare steady state voltage drop calculations for all heavily loaded or long branch circuits and feeders. Base calculations for motor circuits on the basis of an 80 percent power factor and loading consistent with the maximum expected peak load (will not include standby motors). Do not exceed the following total voltage drop from the transformer secondary to the point of utilization including feeder, branch circuit, and transformation:

- Lighting 3 percent
- Motors 4 percent
- Receptacles 4 percent
- Electric Heaters 4 percent

Make voltage dip calculations for motor starting whenever an individual motor exceeds 20 percent of the serving transformer capacity.

Demand Factors

The demand factors listed in Table 2 will be used for sizing power switchboards, motor control centers (MCCs), panelboards, and transformers. Connected load will be used for circuit and equipment sizing per National Electrical Code (NEC) requirements.

TABLE 2
Demand Factors

Service	Demand Factor
Lighting	1.0 x Connected Load
Emergency Lighting	1.0 x Connected Load
Air Conditioning Equipment	1.0 x Connected Load
Ventilation Equipment	1.0 x Connected Load
Drainage Pumps and Ejectors	0.50 x Connected Load
Convenience Receptacles	180 volt-amperes each*
Process Loads	1 x full load amps of non-standby loads plus 25% of largest motor

*Apply NEC demand factor of 50% for totals over 10 kilowatts.

Provide 10 to 20 percent spare/space capacity at switchboards, MCCs and, panelboards.

Metering

Provide multifunction digital meters for all switchboard and MCC mains. All meters will be Allen Bradley and communicate via Ethernet to the programmable logic controller (PLC) to report energy consumption. The plant's existing standard is Allen Bradley Power Monitor 3000.

Branch Circuits

- Connected load and NEC requirements will be used for sizing branch circuit breakers and conductors.
- A minimum wire size of No. 12 American wire gauge (AWG) copper will be used for lighting and receptacle branch circuits. No. 10 AWG will be used when voltage drop requires a larger conductor on lighting circuits, and when receptacle circuits are longer than 75 feet. Where electronic ballasts are specified for fluorescent or high-intensity discharge lighting, a dedicated neutral will be provided for each lighting circuit; NO common neutral for multiple lighting circuits.
- In general, lighting branch circuit loads will be limited to 1,500 watts.
- Lighting and receptacle branch circuits will not be combined.
- The number of convenience receptacles on any one branch circuit will be limited to five duplex.

Panelboards

- Each panelboard will be equipped with a minimum of 20 percent spare breakers with spaces, bus work, and terminations to complete the standard size panelboard.
- Panelboard schedules indicating circuit identification, protective device trip rating, number of poles, load in volt-amperes by phase, rating of main lugs or main circuit breaker, neutral bus size, ground bus size, and integrated short circuit rating of the panelboard will be prepared.

Equipment Identification

Instrumentation and control (I&C) process and instrumentation diagram (P&ID) tag numbers will be used for motors, I&C devices, and other process equipment shown on electrical drawings. This same numbering method will be used to create unique tags for major electrical distribution equipment.

Cable Tray and Raceway Systems

- Electrical design will maximize the use of cable tray per client request.
- A minimum of 25 percent future space will be provided in cable trays.
- Power and 120 V control cables will be run in separate trays from analog and 24 volt direct current (VDC) control cables.

Separate duct banks and manhole networks will be used for the following systems:

- 12.47-kV power distribution
- 480-V power wiring and 120-V control wiring
- Communications systems, including low voltage signal for fire alarm, telephone and data systems, and fiber optic cabling

General guidelines for raceway sizing, selection, and installation are given below:

- Conduit sizing will be based on THW insulation.
- The following minimum sizes will be used:
 - 3/4-inch minimum diameter for conduit installed exposed on walls and ceilings
 - 3/4-inch minimum diameter for conduit concealed in frame construction and finished ceilings
 - 1-inch minimum diameter for conduit embedded in masonry, encased in concrete, and underground
- Raceways will be exposed in process areas.
- Polyvinyl chloride (PVC) -coated rigid galvanized steel conduit will be used for the transition from underground direct burial and under slab PVC conduit and concrete encased (in floor slab) PVC and rigid galvanized steel conduit to exposed rigid galvanized steel conduit. The transition section will extend from 1 foot below grade or

top of floor slab or the last foot of conduit in the floor slab, to 6 inches out of the floor slab, concrete encasement, or above grade.

- The number of conduit bends will be limited to an equivalent of 270 degrees on long runs without pull boxes.
- PVC-coated rigid galvanized steel conduit and fittings that are resistant to direct sunlight and include an interior urethane coating will be used in exposed corrosive interior and exterior areas.
- PVC-coated rigid galvanized steel conduit will be used for underground direct burial low-voltage status/control (less than 100 V) and analog signal circuits.
- PVC Schedule 40 conduit and fittings will be used for underground direct burial, under slab, and concrete-encased 120-V circuits.
- PVC Schedule 40 conduit and fittings will be used for underground concrete-encased 480 V power circuits.
- PVC Schedule 40 conduit and fittings will be used for underground concrete-encased 13.2-kV power circuits.
- Rigid galvanized steel conduit and fittings will be used when exposed or concealed in interior non-corrosive process and non-process areas, and in non-corrosive areas outdoors.
- Flexible, nonmetallic, liquid-tight conduit 4-inch or smaller in size will be used for connections to motors, transformers, etc., as required. Fittings will be PVC-coated in wet or corrosive areas.
- Underground conduit routes will be identified nonmetallic warning tape above underground direct burial conduits.
- Spare raceways will be tagged with a nonferrous metal tag attached to the raceway with a nylon strap. Raceway tags with approved tag number provided by the contractor will identify the raceway origin and destination and will be located at each terminus, near the midpoint, and at minimum intervals of every 50 feet on exposed raceways (in ceiling spaces and surface-mounted).

Wire and Cable

- Stranded copper conductors will be used for all except lighting and receptacle wiring. Solid conductors #10 AWG and smaller will be used for lighting and receptacle wiring.
- Minimum conductor size of No. 12 AWG will be used for power and lighting branch circuits. Type THHN/THWN-2 insulation will be used for No. 10 AWG and smaller conductors (conduit will be sized for Type THW conductors). Type XHHW-2 insulation will be used for No. 8 AWG and larger conductors (conduit will be sized for THW conductors). 60°C conductor ampacity ratings will be used for sizing conductors No. 1 AWG and smaller. 75°C ratings will be used for sizing conductors larger than No. 1 AWG.

- Minimum conductor size of No. 14 AWG will be used for individual 120-V control circuits.
- 24 VDC control wiring will be run separate from 120 V signals.
- Minimum conductor size of No. 12 AWG will be used for 120-V control circuits routed in a common conduit with the power conductors to the motor circuit controls. Combining individual motor power and control conductors in a common conduit will be done up to a maximum power conductor size of #2 AWG.
- Power and control conductors will be color-coded. Conductors No. 8 AWG and smaller will have colored insulation. Conductors No. 6 AWG and larger will be color-coded with tape at each end and at accessible intermediate points.
- Conductors and control cables will be tagged with a permanent sleeve or nylon marker plate attached with a nylon strap. Conductor tags with approved tag number will be provided by the contractor and will be located at each termination and in accessible locations.
- Under normal conditions, the maximum wire size will be limited to 500 kcmil (1,000 circular mils). Parallel conductors will be used for circuits requiring greater capacity.
- 120-V control circuits will be combined in control cables containing multiple #14 AWG stranded copper conductors with type THHN insulation and a common PVC outer jacket.
- 600 V multi-circuit control cable will be used where grouping control circuits is practical, and the number of individual wires exceeds six conductors. When selecting control cable size, 25 percent spare (plus or minus 10 percent) conductors will be used.
- Multi-conductor control cable color coding will be ICEA S-61-402 Appendix K, Method 1, Table K-2.
- Low voltage status/control (less than 100 V) and analog signal circuits will be routed in 600-V single twisted shielded pair instrumentation control cables. The cables will consist of #16 AWG stranded copper conductors with combination PVC/nylon insulation, drain wire, shield, and PVC outer jacket. Signal circuits will be combined in multi-twisted shielded pair instrumentation control cables with common overall shield. The cables will consist of #18 AWG stranded copper conductors, with a combination PVC/nylon insulation, pair and common drain wires, pair and common shields, and PVC outer jacket. Instrumentation control cables will be per ICEA S-82-552. Low voltage status/control and analog signal circuits will not be routed in the same control cable or conduit with 120-V control or power circuits. Low voltage status/control and analog signal circuits will be routed in the same conduit, but not in the same control cable.
- Adequate separation of power and I&C wiring will be provided to avoid signal interference. Long parallel runs will be avoided, and analog wiring will be installed in steel conduit.
- Shielded power cables will be used between adjustable frequency drives and the driven motor.

Color Coding

Conductor insulation colors shall be as shown in Table 3.

TABLE 3
System Color Coding

System	Conductor	Color
All Systems 208Y/120 V	Ground	Green
	Neutral	White
480Y/277 V	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral	White
	Phase A	Brown
12.47 kV	Phase B	Orange
	Phase C	Yellow
	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow

Circuit Identification

- Assign circuit name based on device or equipment at load end of circuit. Identify circuit at each termination and in accessible manholes and pull boxes. Use plastic sleeves for conductor #3 AWG or smaller and plastic marker plates for larger conductors.
- For lighting circuits the panel and circuit number will be identified for each fixture.

Enclosures

- National Electrical Manufacturers Association (NEMA) 1 enclosures will be used for equipment in electrical rooms and finished areas.
- NEMA 12 enclosures will be used for electrical equipment in dry industrial locations.
- NEMA 4 enclosures will be used for outside and in wet locations, and NEMA 4X enclosures will be used for corrosive locations.

Fiber Optic Cabling

- Where used, fiber optic cabling will be installed in conduit (2-inch-diameter minimum) with inner duct. Routing of the raceway system shall provide for large radius turns to prevent breaking of the fiber optic cable.

Convenience Receptacles

- General service duplex receptacles will not be spaced more than 50 feet apart in process areas. Receptacles will be surface-mounted on walls or columns.

- Waterproof receptacles will be installed in damp areas or areas subject to wash down.
- Outlet-mounted ground-fault circuit-interrupters (GFCIs) will be provided where required by the NEC. Panelboard or feed-through type devices will not be used.

Distribution System Protection

General

- Equipment will be selected with adequate momentary and interrupting capacity for the point in the system where it is used. Series rated criteria will not be used, except for self-contained equipment.
- Phase and ground fault protective devices and device settings will be selected that will function selectively to disconnect that portion of the system that is malfunctioning with as little disturbance to the rest of the system as possible.

Preliminary Fault and Coordination Analysis

- A preliminary analysis of the fault duty and device coordination will be made to produce a design that can be accurately bid by the contractor.
- Maximum fault duty will be analyzed with sufficient accuracy to establish the required interrupting ratings of circuit protective devices specified. An infinite bus will be assumed on the source (primary) side of the utility service substation transformer.
- Final coordination studies based on actual equipment purchased will be made by the contractor to establish the range of protective device settings that will result in reasonable selectivity of device operation for both three-phase and ground faults. The following protective device characteristics will be specified:
 - Protective relay type, coil tap range, and time dial range
 - Circuit breaker frame size, trip setting range, time delay ranges

Motor Protection and Control

General

- Each motor will be provided with a suitable controller and devices that will protect the equipment and perform the functions required.
- MCC-type construction will be used.
- MCCs located in the same room with the switchboard that powers them will not have a main circuit breaker. MCCs located in areas remote from the common MCC or switchboard that powers them will have a main circuit breaker.
- MCCs will include feeder circuit breakers and motor starters. Motor starters for motors through 50 horsepower (hp) will be the full voltage, non-reversing, combination type with magnetic-only circuit breaker. Motor starters for motors larger than 50 hp will be the solid-state, soft-start, reduced voltage, combination type with magnetic-only circuit breaker.

- Motor starters will include an ON/OFF/REMOTE or HAND/OFF/REMOTE selector switch with control devices (START/STOP pushbuttons) for operation in the HAND mode, RED motor ON light, GREEN motor OFF light, and AMBER alarm light. Lights will be the push-to-test type. These devices will be mounted on the front of the motor starter control center cubical.
- Variable frequency drives (VFDs) will be Allen Bradley Power Flex and communicate via ethernet connection to the PLC.
- Hard wired safe off relays will be used for Run/Stop command for VFDs. If Smart Motor Control is selected, hard wired safe off relay options will be evaluated for MCC starter buckets.
- Currently at Bend WRF, input/output (I/O) from MCC buckets to PLC are hard wired. MCC manufacturers like Allen Bradley are moving towards networked Ethernet connections for I/O for MCC buckets (Smart Motor Control). Smart Motor Control using Ethernet is recommended for new MCC's added as part of the secondary expansion project. Further evaluation of Smart Motor Control will be completed during the next phase of design.

The advantages to using smart motor control are:

- Easier installation by eliminating excess I/O wiring at MCC's and PLC cabinets
- Reduces the number of I/O modules and the amount of terminal space required at PLC's
- Increases amount of information that can be monitored by the PLC without adding additional conduit and wire
- Reduces amount of conduit and wiring between PLC's and MCC's

Overload Protection

- Each constant speed motor, 50 hp and larger, and all adjustable frequency drive motors will be provided with thermal overload protection in ungrounded phases.

AC Induction Motors

General

- Enclosures for both horizontal and vertical motors 25 hp and smaller will be totally enclosed, fan cooled (TEFC) severe duty for indoor and outdoor locations. In wet and/or corrosive locations, chemical industry severe-duty (CISD-TEFC) motors will be used.
- Motors larger than 25 hp will be open drip-proof, unless TEFC or CISD-TEFC is required for specific conditions (evaluated on a case-by-case basis considering cost and required physical protection). Submerged motors will be totally submersible, air- or oil- sealed. Bearings will be rated 100,000-hour Anti-Friction Bearings Manufacturers' Association (AFBMA) B-10 life.

- Motors will be provided with disconnect plug and receptacles for easy motor replacement as requested by city and as has been successfully used in other facilities onsite.

Alternating current (AC) induction motors will be the premium efficiency type with the following:

- Motors will have a 1.15 service factor.
- NEMA design letter to fit the application (usually NEMA design B), and locked rotor kV-amps (kVA) Code G or lower.
- Motors will be cast iron.
- Bearings for horizontal and vertical motors will be grease-lubricated, with grease addition and relief fittings.
- Motor windings will be copper wire. Aluminum windings are not acceptable.
- Motors 15 hp and larger located in damp or wet areas will be provided with 115-V space heaters to prevent moisture condensation.
- TEFC motors will be equipped with weep holes and drain plugs to withdraw condensed moisture.

Grounding

Electrodes

- A ground ring will be installed around every new building or facility onsite. This ground ring will consist of a bare copper ground wire and driven ground rods at each corner and intervals between at a minimum of 100 feet. Conductors from the ground grid will be connected to the neutral of 480/277-V step-down transformers and 208Y/120-V distribution transformer secondaries, and to each end of the MCC and switchboard ground buses.
- Grounding electrode ground mats or embedded rods and cables will be designed for a maximum resistance to ground of 3 ohms. Where more than one rod is required, rods will be installed at least 20 feet apart. Minimum of No. 3/0 AWG stranded bare copper cable will be used for interconnecting to ground rods and footing rebar.

Equipment Grounding

- A separate ground conductor sized in accordance with NEC requirements will be installed in raceways for power feeders and branch circuit raceways for motor control, lighting, and receptacle loads.
- Shields of shielded instrumentation cables will be grounded to the ground bus at the power supply for the analog or low voltage discrete signal circuit. Shielded instrumentation cables will not be grounded at more than one point.

Lighting

General Requirements

- Lighting design will be consistent with the high-efficiency lighting energy-saving project.
- Interior and exterior areas will be provided with lighting. Interior lighting will include switched lights, continuous-on lights, emergency egress standby lights, and exit lights. Emergency standby and exit lights will each include a battery charger and battery. Exterior lighting will include photocell-controlled lights mounted on buildings near doors or on structures. For areas that have HID lighting, a percentage of the fixtures will include instant on quartz lamps to provide minimal lighting while HID fixtures warm up.
- Lighting levels in maintained foot-candles will be designed to meet recommendations of the Illuminating Engineering Society of North America (IESNA) 8th edition, 1993, IES Lighting Handbook, and the guidelines given herein.
- Exterior lights will be sharp cut-off type to minimize light trespass outside the plant site. Exterior lighting will be laid out to minimize any impacts to future site expansions, both above and below grade. Exterior lighting will include photocell control.
- Luminaires are to meet UL requirements for intended use.

Lighting Calculations

Recommended foot-candle levels for each space will be calculated for maintained illumination per IESNA procedures. The following assumptions will be made, unless specific information is available:

- Reflectances for finished rooms:

Ceilings	80 percent reflectance
Walls	50 percent reflectance
Floors	20 percent reflectance
- Reflectances for unfinished rooms:

Ceilings	50 percent reflectance
Walls	30 percent reflectance
Floors	10 percent reflectance
- Maintenance factor (light loss factor):

Fluorescent lighting	.80
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High-Intensity Discharge Lighting

- Spaces will be addressed on an individual basis as to whether general room lighting is adequate. Spaces where work locations are identified will be designed for additional task lighting.

- Interior lights in large process areas, non-process areas, and finished areas will be fluorescent type powered at 120 V and controlled by local switches. These lights will be provided with energy-efficient electronic ballasts and type T8 fluorescent lamps.

Emergency Lighting System

- Emergency illumination will be provided in appropriate spaces, as required by code to provide life safety, property, and equipment protection.
- Adequate lighting levels will be provided to maintain safe building egress and critical process plant functions. Emergency lighting will be located near MCCs and any equipment locations that need to be monitored on a continuing basis.
- In large process areas, fixtures with emergency battery packs and lighted exit signs with a battery pack will be provided. The battery pack will power the lights for a minimum of 90 minutes.

Exterior Illumination

- Outdoor illumination will be provided in areas that require 24-hour attention. These areas include walkways, ladders, catwalks, and others.
- Exterior lighting will be the high-pressure sodium (HPS) type powered at 277 V, single-phase and controlled by a photocell. Exterior lighting will have sharp cutoff shrouds to limit the migration of light.

Circuiting and Switching

- Each room will be circuited and switched to provide adequate lighting for the anticipated use, and reduced or no lighting when not occupied by switching alternate luminaires, or by switching alternate ballasts.
- Exterior lighting will be controlled by an ON/OFF/AUTO selector switch and roof-mounted photocell. In the AUTO mode, lights turn on at dusk and off at dawn via the photocell.

Lamps

- Energy-efficient lamps will be installed in fluorescent light fixtures.
- HPS lamps are preferred for exterior lighting.

Ballasts

- Energy-efficient two-lamp fluorescent ballasts will be used whenever possible. Fluorescent ballasts are sound-rated by a letter code with "A" used to designate the quietest and "D" for the loudest. Lamp ballasts with a code designation of "A" will be used whenever possible.

Lamp/Luminaire Combinations

The following conditions will be considered in selecting lamp/luminaire combinations:

- Higher lumen per watt and high output type fluorescent lamps will be used whenever possible.
- Fluorescent luminaires will be used in damp area applications with an enclosed and gasketed lamp compartment. Fluorescent lamps will not be exposed to the weather.
- Types of lamps will be kept to a minimum to reduce the inventory requirements for spares.

Fluorescent Luminaires

- Fluorescent recessed luminaires will be used in office-type areas with lay-in ceilings. Door frames hinged with positive latching, no lift-and-shift door frames will be used.
- Fluorescent “enclosed and gasketed” luminaires of non-metallic-type construction will be used for applications in locations subject to saturation with water, or such locations exposed to weather and unprotected. Units will be specified to carry the UL “suitable for wet locations” label.

Luminaire Schedule

- Luminaires used on this project will be listed and described on a luminaire schedule with lamp type, voltage, mounting, and manufacturer listed.

Lighting Levels

Design lighting levels in maintained foot-candles will be as shown in Table 4.

TABLE 4
Design Lighting Levels

Area	Foot-Candles
General Lighting	20
Corridors	10
Storage	20
Process Areas	30
Pump Areas	30
Electrical Room	40
Mechanical Room	30

Codes and Standards

The facility will be designed in accordance with the following applicable building codes and standards:

Codes

- 2011 National Electrical Code (NEC)

- 2009 Life Safety Code (NFPA-101-HB85)
- International Fire Code (IFC)
- National Electrical Safety Code (ANSI C2-1987)
- 2008 Standard for Fire Protection in Wastewater Treatment and Collection Facilities (NFPA 820)

Standards

- American National Standards Association (ANSI)
- National Electrical Manufacturers Association (NEMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Instrument Society of America (ISA)
- Insulated Cable Engineers Association (ICEA)
- Occupational Safety and Health Administration (OSHA)
- American Society for Testing Materials (ASTM)
- Underwriters Laboratory (UL)
- Illuminating Engineering Society (IES)
- National Fire Protection Association (NFPA)

Design Approach

Site Electrical Work Required

In order to power the new loads associated with the Secondary Expansion Project, a new 12.47 kV Utility Switch/Interrupter will be installed adjacent to the existing Utility Switch SW-FL. This new switch will be powered from the spare switch available on SW-FL and will be used to power the new ultraviolet (UV) building transformer.

New Blower Building

A new 12.47 kV-480 V pad mount, oil filled transformer will be installed outside the new blower building adjacent to the new electrical room. This transformer will be fed from the primary side of the existing blower building transformer TX-B. The new transformer will feed a new switchboard and all new loads associated with the new blower building will be powered from this switchboard.

New UV Building

A new 12.47 kV-480 V pad mount oil filled transformer will be installed outside the new reuse disinfection building adjacent to the new electrical room. This transformer will be fed from the new utility switch mentioned above. The new transformer will feed a new switchboard and all new loads associated with the new reuse disinfection building will be powered from this switchboard.

The new plant water pump station, hypochlorite building, and PLE disinfection facilities will be subfed from the new UV electrical room switchboard.

New PLE Disinfection Facility

- New switchboard subfed from the switchboard in the reuse disinfection building
- New generator and automatic transfer switch for standby power.

New Primary Sludge Pump Station

New MCC will be subfed from MCC-SP in existing sludge pump station. MCC-SP is currently on standby power.

New Hypochlorite Facility

- New panelboard subfed from new MCC in the PLE disinfection facility.
- Will be on standby power from new generator at PLE disinfection facility.

New Loads in Existing Solids Building

New loads will be fed from MCC-SH, which is currently on standby power.

Standby Power

In order to accommodate the Class 2 Reliability Standards, the following loads being added as part of the secondary expansion project will have provisions to be powered by a standby generator:

- W4 pumps and motorized strainer in new plant water pump station (PWPS)
- New hypochlorite facility
- New PLE disinfection UV
- New primary sludge pump station (PSPS)
- New loads in the existing solids building

A new generator and automatic transfer switch will be added adjacent to the PLE disinfection facility to back up the PWPS, new hypochlorite facility, and new PLE disinfection UV. Preliminary calculations indicate a 500 kW generator will be required. The new generator will be provided with a sub base fuel tank with fuel storage capable of running generator for 24 hours.

The MCC in the new PSPS will be fed from existing MCC-PSP, which is currently backed up by the existing generator. The new loads in the existing solids building will be fed from MCC-SH, which is currently backed up by the existing generator.

See attachments for equipment and facilities currently on (and proposed to be on) standby power.

Area Classification

Table 5 lists the classification for different areas that will be used to determine the type of enclosures, and other electrical and I&C materials used on this project.

TABLE 5
Area Classifications

Process Area	Classification
Primary Sludge Pump Station	Unclassified due to ventilation/noncorrosive/wet
Primary Clarifier	Class 1, Division 2 (18 inches above water surface and 10 feet horizontally from wetted walls)/corrosive/wet
Solids Handling Building	Unclassified/corrosive/damp
Disinfection	Unclassified/noncorrosive/dry
Plant Water Pump Station	Unclassified/noncorrosive/wet
PLE UV	Unclassified/noncorrosive/wet
Blower Building	Unclassified/noncorrosive/dry
Aeration Basin	Unclassified/corrosive/wet
Hypochlorite Facility	Unclassified/Corrosive/Wet

Addition of Second Utility Feed

Currently, all primary switching, conduit and cabling, all primary transformers, and all secondary conductors from the pad mounted transformers to the main breaker are owned and maintained by Central Electric Coop (CEC). All modifications to this part of the distribution system must be coordinated with CEC. Preliminary coordination with CEC indicates that their system engineer would dictate the configuration of the primary system.

CH2M HILL has provided CEC with all necessary information and is waiting for their system engineer to provide options for adding a second utility feed. Preliminary coordination with CEC indicates that a second utility feed is available adjacent to the airport, but would need to be extended approximately 1.5-2 miles.

Outstanding Issues

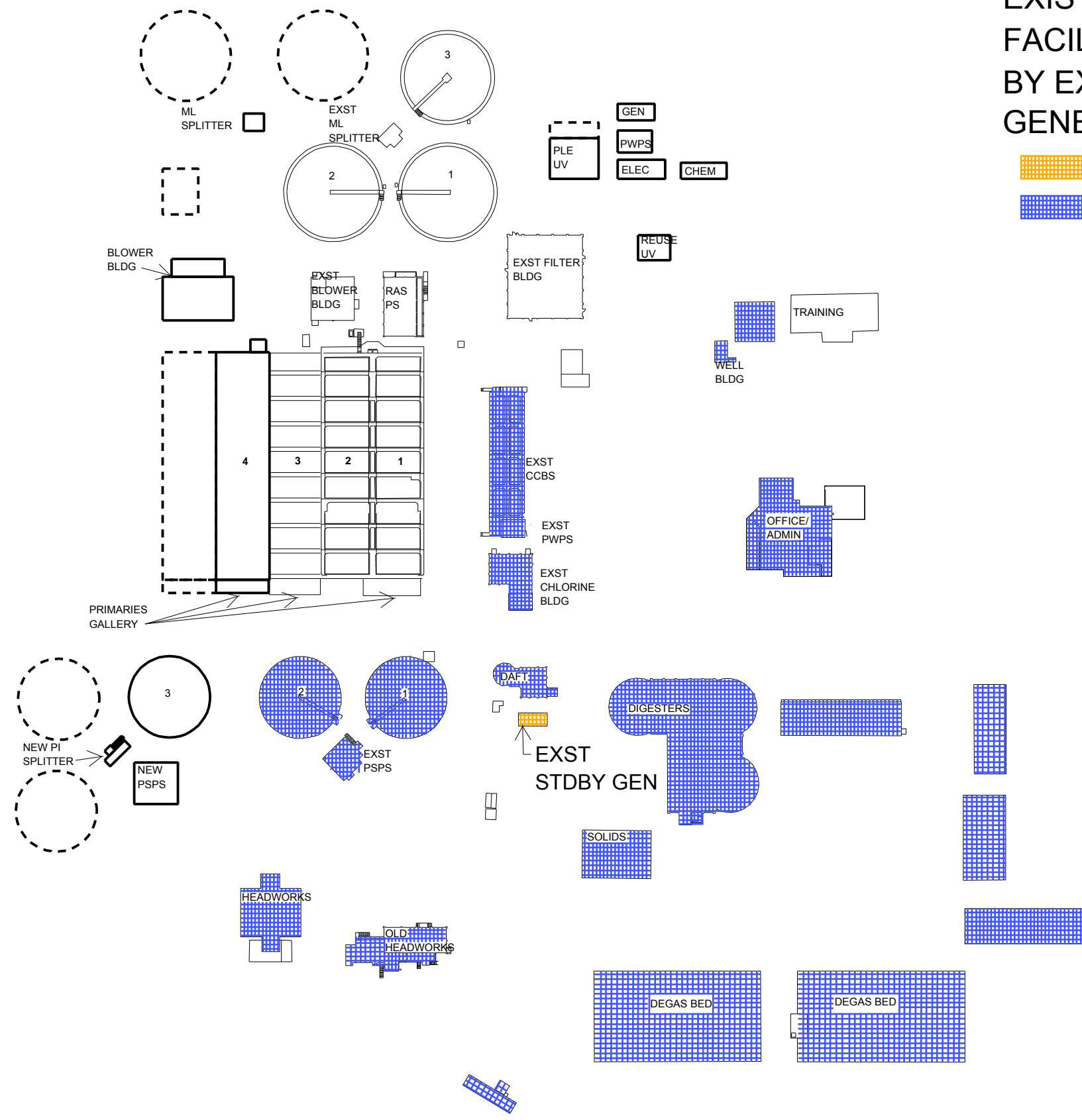
- Approval by Central Electric Cooperative (CEC) of proposed new services. Anticipated load calculations provided to CEC.
- Resolve potential new redundant electrical feed from a separate substation to WRF facility. Results of new electrical feed may allow reduction in standby power requirements.
- Standby power evaluation
- Decision on Smart Motor Control (Ethernet vs. hardwired I/O).
- Approval from plant staff on proposed new generator adjacent to plant water pump station.

Attachments

- Existing Standby Power Schematic

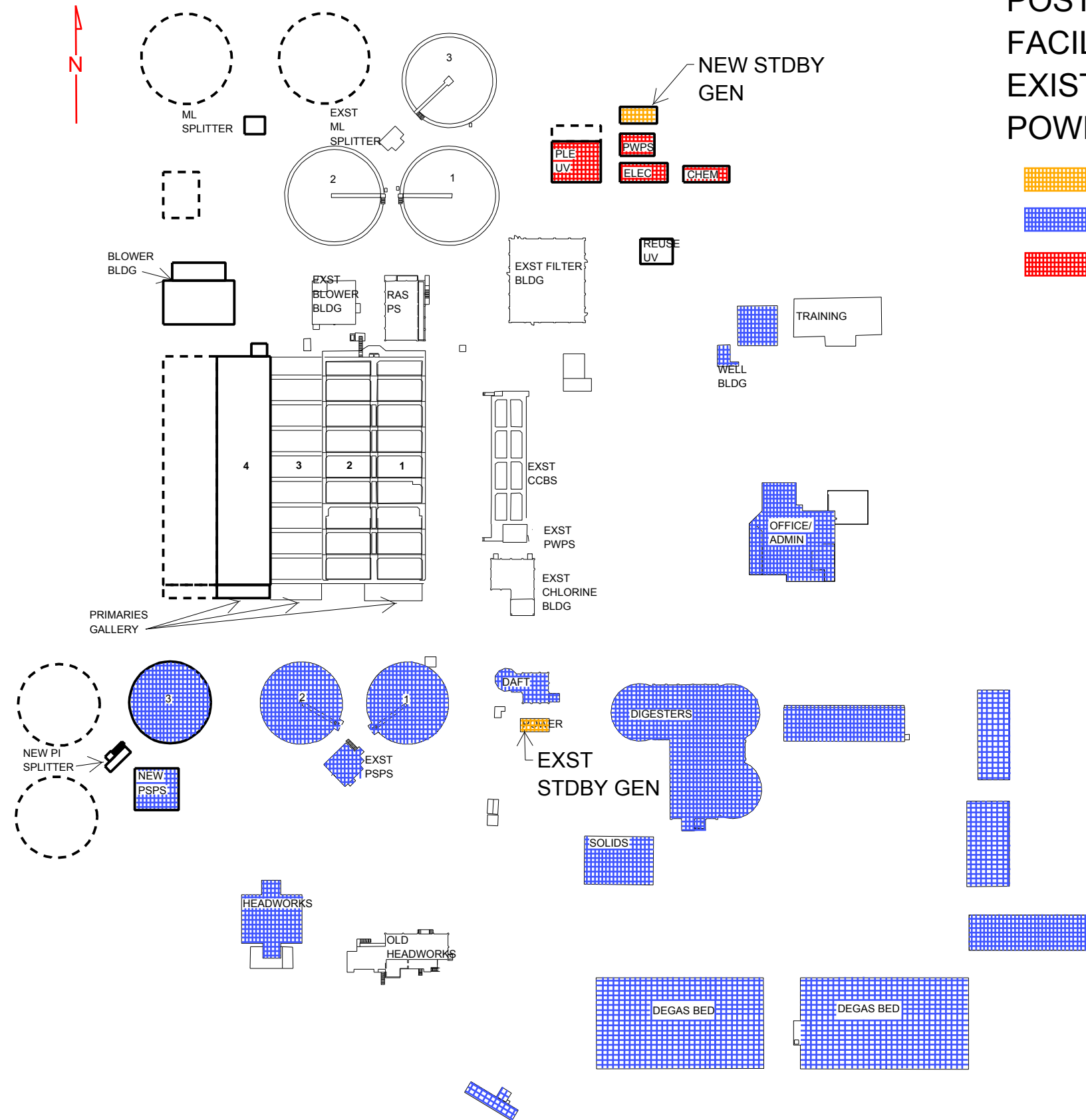
- Proposed Standby Power Schematic
- List of Equipment on Standby Power

Attachments



EXISTING WRF FACILITY:
FACILITIES CURRENTLY SERVED
BY EXISTING STANDBY POWER
GENERATOR

-  STDBY GEN
-  EXST STDBY GEN POWER



POST-WRF EXPANSION:
FACILITIES SERVED BY
EXISTING AND NEW STANDBY
POWER GENERATORS

- STDBY GEN
- EXST STDBY GEN POWER
- NEW STDBY GEN POWER

Major Equipment (and MCC's) on Standby Power

Equipment (and MCC's) on Existing Generator	
Equipment Required by EPA Reliability Requirements	Equipment Not Required per EPA

Existing Equipment

Existing Primary Sludge PS (MCC-PSP):
 Primary Clarifier No. 1 - rake arm
 Primary Clarifier No. 2 - rake arm
 Scum Pump No. 1 (Being installed)
 Existing Air Diaphragm Sludge Pump 1
 Existing Air Diaphragm Sludge Pump 2

Existing Plant Water PS: (MCC-PW)

Plant Water Pump No.1
 Plant Water Pump No.2
 Plant Water Pump No.3
 Sample Pump
 Basin Cleaner Pump
 Rapid Mixer
 Residual Analyzer
 Sampler
 Propeller Meter
 Roof Exhasuer EF-17
 Chlorine Hoist
 Storage Room Emergency Exhauster
 Chlorinator No.1
 Chlorinator No.2
 Chlorine Leak Detector No.1
 Chlorine Leak Detector No.2
 Control Room Emergency Exhauster

Digester Building (MCC-D and MCC-D1):

Waste Gas Burner
 Air Compressor No.1
 Air Compressor No.2

Headworks Building (MCC-HW):

Chemical Solution Pump
 Lime Loss-in-Weight
 Influent Sample Pump No.1
 Influent Sample Pump No.2
 Process Hot Water Pump No.1
 Process Hot Water Pump No.2
 Influent Screen No.1
 Screen Conveyor No.1
 Grinder Motor No.1
 Compactor motor No.1
 high Pressure Water Pump
 Chemical Solution Mixer
 Influent Screen No.2
 Screen Conveyor No.2
 Grinder Motor No.2
 Compactor motor No.2
 Dumpster Loading Conveyor No.1
 Lime Silo BagHouse Shaker
 Influent Screen No.3
 Screen Conveyor No.3
 Grinder Motor No.3
 Compactor motor No.3
 Dumpster Loading Conveyor No.2
 Lime Silo Screw Conveyor
 Influent Screen No.4
 Screen Conveyor No.4
 Grinder Motor No.4
 Compactor motor No.4
 Plant Drain Pump No.1
 Plant Drain Pump No.2
 Odorous Air Fan

Digester Building (MCC-D and MCC-D1):

Sludge Pump No.1
 Sludge Pump No.2
 Sludge Pump No.3
 Sludge Pump No.4
 Sludge Pump No.5
 Grinder No.1
 Grinder No.2
 Grinder No.3
 Mixing Pump No.1
 Mixing Pump No.2
 Mixing Pump No.3
 Mixing Pump No.4
 Digester Feed Pump
 Primary H/W Pump No.1
 Primary H/W Pump No.2
 Digester H/W Loop Pump
 Heat Exchanger No.1
 Heat Exchanger No.2
 Digester Transfer Pumps
 Digester Valves

Solids Handling Building (MCC-SH):

Slide Gate
 North Ramp Heat Mat.
 South Ramp Heat Mat.
 Truck Loading Roll-Up Door No.1
 Truck Loading Roll-Up Door No.2
 Sludge Control Valve
 Digested Sludge Control Valve
 Cake Pump
 Bridge Crane
 GBT1 Control Panel
 Belt Wash Booster Pump
 GBT Ex Fan
 Solids Supply Fan
 Belt Press Ex Fan
 Filter Belt Press
 Filter Belt Press Control Panel CP-FP
 Polymer Transfer Conveyor
 Chemical Solution Mixer
 Chemical Solution Pump
 TWAS Pump No. 1
 Centrifuge 1
 Pressure Washer
 Polymer Injection Pump
 Polymer Mixer
 Polymer Pump 1
 Polymer Pump 2
 Polymer Loss in Weight

Thickener Building (MCC-W)(Not in Use?):

Thickener Recycle Pump
 Thickened Sludge Pump No.1
 Tickened Sludge Pump No.2
 Air Compressor
 Welding Outlet

Administration Building

Maintenance Building

Proposed New Equipment

Proposed New Primary Sludge PS:

Primary Clarifier No. 3 - rake arm
 Primary Sludge Pump No.3
 Primary Sludge Pump No.4
 Scum Pump No.2

Solids Handling Building (MCC-SH):

Proposed New Equipment:
 Gravity Belt Washwater Pump
 Belt Press Washwater Pump
 Cake Pump 2
 TWAS Conveyor
 TWAS Pump 2
 Belt Filter Press 2

Equipment (and MCC's) on New Generator	
Equipment Required by EPA Reliability Requirements	Equipment Not Required per EPA

Proposed New Equipment

New Plant Water Pump Station:

W4 Pump 1
 W4 Pump 2
 W4 Pump 3
 W4 Pump 4
 Motorized Strainer

None Proposed

New Chemical Building:

Hypochlorite Pumps
 Sample Pumps

New Plant Effluent UV Disinfection System

In-Channel UV Disinfection

TM 19 – Materials and Corrosion Control

PREPARED FOR: Jim Wodrich, P.E./City of Bend

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DATE: October 3, 2011

PROJECT: Schematic Design Report
Bend Water Reclamation Facility Secondary Expansion

Background

The environments normally present in wastewater treatment facilities are corrosive and can cause rapid deterioration and premature failure of structures and equipment. Corrosion in wastewater treatment plants is typically caused by several conditions (singly or in combination) that accelerate deterioration of common materials used in construction. Corrosive conditions include:

- Complete or partial immersion in wastewater
- Wastewater atmospheres with wet hydrogen sulfide (H₂S) and its biological byproducts, which include sulfuric acid (H₂SO₄)
- Confined areas with limited ventilation and high humidity

This technical memorandum outlines the approach that will be followed for corrosion mitigation and selection of the optimum materials of construction for the specific conditions of service.

Fabricated Metals

Carbon Steel

Carbon steel is suitable for use only if it is provided with protective coating systems (presented later) that are appropriate and suitable for the intended service conditions. In general, galvanized steel should not be used in high humidity environments because the zinc is sacrificial and can deteriorate rapidly in some exposure conditions.

Atmospheric Exposure

Outdoors and in plant process areas, exposed steel should be provided with high performance coating systems consisting of epoxy primers with polyurethane finish coats. Oil-based (alkyd) enamel paint should be limited to dry, indoor conditioned air spaces.

Immersion Exposure

For immersion applications of carbon steel in wastewater, high performance epoxy coatings should be used. For metals immersed in primary wastewater, chemical resistant epoxy or vinyl ester coatings may be required.

Buried or Underground Service

It is anticipated that the soils at the site will be slightly corrosive to buried metal piping systems. No supplemental corrosion protection should be required for ductile iron, copper, or stainless steel pipe, except as noted below.

Protective coatings should be provided for carbon steel in underground applications. Underground piping fabricated from carbon steel should be protected with tape coating systems (American Water Works Association [AWWA] standard C214). Other suitable alternatives include coal-tar epoxy, 100-percent solids polyurethane, and fusion-bonded epoxy that comply with the applicable AWWA standard.

Underground piping systems that convey chemicals or flammable products (i.e., digester gas, natural gas) should be provided with a supplemented cathodic protection system. Galvanic anode cathodic protection systems should be used because of their ease of operation and maintenance.

Aluminum

Aluminum is suitable for atmospheric exposure. Aluminum should not be used for immersion or burial. Acceptable applications include cable trays, stair treads, grating, and handrails, except in chemical storage areas. Cast aluminum is suitable for electrical boxes and fittings.

Aluminum alloys should not be used for duct work where it will be exposed to chemical environments. Aluminum that will be embedded in or attached directly to concrete should be protected by applying bituminous or epoxy coating in the embedded (or contact) area.

Architectural aluminum surfaces should be Kynar-coated or anodized.

Stainless Steel

Stainless steel may be used to minimize corrosion and coating requirements. Type 304 or Type 316 stainless steel may be used, depending on the specific exposure conditions.

Low-carbon (e.g., Type 316L or 304L) grades of stainless steel should be specified where welding will be done. Otherwise, the heat-affected area may be subject to accelerated corrosion.

Fasteners

Type 316 stainless steel fasteners should be used for all submerged, splash, and spillage exposures. In dry, conditioned environments, galvanized steel fasteners are acceptable.

Copper

Copper is not corrosion-resistant to acidic service or wastewater (because of H₂S). Therefore, copper should not be used in areas where high hydrogen sulfide concentrations and high humidity will be present.

Grating

Aluminum or stainless steel grating and stair treads should be used in process areas except in the chemical areas, where fiberglass reinforced plastic (FRP) should be used. Hot-dipped galvanized (HDG) is acceptable for truck-rated gratings and other gratings in non-process areas.

Handrails

Anodized aluminum or stainless steel should be used where metallic handrails should be used in all outdoor and process areas. FRP handrails should be used in chemical storage areas where the handrails are likely to be exposed to spilling or splashing of chemicals.

Architectural Elements and Structures

Flashing and Roof Accessories

Kynar®-coated aluminum or Galvalume® sheet roofing should be used. Type 304 or 316 stainless steel should be used for all accessories that are not made of the coated metal roofing material.

Doors

The materials for doors should be based on the exposure conditions:

- Aluminum, FRP, or stainless steel doors (including frames and hardware) in process buildings with high humidity or where H₂S is present.
- FRP doors in chemical storage areas.
- Coated galvanized doors for locations where fire-rated doors are required, and where FRP or stainless steel doors are not allowed. Doors should have a high-quality epoxy/polyurethane coating appropriate for the exposure conditions.
- Steel doors coated with oil-based enamel should only be used in dry, indoor areas with conditioned air.

Window Frames

Kynar®-coated aluminum or Type 304 or 316 stainless steel should be used for window frames.

Finish Hardware

All finish hardware should be Type 304 or 316 stainless steel.

Painting and Protective Coatings

The following good painting practices should be followed:

- Apply paint in manufacturer's recommended maximum or minimum allowable temperatures.
- Do not apply paint in dust- or smoke-laden atmosphere, or in damp or humid weather.
- Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent or whenever surface temperature is less than 5°F above dew point of ambient air.

Table 1 lists the standard paint systems that should be used for specific applications.

TABLE 1
Standard Paint Systems—Minimum Requirements for Protective Coatings

System Number	Application	Surface Preparation (SP)	Paint Material	Minimum Coats/Coverage*
No. 2	Submerged metal-domestic sewage	Abrasive blast, or centrifugal wheel blast (SP 5)	Prime as required by finish manufacturer Finish: coal-tar epoxy or high build epoxy	2 coats, 16 mils
No. 3	Submerged metal-primary wastewater	Abrasive blast, or centrifugal wheel blast (SP 5)	Chemical resistant epoxy or vinyl ester	2 coats, 16 mils
No. 4	Exposed metal-corrosive	Abrasive blast, or centrifugal wheel blast (SP 10)	Primer (P): polyamide, anticorrosive epoxy Midcoat (M): high build epoxy Finish (F): polyurethane enamel	P-1 coat, 2.5 mils M-1 coat, 4 mils F-1 coat, 3 mils
No. 5	Exposed metal-mildly corrosive	Abrasive blast, or centrifugal wheel blast (SP 10)	Primer: polyamide, anticorrosive epoxy Finish: polyurethane enamel	P-1 coat, 2 mils F-1 coat, 4 mils
No. 6	Exposed metal-atmospheric	Abrasive blast, or centrifugal wheel blast (SP 6)	Primer: rust-inhibitive primer Finish: alkyd enamel	P-1 coat, 2 mils F-2 coats, 4 mils
No. 8	Buried metal-general	Abrasive blast or centrifugal wheel blast (SP 10)	Tape coat system AWWA C214	As specified by reference standard
No. 10	Galvanized metal conditioning	Solvent clean (SP 1) followed by hand tool (SP 2) or power tool (SP 3)	Primer: coating manufacturer's recommendation	P-1 coat, as recommended by coating manufacturer; finish as required for exposure

TABLE 1
Standard Paint Systems—Minimum Requirements for Protective Coatings

System Number	Application	Surface Preparation (SP)	Paint Material	Minimum Coats/Coverage*
No. 12	Skid-resistant-steel	Abrasive blast, or centrifugal wheel blast (SP 10)	Primer: polyamide epoxy; Finish: epoxy nonskid (aggregated)	P-1 coat, 2.5 mils F-1 coat, 16 mils
No. 13	Skid-resistant-aluminum and FRP	Brush-off blast (SP 7) or plastic surface preparation	Epoxy nonskid (aggregated)	1 coat, 16 mils
No. 21	Skid-resistant-concrete	Brush-off blast (SP7)	Epoxy nonskid (aggregated)	1 coat, 160 SFPG
No. 22	Chemical-resistant wall, heavy-duty-concrete masonry	Brush-off blast (SP7)	Fill: block filler Prime: polyamide epoxy Finish: high build polyamide epoxy high build, gloss	Fill-1 coat, as required to fill voids P-1 coat, 160 SFPG F-1 coat, 160 SFPG
No. 24	Exterior and Interior fiberglass, PVC	Abrade	Finish: acrylic latex	2 coats, 320 SFPGPC
No. 27	Aluminum and dissimilar metal insulation	Solvent clean (SP 1)	Wash primer Finish: bituminous paint	P-1 coat, 0.4 mils F-1 coat, 10 mils
No. 29	Fusion bonded coating	Abrasive blast, or centrifugal wheel blast (SP 10)	Fusion bonded 100 percent solids epoxy or polyurethane	1 or 2 coats, 12 mils
No. 29A	Fusion bonded, steel dowel coating	Abrasive blast, or centrifugal wheel blast (SP 10) or acid pickling (SP 8)	Fusion bonded 100 percent solids epoxy	1 or 2 coats, 7 mils
		TFE lube, shop applied; grease lube alternative, field applied just before installation	TFE lube or grease lube	1 coat, as required

*Cover is stated as Minimum Dry Film Thickness in mils (1 mil = 0.001 inch).

PVC = polyvinyl chloride.

SFPG = square feet per gallon.

SFPGPC = square feet per gallon per coat.

TFE = tetrafluorethylene.

Surface Preparation

Metal Surfaces

Metal surfaces should be prepared in accordance with the Steel Structures Painting Council (SSPC) Specifications as appropriate for the intended service. Current local regulations

regarding the use of abrasive blast materials and volatile organic compounds (VOCs) will need to be followed.

Concrete

Newly placed concrete that requires protective coatings should be prepared as follows:

- Cure poured concrete surfaces for a minimum of 30 days before painting.
- Remove grease, oil, dirt, salts, form-release agents, loose materials, or other foreign matter with solvents, detergents, or other cleaning agents.
- Use brush-off blasting on new concrete. If brush-off blasting is impractical, the surface may be etched with phosphoric acid. Muriatic (hydrochloric) acid should not be used due to the potential for excessive corrosion of metals in and around the concrete.
- Check that moisture content does not exceed manufacturer's recommendations.

Plastics

- Plastic surfaces should be hand-sanded with a medium-grit sandpaper to provide sufficient "tooth" to allow the specified coating system to bond to the substrate.
- If a specific color is required for FRP equipment, the FRP manufacturer should use a pigmented gel coat on the exterior of the FRP.
- Polyvinyl chloride (PVC) and FRP pipe should be color coded with labels and color bands.
- Clean the FRP surface with water (to remove dirt and loose glass fibers); then dry before painting. The resin surfaces should be lightly roughened with sandpaper before painting.

Masonry

- Cure masonry construction a minimum of 14 days before painting.
- Remove oil, grease, dirt, salts, or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable methods.
- Clean masonry surfaces of mortar and grout spillage.

Piping

Atmospheric Exposure

- Metallic piping (carbon steel and ductile iron) exposed to the various atmospheres in a wastewater treatment plant will require a protective coating system. Carbon steel and ductile iron pipe should be painted with Systems No. 4 or 5, depending on the exposure condition. Piping in highly humid environments (such as the solids building) should be coated with System No. 4. Outdoor piping can be coated with System No. 5.

- The foundry-applied asphaltic varnish on ductile iron pipe should be removed before other coatings are applied. The pipe manufacturer should be required to prepare the pipe for coating and apply at least the prime coat in the shop.

Submerged Pipe

- Type 316 stainless steel, FRP, PVC, and chlorinated polyvinyl chloride (CPVC) pipe should be used for immersion applications where possible. The published temperature and pressure limits for plastic materials will need to be followed.
- Coated carbon steel and ductile iron pipe may be suitable for immersion service, depending on the service.

Buried Pipe

- Buried carbon steel pipe should be protected with coatings.
- For buried metallic pipe conveying chemicals or flammable materials, supplemental corrosion protection should be provided with cathodic protection (galvanic anodes).

Pipe Hangers and Supports

In high-moisture areas (e.g., directly above water), Type 316 stainless steel or FRP pipe hangers should be used. In other process areas of the plant, Type 304 or 316 stainless steel or carbon steel (coated with System No.4 or 5) can be used. For dry, conditioned air exposures, hot-dipped galvanized steel is acceptable.

Electrical

Electrical Raceways

- Hot-dipped galvanized steel can be used for interior applications with low humidity and low exposure to hydrogen sulfide.
- PVC-coated galvanized steel should be used for exterior exposure and in high-humidity areas.
- Cable trays may be aluminum or FRP throughout the plant, with galvanized steel only for indoor, low-humidity, conditioned air environments.

Outdoor Electrical Equipment

Lighting, instruments, and electrical enclosures should be Type 304 stainless steel or FRP, conforming to the applicable National Electrical Manufacturers Association standards for the conditions of service.

Motor Control Centers

Motor control centers located in areas of potential hydrogen sulfide should be housed in rooms equipped with activated-carbon filters to remove any trace of hydrogen sulfide in the incoming air. Additional cooling should be provided as required by the equipment design.

parameters. Vapor phase inhibitors (VPI) should be provided for electrical enclosures that are not installed in conditioned rooms.

Special Corrosion Control Considerations

Preliminary and Primary Treatment Structures

Primer Clarifiers—Splitter Boxes and Launderers

Concrete surfaces in the vapor space above wastewater are subject to intense corrosion by acids formed from hydrogen sulfide. This condition most commonly occurs in preliminary and primary treatment stages, and the effect is greatly increased when the structure is covered (i.e., for odor control). For concrete structures that need to be lined for corrosion protection, the liner should extend to a point of 1 foot below the minimum water level. Embedded polyethylene sheet is recommended for concrete lining of new structures, wherever possible. Alternatively, adhesive-applied PVC sheets (Linabond) or a fluid-applied protective coating system could be used. A fluid-applied protective coating system would consist of an abrasive-blast of the concrete, application of a surfacer to fill exposed voids, and application of a flake-filled polyester or reinforced epoxy.

Two structures will be potentially subject to corrosion by hydrogen sulfide at the plant: the new primary clarifier splitter boxes and the launderers in the primary clarifiers. Corrosion protection of these structures can be approached in one of two ways:

- Install a protective lining during construction. This will allow a more cost effective installation while the contractor is mobilized. Embedded high-density polyethylene (HDPE) liners, which are considered to be the most effective and durable corrosion control method for this application, could be installed during initial construction. One of the disadvantages of installation during initial construction is that the liners may not be necessary if the structures are not covered for odor control purposes.
- Install protective liners in the future when the need for the liners is actually established. This is an option if the operation of the facility will allow removal of the structure from service to facilitate application of the protective liner. A specialty contractor will need to be retained to do the work, and the liner materials will be restricted to an adhesive-applied PVC sheet (Linabond) or a fluid applied polyester or epoxy coating.

Primary Clarifier Mechanisms

CH2M HILL performed condition assessment of the protective coatings on the steel mechanism of Primary Clarifier No. 1 on March 21, 2011. This work included visual observations of the coated metal and concrete structure. Limited field tests were made to evaluate paint thickness and adhesion. Paint samples were collected and sent to an analytical laboratory for lead testing. (Refer to *TM 3 – Primary Treatment Improvements*, Attachment 4 for additional information.)

The protective coatings on the primary clarifier steel mechanism are currently in fair condition. The City has replaced the coatings on the mechanism at least once since original construction. The scum baffle and v-notch weir are fiberglass and appear to be in very good

condition. Metal brackets holding the scum baffle appear to be coated and appear to be in good condition.

The most apparent corrosion is on the edges of angle members, center column, and feed well where paint is chipping and peeling. There does not appear to be any significant corrosion or metal loss in the areas where the coating is showing signs of deterioration.

Due to original age of coatings and uncertainties in the repainting work that has been performed over the years, there is a possibility that some paint on the mechanism may contain lead. Two paint samples removed from the center well of the mechanism were found to contain 25 mg/L (top layer of paint) and 6,150 mg/L (all layers of paint to metal surface). The results of these tests indicate that the City will need to develop provisions for worker safety and environmental protection when the existing paint is removed.

Based on the information gathered during this project, the existing clarifier mechanisms can be kept in service. Depending on the City's future plans, the clarifiers could be repainted as part of this project or at some point in the near future.

The submerged concrete appears to be in good condition and protective coatings for submerged concrete do not appear to be necessary. Some leaching of the concrete has occurred in the launders, but the level of deterioration currently does not appear to be sufficient to warrant installation of a protective coating system.

Chemical Containment

Protective coatings should be provided for concrete under pumps and fittings that could leak chemicals that are corrosive to concrete (such as ferric chloride).

Solids Building

Protective coatings on steel components inside the existing solids building are showing signs of deterioration. The condition of these coatings will be reviewed to evaluate the extent and type of paint deterioration. Alternative approaches to repair or re-application of paint in the solids building will be developed after the observations and the evaluation have been completed.

Corrosion Control during Construction

- All materials delivered to the project sites should be protected against corrosion during storage and after installation until commissioned for service.
- Electrical and instrumentation and control equipment should be packaged and protected with desiccant and vapor-phase inhibitors.
- Mechanical, structural, process, and architectural equipment should be coated before shipment to the sites.
- Once on the site, equipment should be stored properly and protected from the elements.

TM 20 – Project Cost Estimate, Schedule, and Construction Phasing

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DATE: October 3, 2011

PROJECT: Schematic Design Report
City of Bend WRF Secondary Expansion Project

Introduction

This technical memorandum (TM) presents the cost estimates developed for the City of Bend Water Reclamation Facility (City of Bend WRF) Secondary Expansion Project as described in the Schematic Design TMs and as presented in the Schematic Design drawings. This TM also defines the criteria and constraints that form the basis for construction phasing, packaging, and sequencing work, leading to the further development of the construction project during Schematic Design.

Basis for Cost Estimate

The design criteria for the recommended improvements to the City of Bend WRF meet the stated design criteria described in *TM 1 – Project Background and Objectives*. From these design criteria (which represent a projection of treatment plant needs for the next 20 years), treatment facilities, hydraulic/yard piping upgrades, electrical, utility, and site improvements have been developed, defining the re-use of existing plant facilities, upgrades, and new treatment facilities needed for reliable wastewater treatment.

These upgrades and improvements are summarized in *TM 2 – Process and Facilities Overview and Recommendations* and further described in *TM 3 through TM 9*. These TMs, the drawings, and the remaining documents that make up this Schematic Design Report form the basis for the cost estimate provided below for the Bend WRF Secondary Expansion Project.

Cost Estimate – 2008 Facilities Plan

The *City of Bend Water Reclamation Facilities Plan* prepared in April 2008, identified estimated costs, as well as phasing and implementation scenarios for the proposed improvements at the City of Bend WRF. The cost estimate summary from the 2008 facilities plan is shown in Table 1. As described in preceding TMs, through the development of this Schematic Design submittal, the proposed improvements have changed significantly from those proposed in

the facilities plan and, to a less extent, from those presented in Project Definition Report. These changes alter the project cost, phasing opportunities, project sequencing requirements, and the overall construction constraints.

TABLE 1
 Capital Improvements Phasing Schedule as Shown in the Bend WRF Facilities Plan Executive Summary
City of Bend WRF Secondary Expansion Project (\$ x 1,000)

Item Description	Construction Year					Total
	2008-2010	2011-2013	2014-2016	2017-2019	2020-2030	
Liquids Treatment						
Primary Splitter Box	\$370					\$370
Primary Clarifier	\$2,320			\$2,320		\$4,640
Aeration Basin				\$1,970		\$1,970
Contact Stabilization Piping Mods	\$310					\$310
Blower Building	\$580					\$580
Blowers	\$510			\$510	\$510	\$1,530
Secondary Clarifier Splitter		\$370				\$370
Secondary Clarifier		\$3,120			\$3,120	\$6,240
Side Stream Aeration Basins	\$3,290					\$3,290
Blower Piping Exterior	\$330			\$330	\$330	\$990
Influent Piping Mods	\$1,210					\$1,210
Secondary Clarifier Piping Mods		\$1,960				\$1,960
Upgraded RAS Pumps	\$2,460					\$2,460
Upgraded WAS Pumps				\$1,640		\$1,640
PAX Feed System	\$510					\$510
Chlorine Contact Basin	\$1,120					\$1,120
Hypochlorite System	\$920					\$920
Evaporation/Percolation Ponds						
Repairs to Ponds 1 and 2				\$1,760		\$1,760
Solids Treatment						
Gravity Thickener System			\$3,300			\$3,300
Belt Filter Press	\$1,250					\$1,250
Support Facilities						
Renovate Admin. Building		\$3,550				\$3,550
New Laboratory		\$3,280				\$3,280
Maintenance Upgrades		\$2,550				\$2,550
Miscellaneous						
Misc Site Improvements (5%)	\$620	\$270	\$170	\$210	\$200	\$1,470
Site Piping (5%)	\$620	\$270	\$170	\$210	\$200	\$1,470
TOTALS	\$16,420	\$15,370	\$3,640	\$8,950	\$4,360	\$48,740

Note:
 2007 Dollars
 Construction Contingency 35%
 Engineering, Legal, Administration 25%
 Interest 6%
 Inflation 3%

Classification of Estimate and Detail Definition

This estimating effort adopts the classification of estimates as defined by the Association for the Advancement of Cost Engineering International (AACE). The industry classification system is Recommended Practice-17R-97: “Cost Estimate Classification System” and 18R-97: “Cost Estimating Classification System as Applied in Engineering, Procurement, and Construction for the Process Industries.”

Figure 1 shows the relationship of level of detail to the expected accuracy of the estimate.

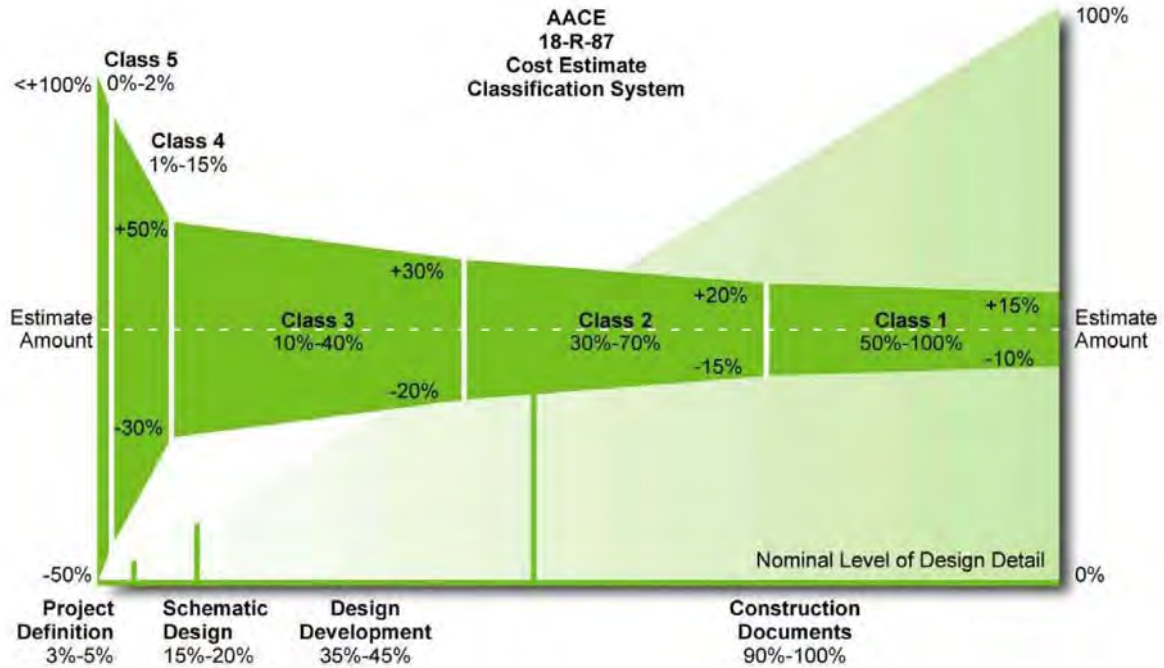


FIGURE 1
Construction Cost Estimate Accuracy Ranges

The capital costs within this Schematic Design Report are Class 3 cost estimates as defined by AACE and adopted by the American National Standards Institute. An estimate of this type is normally expected to be within +30 percent or -20 percent of the actual construction cost. The final cost of the projects will depend on actual labor and materials costs, actual site conditions, productivity, competitive market conditions, bid dates, seasonal fluctuations, final project scope, final project schedule, and other variables. As a result, the final project costs will vary from the estimates presented in this report.

Recommended Project

As previously presented in the Project Definition Report (CH2M HILL, February 2011), this Schematic Design Report continues to recommend designing and constructing the secondary expansion at the Bend WRF to meet the 2030 flow projections provided in the 2008 facilities plan, while installing hydraulic provisions, where appropriate, to

accommodate the build out peak wet weather flow (50 mgd) and ensure ease of future expansion.

However, the cost of building all the required process facilities needed to meet the full 20-year planning period is cost-prohibitive. As a result, this Schematic Design work identifies opportunities to defer some of the costs associated with fully accommodating the 2008 facilities plan projected 2030 flows and loads, while still avoiding any stranded investment in facilities. The following facilities were identified as candidates for cost deferral, and therefore these facilities are not being designed to meet the full 2030 facilities plan flow and load projections. These project elements will be “phased in” over the 20 year planning horizon to more closely match observed influent flows and loads:

- The primary clarifiers.
- The installed integrated fixed-film activated sludge (IFAS) carrier media volume.
- The installed blower capacity.
- The secondary clarifiers.
- The return activated sludge (RAS)/waste activated sludge (WAS) pump station.

As part of the current project, the treatment facility requires a third primary clarifier to meet EPA redundancy criteria, as well as meeting the surface overflow rates (SORs) during peak hydraulic events. The stated design criteria (SOR = 1,000 gallons per day per square foot [gpd/sf], all units in service) indicate that a fourth primary clarifier will be required before 2030. The Bend WRF can treat the 2030 ADMM flow with three primary clarifiers if the SORs go up to 1200 gpd/sf with all units in service. Once the third primary clarifier is online and peak hydraulic events actually occur, the City of Bend can evaluate the actual capacity of the primary clarifiers and determine if a fourth primary clarifier is required before 2030.

The IFAS process provides a unique opportunity to easily increase process capacity by adding additional carrier media and blowers once the initial capital investment in infrastructure is made to accommodate the process. Given the uncertainty associated with the timing of flow and load increases to the treatment facility, it is recommended to initially only provide carrier media and blower capacity to reach the near-term required process capacity of 8.5 mgd ADMM. Additional capacity can be added relatively easily in the future by adding additional carrier media and installing more blower capacity.

The new secondary clarifiers and RAS/WAS infrastructure are not required until the end of the planning horizon (near the point at which flows increase to 11 mgd ADMM). Given the fact that the existing secondary clarifier infrastructure is sufficient to provide reliable operation beyond the near-term process capacity (8.5 mgd ADMM), the deferral of improvements to these facilities is also recommended as a cost saving measure.

Cost Estimate—Recommended Project

These cost estimates have been prepared based on the process modeling performed by CH2M HILL (which defines capacity, volumes, and general layout), CH2M HILL’s costing model (CPES), similar local projects with actual bid results, manufacturers’ quotes, and some detailed takeoffs and estimating based on R.S. Means and CH2M HILL historical estimating and bid data.

The Schematic Design capital cost estimates are summarized in Table 2. Base construction costs are expressed in June 2011 dollars and now include a 25 percent contingency. The costs are not escalated to the mid-point of construction. No sales tax is included for the construction cost total. Engineering, legal expenses, and administration are presented in a separate line item in Table 1. Detailed costs by specific component are provided in Attachment A.

TABLE 2
 Summary of Schematic Design Capital Cost Estimates
City of Bend WRF Secondary Expansion Project

Cost Item	Cost ^a
Base Construction Costs	
<u>Phase 1a</u>	
Site Civil & Electrical	\$1,036,088
Yard Piping: Primary Influent	\$141,018
Yard Piping: Primary Effluent	\$99,248
Yard Piping: Mixed Liquor	\$179,178
Yard Piping: Miscellaneous Systems	\$675,000
Mixed Liquor Splitter Box 2	\$71,701
Blower Building	\$2,783,469
Aeration Basin 4	\$2,074,307
Total Phase 1a	\$7,060,009
<u>Phase 1b</u>	
Site Civil & Electrical	\$254,203
Yard Piping: Secondary Effluent	\$329,037
Yard Piping: Effluent Outfall	\$64,822
Yard Piping: 14-inch RL Tie to 14-inch FE	\$22,198
Filter Building	\$35,000
Hypochlorite Facility	\$455,305
Plant Effluent Disinfection Facility	\$3,260,491
Reuse Disinfection Facility	\$578,272
Total Phase 1b	\$4,999,328
<u>Phase 1c</u>	
Site Civil & Electrical	\$46,794
Yard Piping: Primary Influent	\$153,089
Yard Piping: Primary Effluent	\$52,201
Primary Clarifier 3 (65 feet diameter)	\$707,101
New Primary Sludge Pump Station	\$474,317

TABLE 2
 Summary of Schematic Design Capital Cost Estimates
 City of Bend WRF Secondary Expansion Project

Cost Item	Cost ^a
New Primary Influent Splitter Box	\$246,143
Total Phase 1c	\$1,679,645
<u>Phase 2</u>	
Primary Sludge Pump Station 1	\$214,062
Total Phase 2	\$214,062
<u>Phase 3 (AB 3)</u>	
Retrofit Aeration Basins 1, 2, and 3	\$1,585,367
Total Phase 3	\$1,585,367
<u>Phase 4 (AB 2)</u>	
Retrofit Aeration Basins 1, 2, and 3	\$1,684,724
Total Phase 4	\$1,684,724
<u>Phase 5 (AB 1)</u>	
Retrofit Aeration Basins 1, 2, and 3	\$1,388,773
Total Phase 5	\$1,388,773
<u>Phase 6</u>	
Solids Dewatering Building	\$1,557,126
Total Phase 6	\$1,557,126
Subtotal Base Construction Costs (rounded)	\$20,169,000
Construction Markups	
Subcontractor Markups	\$96,000
Contractor OH&P, Bonds, Mobilization and Insurance ^b	\$3,635,000
Contingency (25%)	\$5,975,000
Subtotal Construction Markups	\$9,706,000
Owner Furnished Equipment (None)	\$0
TOTAL CONSTRUCTION COSTS^c	\$29,875,000
EAL Costs (30% of construction)	\$8,962,000
TOTAL PROJECT COSTS^c	\$38,837,000

^a All costs are in June 2011 dollars. Escalation to mid-point of construction is not included.

^b Contractor markups are based on base construction costs. Contingency is applied to all construction costs.

^c Construction costs and total project costs do not include the cost for non-process facilities (new laboratory, administration building improvements, etc.) not the cost for upgrades and improvements to the existing effluent percolation ponds (Ponds 1 and 2).

Construction Cost Trending

Overall, the construction costs for the recommended project have increased from the costs estimated for the Project Definition Report (February 2011). Although some cost elements have decreased, and some have increased, the overall trend has been an increase in costs. Some of the decisions that have contributed to the cost changes are noted below:

- Based on a site inspection conducted during Schematic Design, a decision was made to not replace the existing primary clarifier mechanisms. The existing mechanisms are showing some corrosion but continued maintenance can extend the life of these mechanisms until a future date when they can be replaced (likely with new stainless steel mechanisms).
- The Schematic Design drawings have significantly more detail associated with the air and PE piping for the aeration basins, accounting for most of the higher costs estimated during Schematic Design. There is more identified ALP piping as well as more piping and fittings in the PE gallery and in the piping configuration at the south end of the aeration basins, resulting in higher estimated costs.
- Even while accounting for the reduced cost of the hypochlorite facility, the decision to switch from hypochlorite disinfection to UV disinfection resulted in a construction cost increase. The present worth costs for the two alternatives are relatively equal.
- The new blower building increased in construction costs due to the larger footprint for air compressors and the enlarged electrical room (to accommodate future loads).
- Replacing the existing belt filter press (as well as the existing centrifuge) with a new belt filter press resulted in a construction cost increase, even though the present worth costs compared more favorably for the two alternatives.
- The Project Definition estimate for the splitter box for the new primary clarifier (PC 3) was based on rough sketches and did not reflect the full costs of the facility presented in Schematic Design. The splitter box is now a separate structure from the new primary sludge pump station. Construction costs have increased for this facility.
- Utilizing steel frame buildings with precast panels (rather than CMU) resulted in an increase in construction costs. There may be opportunity to reduce the costs of the steel frame design as the detailed structural requirements for each building are analyzed.
- The civil site work and grading requirements identified in the Project Definition were relatively undefined, so contingency costs were included at that time. Those Project Definition estimates with that contingency turned out to include more costs than needed for the refined civil site work depicted in this Schematic Design Report. Therefore, those costs actually were reduced.

These decreases and increases in individual project elements have resulted in an overall increase in construction costs of approximately \$3.3 million (including contingencies, contractor markups, overhead and profit). The comparison of Project Definition costs versus Schematic Design costs is presented in Attachment B.

Construction Sequencing and Constraints

Selection of the integrated fixed-film activated sludge (IFAS) process results in significant modifications to the existing aeration basins. This process change will require the sequential construction and conversion of IFAS aeration basins, coordinated closely with operations. The IFAS process change, coupled with the hydraulic and yard piping upgrades, will have a significant effect on plant operations throughout the construction phase. These constraints and the need for sequential construction will also tend to extend the overall duration of the construction schedule. The following operational constraints and recommended sequencing are relatively unchanged from the Project Definition Report. Those constraints and recommendations are presented again in the following sections, with minor updates and changes based on the Schematic Design Report.

Operational Constraints

The re-use and conversion of the existing aeration basins and primary clarifiers requires careful planning and operational consideration so that permit limits and operational goals can be met throughout construction.

The requirement to construct new and rebuilt facilities in the midst of ongoing plant operation results in a number of sequencing requirements and construction constraints that must eventually be built into the construction schedule and bid documents, as requirements for the contractor that will eventually build the project.

The City of Bend WRF, as currently designed, lacks redundancy in certain key processes (primary clarification and aeration basins). This makes it difficult to take facilities offline before replacement facilities have been constructed. These operational constraints will also influence the ultimate construction schedule, and required sequencing for the construction contractor. A preliminary list of operational constraints is presented below on a unit process basis.

Some of these constraints are also influenced by seasonal influent flow characteristics. Wet weather flows can occur at any time of the year, but spring weather typically brings larger storms, snow melt, and less predictable weather patterns that can produce high influent flows and colder water temperatures. In general, there is more risk in removing facilities from service during these periods that experience larger storms and snow melt events.

Headworks

The existing headworks was recently constructed. No significant improvements are planned for this unit process. Raw wastewater flow into the headworks facility can only be completely shut down for approximately 2 hours, from 4 am to 6 am each day. Work on the existing and new primary influent piping will require raw wastewater shutdowns and diversions as new piping is connected into the existing primary influent header downstream of the influent screens.

Primary Clarifiers

The construction and upgrades associated with the primary influent and effluent piping will require sequential construction while maintaining operation of some primary clarifiers at all times. The following sequence and constraints are recommended:

- Construct offline and start up Primary Clarifier 3 (PC 3) with separate splitter box and new primary influent (PI) piping.
- Connect new primary effluent (PE) from PC 3 over to west end of the existing PE header accounting for required sequencing of construction of the pipe gallery extension adjacent to Aeration Basin 4.
- Disconnect and upgrade existing PI/PE piping to/from Primary Clarifier 1 (PC 1) and Primary Clarifier 2 (PC 2) influent/effluent connections, along with connection of parallel PE piping, upsizing existing 30-inch PE east of headworks to 42-inch.

This will require operating with PC 3 only for some period of time:

- Therefore, consider delaying PC 1 and PC 2 upgrades until full IFAS upgrades are in place (three aeration basins) to accommodate reduced biochemical oxygen demand (BOD)/total suspended solids (TSS) removal in primary clarifiers.
- Cutting in 30-inch butterfly valve into existing 30-inch PI will require a brief shutdown. Paralleling the existing 30-inch PI with new 30-inch PI will minimize outage time (shutdown only for tie-ins to junction boxes each end of parallel pipe).

Constructing PC 3 to the west of PC 2 requires the construction of a new primary sludge pump station, but this pump station can be built offline while constructing PC 3. Once PC 3 and the new primary sludge pump station are operational, the new primary sludge/scum pump station allows for retrofit of existing primary sludge pump station while work is being conducted on the PI/PE piping for PC 1 and PC 2. Primary sludge pumping shutdowns from PC 1/PC 2 are expected to be minor, as required to facilitate primary sludge pump tie-ins from PC 3.

Aeration Basins

Throughout the year, there is little ability to take one of the three existing aeration basins offline. Operating with only two aeration basins in modified Ludzack-Ettinger (MLE) mode can only be relied upon for relatively short periods. Therefore, the new aeration basin (AB 4), the new blower building, and the new mixed liquor (ML) piping and splitter box will be constructed and placed in service (initially as an MLE system that will be converted to IFAS operation) prior to taking any existing aeration basins out of service for modifications.

Once the new blower building is operable and AB 4 is up and running (as an MLE basin, without IFAS media), the retrofit of AB 3 for IFAS operation can be completed (while continuing to operate AB 1, AB 2, and the new AB 4 as MLE basins). Once AB 3 and AB 4 are constructed and tested, IFAS media can be added to these two basins, and all flow can be directed to these two basins to allow AB 2 (and possibly AB 1) to be retrofitted for IFAS operation.

Modifying a single aeration basin for IFAS operation involves the following critical improvements:

- Influent feed channel
- Sieve wall with plate screens for surface wasting
- Basin drain configuration

- Collection channel
- Coarse bubble diffuser system
- Blower and aeration piping upgrades
- New baffle walls in Zone 5 and small wall at the collection channel exit
- Anoxic/aerobic swing zone mixer
- Replacement and reconfiguration of the stepfeed piping
- Installation of new mixed liquor recirculation (MLR) pumping system with new MLR piping
- New instrumentation and control for the IFAS operation

Consideration of AB 3 and AB 4 tank drain piping, and sequence of construction of a new plant drain pump station may require temporary pumping by contractor to transfer clean water and mixed liquor between basins as part of startup testing of all aeration basins. Early construction of a new plant drain pump station would be preferred and is planned to be integral with the extend PE gallery.

Secondary Clarifiers

The existing three secondary clarifiers are not significantly affected by the proposed construction, although there will be some tie-ins and construction that could impact individual clarifiers, during the time that mixed liquor piping and secondary effluent piping are being upgraded. Specific operational constraints will be coordinated with Bend staff, and incorporated into the final contract documents.

Disinfection and Reuse Facilities

New plant effluent (PLE), ultraviolet (UV) light disinfection facilities, hypochlorite facility, and plant water pump station must be complete and in service before the secondary effluent piping modifications can take place and before the existing chlorine contact basins (CCBs) and plant water pump station can be abandoned/demolished.

For the most part, the new disinfection facilities (in-channel UV facility and sodium hypochlorite storage) will be constructed offline. Relatively short tie-ins (with shutdowns and possibly diversion pumping) will be needed to connect secondary effluent piping to the new UV facility, connect that new facility to the existing 42-inch outfall, and to connect new secondary effluent piping to the reuse filter feed pump station. Specific operational constraints will be coordinated with Bend staff, and incorporated into the final contract documents.

The secondary effluent tie-in piping to the modified filter feed pump station would be more easily accomplished during non-reuse periods; however, the constraint could be overcome with some short-duration shutdowns and potential coordination with Pronghorn, the reuse customer.

While the new in-vessel, UV light reuse disinfection system may be constructed at any time, the reuse system modifications, piping modifications, etc., must be performed outside the City of Bend's contracted irrigation season. The reuse facilities are only utilized seasonally, so upgrades and piping connections can be constructed during the off season so that reuse operations are relatively unaffected by the proposed work.

The new plant water pump station will be constructed as part of the new plant effluent UV facility. The construction of the new secondary effluent piping and the eventual abandonment of the existing secondary effluent piping to the existing CCBs will need to be coordinated to maintain plant water availability throughout construction.

Solids Building Upgrades

The improvements and upgrades to the existing solids building will need to be sequenced to allow near-continuous WAS thickening. Installation of the new belt filter press, replacement of the existing belt filter press, and polymer and cake pumps additions will need to be closely coordinated with operations.

The new belt filter press could be installed at any time along with the removal of the existing centrifuge unit, while maintaining the operation of the existing BDP belt filter press. Minor shutdowns and tie-ins for process piping and support facilities will have an impact on dewatering operations, but these activities can be scheduled for the most part outside of normal dewatering operational periods. After the centrifuge is replaced with a new belt filter press, then the existing press could be replaced.

The installation of two new presses (rather than just one) presents alternative opportunities for construction. The use of the existing drying beds or a trailer-mounted dewatering unit would allow for the full shutdown and removal of all the dewatering equipment on the mezzanine level. This would then allow for more efficient and higher quality retrofit, preparation, and coating of the existing building structure, without conflicting with operations. The duration of the work would be shortened, dewatering operations could continue, and the building structure could be repaired and re-coated without working around existing equipment and operations staff.

Upgrades to the existing polymer system will need to be sequenced so that polymer is continuously available for the both the thickening and the dewatering operation. A temporary polymer system may be needed during construction to allow for efficient upgrades to the existing polymer system.

Recommended Sequencing

Recommended sequencing, phasing, and completion milestones for major process improvements are designated in the schedule figure provided at the end of this TM. Pending cash flow and financial analysis of the phasing plan, the following major facility sequence is recommended:

- Phase 1a – AB 4, Blower Building, ML piping, ML splitter box.
- Phase 1b – New hypochlorite facility, new plant effluent UV and plant water pumping facility, secondary effluent piping improvements, new reuse UV facility and reuse piping relocation work
- Phase 1c – PC 3, new primary sludge pump station, with new PI, PE piping
- Phase 2 – PI/PE piping improvements associated with existing PC 1 and PC 2, and existing primary sludge pump station improvements
- Phase 3 – AB 3 IFAS conversion

- Phase 4 – AB 2 IFAS conversion
- Phase 5 – AB 1 IFAS conversion
- Phase 6 – Solids process improvements
- Site Civil and Plant Utilities work

Constraints

- Phase 1a, 1b, and 1c work could begin concurrently at notice to proceed, or that work could be staged to manage cash flow. Reuse facility work needs to be completed during the non-irrigation season (for the UV and filter work), but that work also needs to be done subsequent to the Phase 1b (PLE UV) work being completed. Cash flow could be managed by postponing this reuse work until later in the project.
- Relocation of the Pronghorn reuse piping needs to be completed prior to the construction of the new effluent UV facility. Plant effluent pipe construction needs to be coupled with the construction and startup of the new effluent UV facility.
- Phase 2 PI/PE tie-ins require the shutdown of PC 1 and PC 2 and that work cannot occur until Phase 1a (AB 4) and Phase 1c (PC 3) are complete. In addition Phase 3 (AB 3 conversion) and operation in IFAS mode is a prerequisite for removing PC 1 and PC 2 from service.
- Phases 3, 4, and 5 shall be performed sequentially following completion of Phase 1a.
- Phase 4 and 5 (IFAS Basin conversion for AB 2 and AB 1) could be conducted in parallel since AB 3 and AB 4 would be operating in IFAS mode with excess IFAS media.
- Phase 6 (Solids) has no known constraints, but operational needs suggest completing that solids work early in the overall construction schedule.
- Site civil work and plant utilities work will be conducted throughout the overall construction schedule, integrated into the project elements described above as specific areas of the site are impacted.

Additional sequencing analysis and detailing will occur during subsequent design phases. Specific operational constraints and sequencing requirements will be coordinated with Bend staff, and incorporated into the final contract documents.

Opportunities for Deferral of Project Elements

As noted above, the cost of building all the required process facilities needed to meet the full 20-year planning period is cost-prohibitive. As a result, the design has identified opportunities to defer some of the costs associated with fully accommodating the 2008 facilities plan projected 2030 flows and loads, while still avoiding any stranded investment in facilities. The following facilities were identified as candidates for cost deferral, and therefore these facilities are not being designed to meet the full 2030 facilities plan flow and load projections. These project elements will be “phased in” over the 20 year planning horizon to more closely match observed influent flows and loads:

- The primary clarifiers.

- The installed integrated fixed-film activated sludge (IFAS) carrier media volume.
- The installed blower capacity.
- The secondary clarifiers.
- The return activated sludge (RAS)/waste activated sludge (WAS) pump station.

The 2008 facilities plan identified some non-process facility upgrades (new laboratory, administration building upgrades, etc.) that are not currently included in the defined project. The cost of these improvements is also being deferred and these non-process facilities are not included in the overall cost estimate presented here.

In addition, the 2008 facilities plan identified some upgrades and improvements to the existing effluent percolation ponds (Ponds 1 and 2). The condition of these ponds has not been further evaluated and the cost of these improvements is not included in the overall cost estimate presented here.

As the design work progresses, further opportunities for deferral of project elements (and individual pieces of equipment) may become obvious, and will be documented as they develop. The additional project elements that could possibly be deferred are as follows:

1. Installation of parallel 30-inch PI to PC 1 and PC 2 can possibly be deferred until beyond 30 mgd design flow.
2. Installation of screens, media, and other IFAS conversion elements for Aeration Basin 1 could be deferred until a later date. Three IFAS basins have enough capacity to meet the 2030 design criteria.
3. Retrofit of the existing primary sludge pump station could be deferred as long as the existing digester feed pumps and blend tank are kept in service.

ID	Task Name	Duration	Start	Finish	Predecessors	Timeline																
						Apr	2011	Jun	2012	2013	2014	2015										
1	Award Contract	0 days	Mon 7/13/09	Mon 7/13/09																		
2	Value Planning/Engineering	54 days	Mon 6/15/09	Thu 8/27/09																		
8	Amendment 1	56 days	Wed 8/12/09	Wed 10/28/09																		
21	Amendment 2	225 days	Thu 10/29/09	Wed 9/8/10																		
52	Survey Work	40 days	Wed 8/12/09	Tue 10/6/09	1FS+22 days																	
53	Geotech Work	40 days	Wed 8/12/09	Tue 10/6/09	1FS+22 days																	
54																						
55	Design Project Management	645 days	Tue 11/3/09	Mon 4/23/12	1SS,120FF																	
56																						
57	Project Chartering and Kickoff - Predesign	5 days	Thu 8/26/10	Wed 9/1/10	8,47																	
60	Project Definition Phase	110 days	Thu 9/2/10	Wed 2/2/11	57																	
84																						
85	Project Delivery Evaluation & Optional CM/GC	149 days	Fri 7/15/11	Wed 2/8/12																		
98																						
99	Schematic Design Phase	140 days	Tue 1/11/11	Mon 7/25/11																		
119																						
120	Final Design Efforts	180 days	Tue 8/16/11	Mon 4/23/12	99FS+15 days																	
125	Bidding Period	90 days	Tue 4/24/12	Mon 8/27/12	120																	
126																						
127	Construction	620 days	Tue 8/28/12	Mon 1/12/15	125																	
128	Contracting/Mobilization	3 mons	Tue 8/28/12	Mon 11/19/12																		
129	Phase 1a – AB4, Blower Building, ML piping, ML s	18 mons	Tue 11/20/12	Mon 4/7/14	128																	
130	Phase 1b – New hypo facility, new PLE UV, secon	14 mons	Tue 1/15/13	Mon 2/10/14	128FS+2 mons																	
131	Phase 1c – PC3, new primary sludge pump station	14 mons	Tue 3/12/13	Mon 4/7/14	128FS+4 mons																	
132	Phase 2 – PI/PE piping improvements and clarifier	4 mons	Tue 9/23/14	Mon 1/12/15	129,131,134																	
133	Phase 3 – AB3 IFAS conversion	3 mons	Tue 4/8/14	Mon 6/30/14	129																	
134	Phase 4 – AB2 IFAS conversion	3 mons	Tue 7/1/14	Mon 9/22/14	133																	
135	Phase 5 – AB1 IFAS conversion	3 mons	Tue 7/1/14	Mon 9/22/14	133																	
136	Phase 6 – Solids process improvements	16 mons	Tue 8/28/12	Mon 11/18/13																		
137	Site Civil, Plant Utilities, Site Circulation	25.3 mons	Tue 11/20/12	Tue 10/28/14	128																	

Project: Bend Sec Improvement Proj
Date: Wed 6/8/11

Task: Progress
Split: Milestone

Summary: External Tasks: Split:

Project Summary: External MileTask: MileTask:

Page 1

Attachment A—Cost Estimate Details

Wastewater Reclamation Facility Expansion - Summary
Schematic Design, Class 3 Estimate
391657.A3.03.01 / Rev. 2

Project name	Bend WRF 2nd Expansion_SD Bend OR USA
Client	City of Bend, Oregon
Architect	CH2M Hill Inc.
Engineer	CH2M Hill Inc.
Estimator	Lawson, B
Labor rate table	2011 Labor
Equipment rate table	2010 Equipment
Job size	1 LS
Duration	24 MO
Project	WRF 2nd Expansion
Project Number	391657.A3.03.01
Market Segment	Water
Business Group	Water
Project Conditions	Existing Plant
Estimate Class 1-5	Class 3
Design Stage	Schematic
Region	Northwest
Project Manager	Dave Green/PDX
Design Manager	Dave Green/PDX
QC Reviewer	Design Team
Rev No. / Date	2 / June 8 2011
Estimate No.	2011.0007
ENR CCI Index	9103.94 (20 City)
Material's Index	2824.87
Index's Date	June 2011
Report format	Sorted by 'Bid Group/Bid Item/CSI/Assembly' 'Detail' summary Paginate
Cost index	Oregon-Bend

Bid Group	Bid Item	CSI	Assembly	Phase	Description	Takeoff Quantity	Crew	Labor Cost/Unit	Material Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Process Equip Cost/Unit	Total Cost/Unit	Total Amount	Grand Total
A					Phase 1a										
	01				Site Civil & Electrical										
		01			General Requirements	1.00 LS		200,000.00	200,000.00	400,000.00			800,000.00	800,000	1,181,164
		26			Electrical	1.00 LS		58,027.43	30,526.87	12,040.38	5,251.65	70,000.00	175,846.33	175,846	260,154
		31			Earthwork	1.00 LS		7,639.43	943.25	9,445.72	32,000.00		50,028.40	50,028	77,065
		32			Exterior Improvements	1.00 LS		923.32	8,715.72	574.68			10,213.72	10,214	15,080
					01 Site Civil & Electrical	1.00 LS		266,590.18	240,185.84	422,060.78	37,251.65	70,000.00	1,036,088.45	1,036,088	1,533,463
	02				Yard Piping: PI, Primary Influent										
		40			Process Integration	1.00 LS		44,671.91	77,729.28	18,617.00			141,018.19	141,018	208,207
					02 Yard Piping: PI, Primary Influent	1.00 LS		44,671.91	77,729.28	18,617.00			141,018.19	141,018	208,207
	03				Yard Piping: PE, Primary Effluent										
		40			Process Integration	1.00 LS		18,835.28	72,922.88	7,489.36			99,247.52	99,248	146,535
					03 Yard Piping: PE, Primary Effluent	1.00 LS		18,835.28	72,922.88	7,489.36			99,247.52	99,248	146,535
	04				Yard Piping: ML, Mixed Liquor										
		40			Process Integration	1.00 LS		53,733.65	101,661.12	23,783.12			179,177.89	179,178	264,548
					04 Yard Piping: ML, Mixed Liquor	1.00 LS		53,733.65	101,661.12	23,783.12			179,177.89	179,178	264,548
	08				Yard Piping: Misc Systems										
		40			Process Integration	1.00 LS		270,000.00	270,000.00	135,000.00			675,000.00	675,000	996,607
					08 Yard Piping: Misc Systems	1.00 LS		270,000.00	270,000.00	135,000.00			675,000.00	675,000	996,607
	13				ML Splitter Box #2										
		03			Concrete	46.99 CY		394.68	244.47	6.13			645.28	30,322	44,769
		05			Metals	1.00 LS		3,071.92	12,738.95	309.43			16,120.30	16,120	23,801
		26			Electrical	1.00 LS		2,000.00	1,500.00	500.00			4,000.00	4,000	5,906
		31			Earthwork	1.00 LS		4,303.60		1,914.04			6,217.64	6,218	9,180
		40			Process Integration	1.00 LS		1,276.90	13,764.23				15,041.13	15,041	22,208
					13 ML Splitter Box #2	1.00 LS		29,198.61	39,490.70	3,011.46			71,700.77	71,701	105,863
	32				Blower Building										
		03			Concrete	150.91 CY		457.38	1,805.79	97.61			2,360.78	356,265	526,010
		05			Metals	1.00 LS		75,003.76	207,123.20	15,611.69			297,738.65	297,739	439,598
		06			Wood, Plastics & Composites	1.00 LS		1,230.16	1,503.13				2,733.29	2,733	4,036
		07			Thermal & Moisture Protection	1.00 LS		19,762.95	37,800.78	141.88			57,705.61	57,706	85,200
		08			Openings	1.00 LS		10,700.51	16,083.45	13.28			26,797.24	26,797	39,565
		26			Electrical	1.00 LS		94,368.75	87,465.19	15,924.99			197,758.93	197,759	291,982
		40			Process Integration	1.00 LS		57,883.80	104,496.20	357.06	10,741.59		173,478.65	173,479	257,208
		46			Water & Wastewater Equipment	1.00 LS		44,823.35	15,250.00	12,555.65	1,750.00	887,450.00	961,829.00	961,829	1,420,273
					32 Blower Building	1.00 LS		372,796.27	742,233.33	59,335.50	12,491.59	887,450.00	2,074,306.69	2,074,307	3,063,870
	31.2				Aeration Basin #4										
		02			Existing Conditions	1.00 LS		3,246.73	184.83	1,191.20			4,622.76	4,623	6,825
		03			Concrete	1,238.39 CY		281.32	234.84	5.90			522.06	646,516	954,551
		05			Metals	1.00 LS		29,580.45	98,200.05	2,470.02			130,250.52	130,251	192,309
		08			Openings	1.00 LS		535.79	2,797.08				3,332.87	3,333	4,921
		09			Finishes	1.00 LS					10,000.00		10,000.00	10,000	15,765
		26			Electrical	1.00 LS		25,000.00	10,000.00	5,000.00			40,000.00	40,000	59,058
		31			Earthwork	1.00 LS		58,464.06	7,404.32	48,255.84			114,124.22	114,124	168,499
		40			Process Integration	1.00 LS		203,211.66	597,519.66	5,579.64	80,542.02		886,852.98	886,853	1,317,453
		46			Water & Wastewater Equipment	1.00 LS		160,765.52	28,513.16	6,841.11	1,400.00	750,250.03	947,769.82	947,770	1,399,480
					31.2 Aeration Basin #4	1.00 LS		829,186.28	1,035,441.78	76,648.65	91,942.02	750,250.03	2,783,468.76	2,783,469	4,118,861
					A Phase 1a	1.00 LS		1,885,012.18	2,579,664.93	745,945.87	141,685.26	1,707,700.03	7,060,008.27	7,060,008	10,437,955

Bid Group	Bid Item	CSI	Assembly	Phase	Description	Takeoff Quantity	Crew	Labor Cost/Unit	Material Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Process Equip Cost/Unit	Total Cost/Unit	Total Amount	Grand Total
B					Phase 1b										
	01				Site Civil & Electrical										
	03				Concrete	1.00 CY					100,000.00		100,000.00	100,000	157,646
	26				Electrical	1.00 LS		15,530.62	9,426.29	966.07	333.00	20,000.00	46,255.98	46,256	68,328
	31				Earthwork	1.00 LS		7,727.17	1,059.50	7,917.39	7,000.00		23,704.06	23,704	35,698
	32				Exterior Improvements	1.00 LS		8,200.18	70,840.00	5,202.49			84,242.67	84,243	124,381
					01 Site Civil & Electrical	1.00 LS		31,457.97	81,325.79	14,085.95	107,333.00	20,000.00	254,202.71	254,203	386,052
	05				Yard Piping: SE, Secondary Effluent										
	40				Process Integration	1.00 LS		84,347.17	212,601.18	32,089.10			329,037.45	329,037	485,809
					05 Yard Piping: SE, Secondary Effluent	1.00 LS		84,347.17	212,601.18	32,089.10			329,037.45	329,037	485,809
	06				Yard Piping: EO, Effluent Outfall										
	40				Process Integration	1.00 LS		21,434.84	35,592.63	7,794.04			64,821.51	64,822	95,706
					06 Yard Piping: EO, Effluent Outfall	1.00 LS		21,434.84	35,592.63	7,794.04			64,821.51	64,822	95,706
	07				Yard Piping: 14" RL Tie To 14" FE										
	40				Process Integration	1.00 LS		6,900.93	12,126.98	3,170.38			22,198.29	22,198	32,775
					07 Yard Piping: 14" RL Tie To 14" FE	1.00 LS		6,900.93	12,126.98	3,170.38			22,198.29	22,198	32,775
	26				Filter Building										
	40				Process Integration	1.00 LS		20,000.00	10,000.00	5,000.00			35,000.00	35,000	51,676
					26 Filter Building	1.00 LS		20,000.00	10,000.00	5,000.00			35,000.00	35,000	51,676
	29				Hypochlorite Facility										
	03				Concrete	103.49 CY		153.43	215.83	5.18			374.44	38,751	57,214
	05				Metals	1.00 LS		11,101.92	25,927.13	2,909.37			39,938.42	39,938	58,967
	06				Wood, Plastics & Composites	1.00 LS		9,055.28	11,130.95	686.04			20,872.27	20,872	30,817
	07				Thermal & Moisture Protection	1.00 LS		4,946.67	11,558.13	7.62			16,512.42	16,512	24,380
	22				Plumbing	1.00 LS		16,430.36	10,000.00				26,430.36	26,430	39,023
	26				Electrical	1.00 LS		20,000.00	10,000.00	5,000.00			35,000.00	35,000	51,676
	40				Process Integration	1.00 LS		54,811.67	50,000.00				104,811.67	104,812	154,750
	43				Liquid Storage	1.00 LS		3,287.48	6,088.00		7,000.00	18,000.00	34,375.48	34,375	51,454
	46				Water & Wastewater Equipment	1.00 LS		20,587.63	14,268.00	4,257.29		99,500.00	138,612.92	138,613	204,656
					29 Hypochlorite Facility	1.00 LS		156,099.85	161,308.36	13,396.31	7,000.00	117,500.00	455,304.52	455,305	672,937
	43				Plant Effluent Disinfection Facility										
	03				Concrete	441.38 CY		315.61	484.25	19.71			819.56	361,739	534,092
	05				Metals	1.00 LS		30,780.67	96,031.49	5,123.50			131,935.66	131,936	194,797
	06				Wood, Plastics & Composites	1.00 LS		8,329.93	12,990.99				21,320.92	21,321	31,479
	07				Thermal & Moisture Protection	1.00 LS		12,801.06	25,153.10	53.01			38,007.17	38,007	56,116
	08				Openings	1.00 LS		8,438.41	12,911.90	10.63			21,360.94	21,361	31,538
	09				Finishes	1.00 LS					5,000.00		5,000.00	5,000	7,882
	22				Plumbing	1.00 LS		16,430.36	10,000.00				26,430.36	26,430	39,023
	26				Electrical	1.00 LS		75,000.00	100,000.00	25,000.00			200,000.00	200,000	295,291
	35				Waterway & Marine Construction	1.00 LS		29,754.48	51,000.00			118,284.00	199,038.48	199,038	293,871
	40				Process Integration	1.00 LS		40,584.84	136,940.09	77.52	494.20		178,096.65	178,097	263,001
	46				Water & Wastewater Equipment	1.00 LS		46,502.08	39,760.00	4,419.51	2,800.00	1,984,080.00	2,077,561.59	2,077,562	3,067,707
					43 Plant Effluent Disinfection Facility	1.00 LS		407,926.50	698,524.27	43,381.90	8,294.20	2,102,364.00	3,260,490.87	3,260,491	4,814,798
	44				Reuse Disinfection Facility										
	03				Concrete	31.38 CY		149.74	221.71	5.67			377.12	11,834	17,472
	05				Metals	1.00 LS		5,351.30	5,209.38	1,325.87			11,886.55	11,887	17,550
	06				Wood, Plastics & Composites	1.00 LS		7,695.29	4,628.18	686.04			13,009.51	13,010	19,208
	09				Finishes	1.00 LS					5,000.00		5,000.00	5,000	7,882
	26				Electrical	1.00 LS		20,000.00	10,000.00	5,000.00			35,000.00	35,000	51,676
	40				Process Integration	1.00 LS		29,034.94	73,797.34	895.69	623.74		104,351.71	104,352	154,133
	46				Water & Wastewater Equipment	1.00 LS		18,690.88		7,095.20		371,404.00	397,190.08	397,190	586,433
					44 Reuse Disinfection Facility	1.00 LS		85,471.19	100,592.09	15,180.79	5,623.74	371,404.00	578,271.81	578,272	854,355
					B Phase 1b	1.00 LS		813,638.45	1,312,071.30	134,098.47	128,250.94	2,611,268.00	4,999,327.16	4,999,327	7,394,108

Bid Group	Bid Item	CSI	Assembly	Phase	Description	Takeoff Quantity	Crew	Labor Cost/Unit	Material Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Process Equip Cost/Unit	Total Cost/Unit	Total Amount	Grand Total
C					Phase 1c										
	01				Site Civil & Electrical										
		31			Earthwork	1.00 LS		7,822.18	943.25	9,536.85	5,000.00		23,302.28	23,302	34,905
		32			Exterior Improvements	1.00 LS		2,111.74	20,059.34	1,320.15			23,491.23	23,491	34,684
	02				01 Site Civil & Electrical	1.00 LS		9,933.92	21,002.59	10,857.00	5,000.00		46,793.51	46,794	69,589
					Yard Piping: PI, Primary Influent										
		40			Process Integration	1.00 LS		49,343.91	74,342.33	29,402.26			153,088.50	153,089	226,028
					02 Yard Piping: PI, Primary Influent	1.00 LS		49,343.91	74,342.33	29,402.26			153,088.50	153,089	226,028
	03				Yard Piping: PE, Primary Effluent										
		40			Process Integration	1.00 LS		15,646.70	29,103.35	7,451.29			52,201.34	52,201	77,073
					03 Yard Piping: PE, Primary Effluent	1.00 LS		15,646.70	29,103.35	7,451.29			52,201.34	52,201	77,073
	21				Primary Clarifier #3 (65 FT DIA)										
		03			Concrete	244.54 CY		330.76	243.67	7.40			581.83	142,280	210,069
		09			Finishes	1.00 LS					5,000.00		5,000.00	5,000	7,882
		26			Electrical	1.00 LS		2,000.00	1,500.00	500.00			4,000.00	4,000	5,906
		31			Earthwork	1.00 LS		33,644.55	2,000.00	14,729.84			50,374.39	50,374	74,376
		40			Process Integration	1.00 LS		8,013.17	35,263.12	1,759.61	143.00		45,178.90	45,179	66,719
		46			Water & Wastewater Equipment	1.00 LS		28,545.12	650.00	10,288.86		188,000.00	227,483.98	227,484	335,870
					21 Primary Clarifier #3 (65 FT DIA)	1.00 EA		153,085.75	99,001.17	29,086.92	5,143.00	188,000.00	474,316.84	474,317	700,822
	22				New Primary Sludge Pump Station										
		03			Concrete	72.97 CY		453.76	1,239.26	83.31			1,776.33	129,619	191,376
		04			Masonry	1.00 LS		2,142.65	970.32	18.79			3,131.76	3,132	4,624
		05			Metals	1.00 LS		15,886.44	84,752.21	2,714.90			103,353.55	103,354	152,597
		07			Thermal & Moisture Protection	1.00 LS		7,802.01	10,639.57	64.15			18,505.73	18,506	27,323
		08			Openings	1.00 LS		8,095.20	14,142.82	13.28			22,251.30	22,251	32,853
		09			Finishes	1.00 LS					5,000.00		5,000.00	5,000	7,882
		22			Plumbing	1.00 LS		12,034.06	13,802.71				25,836.77	25,837	38,147
		23			HVAC	1.00 LS		7,868.59	10,000.00	1,424.57			19,293.16	19,293	28,486
		26			Electrical	1.00 LS		34,654.94	30,710.00	10,000.00			75,364.94	75,365	111,273
		31			Earthwork	1.00 LS		8,255.31		3,457.84			11,713.15	11,713	17,294
		40			Process Integration	1.00 LS		39,532.06	95,437.09	1,683.81	1,847.29		138,500.25	138,500	204,674
		46			Water & Wastewater Equipment	1.00 LS		18,630.62	7,014.00	5,587.47	3,600.00	119,700.00	154,532.09	154,532	228,520
					22 New Primary Sludge Pump Station	1.00 LS		188,012.64	357,897.36	31,043.96	10,447.29	119,700.00	707,101.25	707,101	1,045,048
	23				New PI Splitter Box										
		03			Concrete	111.65 CY		455.32	250.66	5.95			711.93	79,487	117,359
		05			Metals	1.00 LS		3,229.38	12,084.40	136.25			15,450.03	15,450	22,811
		31			Earthwork	1.00 LS		25,415.29	560.55	3,489.64			29,465.48	29,465	43,504
		40			Process Integration	1.00 LS		19,098.41	88,554.05	14,088.52			121,740.98	121,741	179,745
					23 New PI Splitter Box	1.00 LS		98,579.49	129,185.24	18,378.48			246,143.21	246,143	363,419
					C Phase 1c	1.00 LS		514,602.41	710,532.04	126,219.91	20,590.29	307,700.00	1,679,644.65	1,679,645	2,481,979

Bid Group	Bid Item	CSI	Assembly	Phase	Description	Takeoff Quantity	Crew	Labor Cost/Unit	Material Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Process Equip Cost/Unit	Total Cost/Unit	Total Amount	Grand Total
D					Phase 2										
	19				PrimarySludge Pump Station #1										
		02			Existing Conditions	1.00 LS		13,619.30		4,788.88			18,408.18	18,408	27,179
		03			Concrete	1.74 CY		244.67	198.94	2.02			445.63	775	1,145
		22			Plumbing	1.00 LS		1,434.70	3,871.89				5,306.59	5,307	7,835
		26			Electrical	1.00 LS		4,654.94	10,710.00				15,364.94	15,365	22,686
		40			Process Integration	1.00 LS		8,588.20	8,425.80	2,660.97			19,674.97	19,675	29,049
		46			Water & Wastewater Equipment	1.00 LS		18,630.62	7,014.00	5,587.47	3,600.00	119,700.00	154,532.09	154,532	228,520
					19 PrimarySludge Pump Station #1	1.00 LS		47,353.49	30,367.84	13,040.83	3,600.00	119,700.00	214,062.16	214,062	316,413
					D Phase 2	1.00 LS		47,353.49	30,367.84	13,040.83	3,600.00	119,700.00	214,062.16	214,062	316,413

Bid Group	Bid Item	CSI	Assembly	Phase	Description	Takeoff Quantity	Crew	Labor Cost/Unit	Material Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Process Equip Cost/Unit	Total Cost/Unit	Total Amount	Grand Total
E					Phase 3 (AB #3)										
	31.1				Retrofit Aeration Basins #1,#2, & #3										
		02			Existing Conditions	1.00 LS		151,408.37	184.83	2,718.34			154,311.54	154,312	227,834
		03			Concrete	107.98 CY		500.91	240.26	6.55			747.72	80,738	119,207
		05			Metals	1.00 LS		10,486.82	5,112.69	2,221.90			17,821.41	17,821	26,313
		26			Electrical	1.00 LS		15,000.00	5,000.00	2,500.00			22,500.00	22,500	33,220
		40			Process Integration	1.00 LS		105,493.93	305,487.70	2,567.78	17,220.64		430,770.05	430,770	637,735
		46			Water & Wastewater Equipment	1.00 LS		149,136.71	24,190.16	4,248.71	1,400.00	700,250.03	879,225.61	879,226	1,298,277
					31.1 Retrofit Aeration Basins #1,#2, & #3	1.00 LS		485,614.19	365,918.59	14,963.52	18,620.64	700,250.03	1,585,366.97	1,585,367	2,342,586
					E Phase 3 (AB #3)	1.00 EA		485,614.19	365,918.59	14,963.52	18,620.64	700,250.03	1,585,366.97	1,585,367	2,342,586

Bid Group	Bid Item	CSI	Assembly	Phase	Description	Takeoff Quantity	Crew	Labor Cost/Unit	Material Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Process Equip Cost/Unit	Total Cost/Unit	Total Amount	Grand Total
F					Phase 4 (AB #2)										
	31.1				Retrofit Aeration Basins #1,#2, & #3										
		02			Existing Conditions	1.00 LS		148,193.57		1,527.14			149,720.71	149,721	221,056
		03			Concrete	176.88 CY		305.79	146.67	4.00			456.46	80,738	119,207
		05			Metals	1.00 LS		10,486.82	5,112.69	2,221.90			17,821.41	17,821	26,313
		26			Electrical	1.00 LS		15,000.00	5,000.00	2,500.00			22,500.00	22,500	33,220
		31			Earthwork	1.00 LS		1,876.02	210.35	1,092.79			3,179.16	3,179	4,694
		40			Process Integration	1.00 LS		125,021.31	359,705.03	2,734.93	17,896.48		505,357.75	505,358	747,928
		46			Water & Wastewater Equipment	1.00 LS		153,012.98	25,631.16	5,112.84	1,400.00	720,250.03	905,407.01	905,407	1,336,933
					31.1 Retrofit Aeration Basins #1,#2, & #3	1.00 LS		507,679.06	421,602.44	15,896.39	19,296.48	720,250.03	1,684,724.40	1,684,724	2,489,350
					F Phase 4 (AB #2)	1.00 EA		507,679.06	421,602.44	15,896.39	19,296.48	720,250.03	1,684,724.40	1,684,724	2,489,350

Bid Group	Bid Item	CSI	Assembly	Phase	Description	Takeoff Quantity	Crew	Labor Cost/Unit	Material Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Process Equip Cost/Unit	Total Cost/Unit	Total Amount	Grand Total
G					Phase 5 (AB #1)										
	31.1				Retrofit Aeration Basins #1,#2, & #3										
		02			Existing Conditions	1.00 LS		148,193.57		1,527.14			149,720.71	149,721	221,056
		03			Concrete	315.54 CY		385.13	252.31	5.70			643.14	202,937	299,627
		05			Metals	1.00 LS		19,438.32	28,717.79	3,552.53			51,708.64	51,709	76,346
		08			Openings	1.00 LS		535.79	2,797.08				3,332.87	3,333	4,921
		26			Electrical	1.00 LS		15,000.00	5,000.00	2,500.00			22,500.00	22,500	33,220
		31			Earthwork	1.00 LS		1,876.02	210.35	1,092.79			3,179.16	3,179	4,694
		40			Process Integration	1.00 LS		104,376.09	321,904.71	2,567.78	17,203.75		446,052.33	446,052	660,297
		46			Water & Wastewater Equipment	1.00 LS		133,646.64	24,141.66	864.14	1,400.00	349,290.03	509,342.47	509,342	752,161
					31.1 Retrofit Aeration Basins #1,#2, & #3	1.00 LS		544,591.70	462,383.88	13,903.74	18,603.75	349,290.03	1,388,773.10	1,388,773	2,052,322
					G Phase 5 (AB #1)	1.00 EA		544,591.70	462,383.88	13,903.74	18,603.75	349,290.03	1,388,773.10	1,388,773	2,052,322

Bid Group	Bid Item	CSI	Assembly	Phase	Description	Takeoff Quantity	Crew	Labor Cost/Unit	Material Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Process Equip Cost/Unit	Total Cost/Unit	Total Amount	Grand Total	
H					Phase 6											
	67				Solids Dewatering Building											
		02			Existing Conditions	1.00 LS					55,000.00		55,000.00	55,000	86,705	
		05			Metals	1.00 LS		10,174.15	20,845.44	2,373.45			33,393.04	33,393	49,303	
		09			Finishes	1.00 LS					100,000.00		100,000.00	100,000	157,646	
		13			Special Construction	1.00 LS		30,000.00	24,000.00	10,000.00	100,000.00		164,000.00	164,000	252,139	
		23			HVAC	1.00 LS		15,718.30	20,000.00	2,848.29			38,566.59	38,567	56,942	
		26			Electrical	1.00 LS		40,000.00	30,000.00	15,000.00			85,000.00	85,000	125,499	
		40			Process Integration	1.00 LS					350,000.00		350,000.00	350,000	551,759	
		46			Water & Wastewater Equipment	1.00 LS		45,077.74	12,650.00	1,338.45	3,600.00	668,500.00	731,166.19	731,166	1,079,894	
					67 Solids Dewatering Building	1.00 LS		140,970.19	107,495.44	31,560.19	608,600.00	668,500.00	1,557,125.82	1,557,126	2,359,887	
					H Phase 6	1.00 LS		140,970.19	107,495.44	31,560.19	608,600.00	668,500.00	1,557,125.82	1,557,126	2,359,887	

Estimate Totals

Description	Amount	Totals
Labor	4,939,462	
Material	5,990,036	
Subcontract	959,247	
Equipment	1,095,629	
Process Equipment	<u>7,184,658</u>	
Subtotal Direct Costs	20,169,032	20,169,032
Subcontractor Markups	<u>95,925</u>	10.00 %
Subtotal Sub Contractor	95,925	20,264,957
Sales Tax		
Subtotal Sales Tax		20,264,957
Contractors Overheads	1,621,197	8.00 %
Contractors Profit	1,094,308	5.00 %
Bonds & Insurance	<u>919,218</u>	4.00 %
Subtotal Markups	3,634,723	23,899,680
Contingency	<u>5,974,920</u>	25.00 %
Subtotal	5,974,920	29,874,600
Escalation		
Subtotal		29,874,600
Construction Total		29,874,600

Attachment B—Cost Trending

Bend Secondary Expansion
SD Cost Estimate Trend
9-Jun-11

Project Area	PD Report	SD Report	Change	Comments
Phase 1a				
Site Civil & Electrical	\$1,369,000	\$1,036,088	-\$332,912	
Yard Piping: PI	\$119,000	\$141,018	\$22,018	
Yard Piping: PE	\$99,000	\$99,248	\$248	
Yard Piping: ML	\$151,000	\$179,178	\$28,178	
Yard Piping: Misc.	\$675,000	\$675,000	\$0	
ML Splitter Box	\$72,000	\$71,701	-\$299	
Plant Water PS	\$552,000	\$0	-\$552,000	Moved to Phase 1b
Aeration Basin 4	\$2,386,000	\$2,783,469	\$397,469	
New Blower Building	\$1,771,000	\$2,074,307	\$303,307	
Total Phase 1a	\$7,194,000	\$7,060,009	-\$133,991	
Phase 1b				
Site Civil & Electrical	\$127,000	\$254,203	\$127,203	Moved from Phase 7
Yard Piping: SE	\$295,000	\$329,037	\$34,037	
Yard Piping: Effluent Disposal	\$43,000	\$64,822	\$21,822	
Yard Piping: 14"RL tie to 14"FE	\$0	\$22,198	\$22,198	Moved from Phase 7
Filter Building Mods.	\$0	\$35,000	\$35,000	Moved from Phase 7
Hypochlorite Facility	\$765,000	\$455,305	-\$309,695	
PLE UV Disinfection & PWPS	\$0	\$3,260,491	\$3,260,491	
CCB	\$848,000	\$0	-\$848,000	Replaced by PLE UV
Reuse Disinfection Facility	\$0	\$578,272	\$578,272	Moved from Phase 7
Total Phase 1b	\$2,078,000	\$4,999,328	\$2,921,328	
Phase 1c				
Site Civil & Electrical	\$15,000	\$46,794	\$31,794	
Yard Piping: PI	\$147,000	\$153,089	\$6,089	
Yard Piping: PE	\$36,000	\$52,201	\$16,201	
Primary Sludge PS 2	\$416,000	\$707,101	\$291,101	
Primary Clarifier 3	\$451,000	\$474,317	\$23,317	
Primary Splitter Box 2	\$0	\$246,143	\$246,143	
Total Phase 1c	\$1,065,000	\$1,679,645	\$614,645	
Phase 2				
PC 1 Mechanism Replace	\$268,000	\$0	-\$268,000	
PC 2 Mechanism Replace	\$268,000	\$0	-\$268,000	
Primary Sludge PS 1	\$154,000	\$214,062	\$60,062	
Total Phase 2	\$690,000	\$214,062	-\$475,938	
Phase 3				
Retrofit AB 3	\$1,411,000	\$1,585,367	\$174,367	
Total Phase 3	\$1,411,000	\$1,585,367	\$174,367	
Phase 4				
Retrofit AB 2	\$1,395,000	\$1,684,724	\$289,724	
Total Phase 4	\$1,395,000	\$1,684,724	\$289,724	
Phase 5				
Retrofit AB 1	\$1,023,000	\$1,388,773	\$365,773	
Total Phase 5	\$1,023,000	\$1,388,773	\$365,773	
Phase 6				
Solids Building Upgrades	\$1,387,000	\$1,557,126	\$170,126	
Total Phase 6	\$1,387,000	\$1,557,126	\$170,126	
Phase 7				
Site Civil & Electrical	\$60,000	\$0	-\$60,000	Moved to Phase 1B
Yard Piping RL	\$44,000	\$0	-\$44,000	Moved to Phase 1B
Filter Building Mods.	\$35,000	\$0	-\$35,000	Moved to Phase 1B
Reuse UV Facility	\$873,000	\$0	-\$873,000	Moved to Phase 1B
Total Phase 7	\$1,012,000	\$0	-\$1,012,000	
Subtotal Base Constr. Cost	\$17,255,000	\$20,169,034	\$2,914,034	
Subcontractor Markups	\$99,000	\$95,925	-\$3,075	
OH&P, Bonds, Mob, Insur	\$3,113,000	\$3,634,723	\$521,723	
Contingency	\$6,140,000	\$5,974,920	-\$165,080	
Owner Furnished Equipment (none)	\$0	\$0	\$0	
Total Construction Cost:	\$26,607,000	\$29,874,600	\$3,267,600	
EAL Costs (30% of construction)	\$7,982,000	\$8,962,380	\$980,380	
Total Project Cost:	\$34,589,000	\$38,836,980	\$4,247,980	

Bend WRF Solids Meeting/ Discussion

ATTENDEES: Brady Fuller/ CH2M HILL Jim Wodrich/ COB
Jason Krumsick/ CH2M HILL Scott Thompson/ COB
Jim Smith/ CH2M HILL

FROM: CH2M HILL

DATE: March 1, 2011 and March 8, 2011

PROJECT NUMBER: 391657

NOTES by Brady Fuller:

March 1, 2011 Solids Meeting

- 1) Discussed polymer feed system, dilution valve, options for dedicated feed pumps vs. existing common discharge with recirculation back to feed tank.
- 2) Discussed polymer mixing valve, and potential "clogging" which may result in higher variable backpressures, and therefore may change polymer feed rates in the existing pressure setpoint control system. Dedicated polymer feed pumps with mag meter flow setpoint controlling pump speed would improve this control.
- 3) Drying beds- Potential backup to complying with Class B Biosolids regs versus minimum 15-day anaerobic digestion SRT.
- 4) Discussed volume of biosolids hopper
- 5) Ask Steve Prazak for unit weight of biosolids
- 6) Recycle flow streams
 - a) Digester supernatant can be routed to Primary Influent if there is a digester upset of need to store more solids. This could happen in a mechanical failure.
 - b) GBT Filtrate to Primary Splitter structure (May 19, 2011- Jim Wodrich conveyed to CH2M HILL that filtrate gravity line apparently has hydraulic capacity limitations of 400 gpm max)
 - c) GBT filtrate/ WW from BFP to headworks structure
- 7) All digester gravity flow to degas
- 8) Dissolved air flotation thickener is still functional- filtrate reaeration pilot was done in the DAFT
- 9) Dewatering

- a) Flow control set point
 - b) 5 transfer pumps available, and 4 have VFD's
- 10) Krumsick to ask Clean Water Services for information on Kynar pipe performance
- 11) Digester feed system
- a) Feed tank pump- cannot pump thicker than 5% based on nuclear density gauge
 - b) Staff removed the Muffin Monster from the suction side of TWAS mix tank pump to improve suction head conditions.
 - c) 30 gpm on 4 inch suction was apparently causing net positive suction head available (NPSHA) issues.
 - d) New ball check valves on the PS pumps were required.
 - e) Can pump from PS, TWAS to digester separately
- 12) Thickening
- a) Run GBT 24/7. Both PS and TWAS are routed to inlet of digester mix pump
 - b) Always recirculating the blended PS and TWAS back to blend tank
 - c) There is a pressure indicator (PI) on Fisher PCV on post dilution water
 - d) DAFT, potential hip pocket backup to GBT, can achieve 3-3.5% total solids when used with polymer. However, existing DAFT does not presently have capability to add polymer.
- 13) Polymer system
- a) Batch tank= 0.25% active is typical feed concentration today. Post dilution is available to further dilute the polymer
 - b) Store Poly Supersacks or Big Bags in Tin Shed, not in environmentally controlled environment. There is room for 6+ supersacks
- 14) Overhead crane
- a) Potentially can adjust crane end stops to reach gear box.
 - b)
- 15) Dewatering
- a) Jim has entire manual of submittal data for solids bldg. Brady provided it to Krumsick.
 - b) Reilly says Ashbrook makes a dual use unit
 - c) DAFT, Belts, Rollers, Degas Bed – thickening backups, new motor, drive, spare parts

- d) Don't spend time making the backup work
 - e) Cleaning system should remain
 - f) Coordinate programming for cake load to loss in weight algorithm
- 16) Dewatered cake conveyance
- a) Poly slip ring for cake pump not typically used
 - b) Had to overspeed the cake pump to get it moving
 - c) Look at changing conveyor with I/P converter
- 17) Primary sludge pumping
- a) Flow measurement w/ remote PS pump control
 - b) GBT feed pump is the WAS pump
- 18) Secondary scum
- a) SSM- and re use filter back wash to RAS wetwell
 - b) Two (2) sump pumps take care of floor drainage
 - c) Most SSM goes to RAS
 - d) Consider how to avoid sending SSM back to AB

March 8, 2011 Solids Meeting

- 1) Clarify drying bed option for redundancy (affect on gas production, vector attraction, VS destruction). Do a digester study (what if GBT fails for a period of time, use DAFT?)
- 2) This is an option to defer additional digester capacity.
- 3) Study the ongoing solids concentration from 2% toward 4%.
- 4) Is there a need by bypass primary sludge or TWAS to digester 3 due to hydraulic thick sludge bottleneck?
- 5) Measure primary sludge, and remove dependency on feed tank and single centrifugal screw impeller pumping?
- 6) At some point, the sludge production is enough that the WRF runs out of storage capacity in Digester 2 with the current dewatering schedule. When is that?
- 7) What to do to get thicker sludge? Off-line PS thickener. This has odor issues, produces VFAs. Could tweak the primary sludge pumping algorithm to get some fermentation. Rake arm torque setting would need adjusted and tested.
- 8) Belt press spray bar. Need to move wash box to get at spray bar on existing BDP unit. Motors and hydraulic system require maintenance. Some struvite accumulation on rollers, makes it lose belt tracking ability.

- 9) Motor housings rusted away in short time period. The dry polymer fill method includes a big bag of polymer held by the crane. Put a plastic bag over the fill point to prevent moisture contamination.

PRESENTATION

Bend WRF Predesign: Schematic Design Solids Workshop



Dave Green, CH2M HILL *William Leaf, CH2M HILL*
Jim Griffiths, CH2M HILL *Brady Fuller, CH2M HILL*
Jim Smith, CH2M HILL
Jason Krumsick, CH2M HILL

March 1, 2011 **CH2MHILL**

Workshop Agenda

- Project Overview – Work to Date
- Project Definition Review Solids
- Schematic Design:
 - Thickening
 - Digestion
 - Dewatering
 - Filtrate Conveyance
 - Cake Storage and Load out
 - Polymer System
 - Near Term Solids Recommendations
- Schematic Design - Next Steps

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Project Overview

- Process Evaluation Work – Selection of IFAS
- Deschutes Brewery Evaluation
- Predesign
 - Project Definition (kicked off in September 2010)
 - Schematic Design
- Project Definition
 - Final Report delivered in February 2011

3 **CH2MHILL**

Project Definition Review Design Criteria - Flows

Year 2030 - Projected Flows (2008 Facilities Plan)

Flow Condition (mgd)

- Average Annual Flow 10.9
- **Average Day Maximum Month Flow 11.9**
- Peak Day Flow 13.6
- Peak Dry Weather Flow 21.4
- Peak Wet Weather Flow 29.1

4 **CH2MHILL**

Project Definition Review Design Criteria - Loads

Year 2030 - Projected Loads (2008 Facilities Plan)

Biochemical Oxygen Demand Loading (ppd)

- Average Annual 31,800
- Average Day Maximum Month 38,800

Total Suspended Solids Loading (ppd)

- Average Annual 31,300
- Average Day Maximum Month 42,600

Total Kjeldahl Nitrogen Loading (ppd)

- Average Annual 4,500
- Average Day Maximum Month 5,900

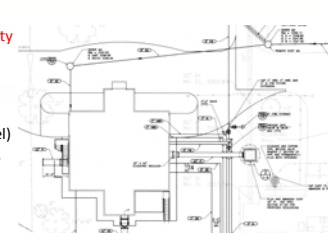
NH3-N Loading (ppd)

- Average Annual 2,900
- Average Day Maximum Month 3,600

5 **CH2MHILL**

Project Definition Review Headworks

- **No work planned for this facility**
- Existing Capacity: 30 MGD
- Ultimate Capacity: 45 MGD
- Buildout Capacity: 50 MGD (from Collection System Model)
- Utilize existing 42-inch header in headworks



6 **CH2MHILL**

Project Definition Review Primary Clarifier Recommendations

Primary Clarifiers

- Construct 3rd Primary Clarifier immediately. Primary Clarifier No. 4 is not required until 2030 (> 30 mgd peak flow).
- Replace or rehab mechanisms for existing PC1 and PC2. Evaluate SST versus coated steel solutions.
- New splitter box and possible Plant Drain Pump Station.

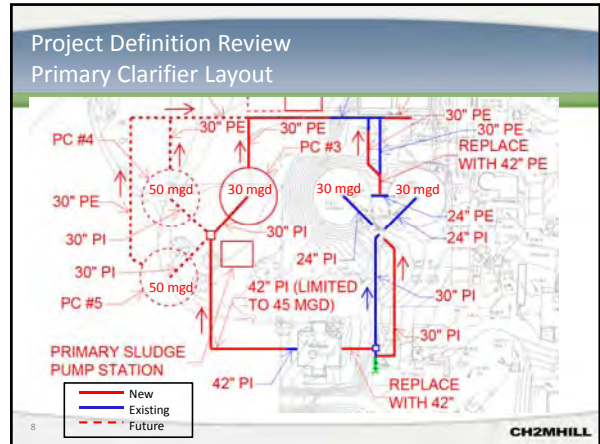
New Primary Sludge Pump Station

- New sludge pumps (air-operated diaphragm, screw-centrifugal, or progressing cavity)

Existing Primary Sludge Pump Station

- Upgrade ventilation to meet NFPA 820
- Upgrade pump systems to match new pump station
- Controls

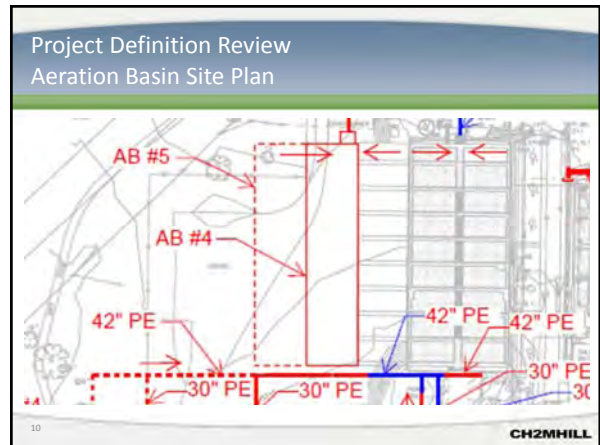
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Project Definition Review Aeration Basins

- Project Definition to determine number of aeration basins and associated IFAS configuration
- Three (3) Existing 1.05-Mgal aeration basins – operated in a MLE configuration
- Two alternatives for expansion
 - Alternative 1 from Fact Sheet dropped
 - Alternative 1 (Alt 2 in Fact Sheet)
 - Convert 3 existing units to IFAS configuration
 - Aeration Basin (AB) 4 not installed
 - Alternative 2 (Alt 3 in Fact Sheet)
 - Build AB 4 prior to converting AB 1, 2, and 3
 - Build AB 4 w/common wall construction
 - Optimize media distribution

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Project Definition Review Aeration Basins – Recommendation

Feature	Sizing Information
Retrofit Aeration Basin 1, 2, and 3 to an IFAS system	See Fact Sheet 4
Install Aeration Basin 4	Length x Width = 210 ft x 44 ft Side water depth = 15 ft Anoxic volume per basin = 0.48 MG Aerobic volume per basin = 0.56 MG IFAS aerobic volume per basin = 0.34 MG Total volume per basin = 1.04 MG Reactor Configuration Equal to AB 1, 2, and 3 (See Fact Sheet 4)
Near-term Process Capacity	Use common wall construction with Aeration Basin 3 8.5-mgd ADMM
IFAS Carrier Media Volume	AB 1 – No Media, internal modifications for future media only AB 2 – 427.1 yd ³ (25% Fill) AB 3 – 427.1 yd ³ (25% Fill) AB 4 – 427.1 yd ³ (25% Fill)

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Project Definition Review Aeration Basins – Air Demands

IFAS Zone DO = 4.0 mg/L Wastewater Temperature = 25°C				
ADMM Wastewater Flow	7.3 MGD	8.5 MGD	11.9 MGD	17 MGD
Maximum Month Air Demand (scfm) ¹	17,100	20,000	27,500	37,600
Maximum Week Air Demand (scfm) ²	21,600	25,200	34,700	47,400

IFAS Zone DO = 6.0 mg/L Wastewater Temperature = 15°C				
ADMM Wastewater Flow	7.3 MGD	8.5 MGD	11.9 MGD	17 MGD
Maximum Month Air Demand (scfm) ¹	22,300	25,700	35,000	52,500

IFAS Zone DO = 2.0 mg/L Wastewater Temperature = 25°C				
ADMM Wastewater Flow	7.3 MGD	8.5 MGD	11.9 MGD	17 MGD
Minimum Week Air Demand (scfm) ³	3,600	4,100	5,800	8,200

- Maximum month influent flows, as listed, with the associated loads are utilized
- Maximum week influent flow and loads, associated with the listed ADMM value, are utilized
- Minimum week influent flow and loads, associated with the listed ADMM value, are utilized

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Project Definition Review Blower Building(s) - Recommendations

- Construct new block building, with five 300 hp and one 100 hp high-speed direct-drive turbo blowers. Redundancy will be provided by the existing centrifugal blowers.
- The new blower building will provide process air to treat up to 8.5 mgd ADMM influent flow.
- Providing this new building will allow for easier retrofitting of the existing blower building as flows reach 8.5 mgd ADMM.
- Above 8.5 mgd ADMM:
 - Install a sixth 300 hp direct-drive turbo blower in the new blower building
 - Retrofit and replace the existing 250 hp blowers in the existing blower building with four 300 hp high-speed direct-drive turbo blowers
- At full build out of both blower buildings (16 mgd ADMM, DO 6mg/L, waste water temp 25°C) blower system will consist of:
 - Six 300 hp high-speed direct-drive turbo blowers in the new blower building
 - And four 300 hp high speed direct drive turbo blowers in the existing retrofitted blower building.

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Project Definition Review Secondary Clarifiers

- Capacity with (3) existing clarifiers addresses near-term conditions:
 - Up to 10-mgd ADMM, firm capacity
 - Fourth clarifier needed about 2025/2027 (based on facility plan projections of flow and load)
 - RAS withdrawal through the clarifier mechanism and RAS piping is expected to meet RAS rates required for the IFAS process up to ADMM of 11.5 mgd. (Testing during schematic design has confirmed).
- One more (fourth clarifier) provides capacity for 16-mgd ADMM (assuming 4 IFAS aeration basins in service)
- Fifth clarifier required for buildout beyond 17-mgd ADMM
- With the IFAS secondary treatment process being a relatively high-rate system (lower SRT values), the RAS withdrawal rate becomes limiting
- New RAS pump station is likely required about the same time as Secondary Clarifier No. 4

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Project Definition Review Secondary Clarifiers – New Splitter Structure

- Construct new Secondary Splitter Box to serve future SC 4 and SC 5
- Required to reduce headloss between the aeration basins and secondary clarifiers
- Hydraulic connection between the proposed new splitter box and the existing splitter box is recommended to provide equal flow split with parallel ML pipes

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Project Definition Review Plant Effluent Disinfection

- Existing CCBs currently used for disinfection of all plant flow. Reuse flow is pumped from CCB effluent through filters
 - Existing CCBs are at capacity
 - Requires reconfiguration of reuse flow to meet current DEQ requirements
 - Location is not suitable for long-term expansion
- Existing 42" outfall will be at capacity for planned 30 mgd peak flows
 - Parallel outfall required when peak flows exceed 30 mgd
- Replace existing chlorine gas system with delivered sodium hypochlorite system
 - Provide 60-day storage for WRF and for use at off-site applications

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Project Definition Review Plant Effluent Disinfection

- Existing CCB/chlorine facilities located east and plant expanding to west and north. Recommend abandoning them and laying out facilities for buildout.
- Add two new 15-mgd CCBs in the area north of reuse facility
 - Existing Pronghorn and Avion lines to be rerouted around basins, parallel to existing plant outfall
 - Parshall flume to measure plant effluent flow (CCB 1&2, and 3&4 each have a Parshall flume) to provide turndown over flow range
- New Chemical Facility south of new CCBs
 - Sunshade structure with insulated bulk storage tanks for delivered sodium hypochlorite
 - 3-foot containment walls for tanks and 8-inch containment curbs for pumps
 - Sufficient add'l storage of chemical provided for winter usage and for remote water use.

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Project Definition Review Plant Outfall - Hydraulic Improvements

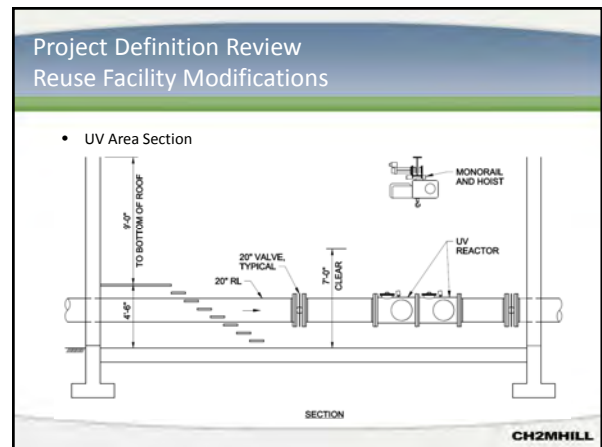
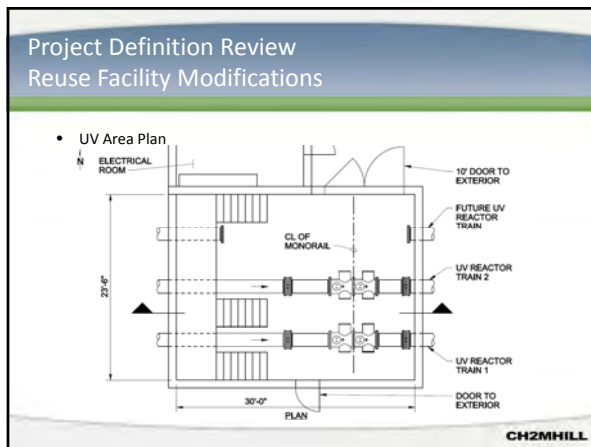
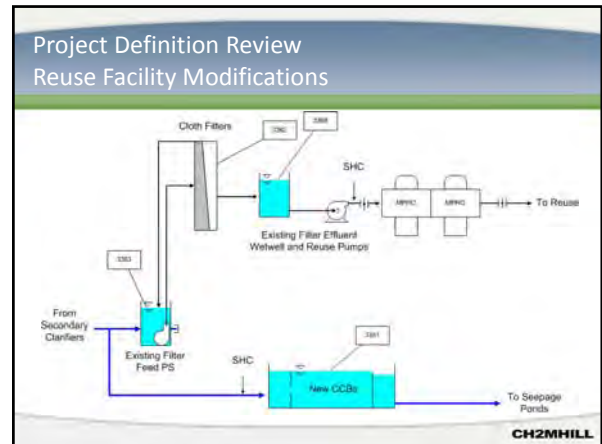
- Existing 42-inch outfall pipe is adequate to about 30 mgd.
- Recommendation: Beyond 30 mgd peak flow, recommend parallel 42-inch line and modifications at distribution structure.

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Project Definition Review Reuse Facility Modifications

- In-vessel UV (Recommended)
 - Modify SE piping to divert SE to existing filter feed PS
 - Utilize existing Pronghorn reuse pumps to drive flow through new in-vessel UV units and on to Pronghorn
 - Use sodium hypochlorite for residual in reuse pipeline
 - Reroute re-use (RL) piping parallel to existing 42" outfall, around new CCBs
 - Evaluate low pressure vs. medium pressure high output technology in Schematic Design

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Workshop Agenda

- Project Overview – Work to Date
- Project Definition Review Solids
- Schematic Design:
 - Thickening
 - Digestion
 - Dewatering
 - Filtrate Conveyance
 - Cake Storage and Load out
 - Polymer System
 - Near Term Solids Recommendations
- Schematic Design - Next Steps

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Project Definition Review – Solids Bldg

- Improvements and evaluations identified in Project Definition:
 - Removal of centrifuge new Belt Filter Press
 - Add new cake pump
 - Conversion of existing Belt Filter Press to Dual use BFP/GBT.
 - Evaluate Polymer system and feed pumps to feed two BFP in parallel.

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Project Definition Review – Solids Bldg (continued)

- Improvements and evaluations identified in Project Definition
 - Add odorless air curtain and exhaust hood around BFPs and GBT.
 - Filtrate line rerouting and Struvite mitigation.
 - Implement Control improvements for better automation
 - New wash water pump for new BFP

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Project Definition Review

- Solids Building – Long Term:
 - GBT adequate through build out (17.5 MGD)
 - Replace centrifuge with a second BFP, cake pumps and associated wash water pump. 2 BFP running in parallel. A third BFP or longer operating hours are ultimately required.
 - A third BFP or second GBT requires expanding existing solids building or dedicating the building to dewatering only.
 - Further evaluation of technology and plant configuration/layout will need to be conducted as this deadline approaches.

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Schematic Design Thickening – Gravity Belt Thickener

- Summary:
 - Current GBT provides WAS thickening capacity through build out (17.5 MGD). Additional WAS pumping capacity will be required to upgrade from current capacity of 200 gpm to 230 gpm at build out.
- Critical assumptions:
 - Hydraulic capacity of current GBT: 400 gpm
 - Solid Loading capacity of GBT: 650 lb/hr*m
 - Current WAS pumping capacity: 200 gpm
 - Solids Capture Efficiency: 90%
 - Operation: 24 hr/day, 7 days/week
 - Target Performance: TWAS 8% TS



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Schematic Design Thickening – GBT Cont)

- Redundancy (rather than mods to existing BFP)
 - Existing DAFT
 - Spare Parts on site (rollers, bearings, belts, motors, TWAS pump spare parts)
 - Liquid Storage in Secondary Process
- Recommendations
 - Existing GBT capacity is adequate past year 2030. Add additional WAS pumping capacity with the construction of the fourth Secondary clarifier. This will provide thickening capacity through Build out, 17.5 MGD
- Other O&M issues?

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Schematic Design Digestion

- Summary
 - Additional thickening performance (PS thickness greater than 4%) or digester capacity will be required at approximate 8.5 MGD max month influent flow to provide a minimum 15 day SRT with the existing digester capacity



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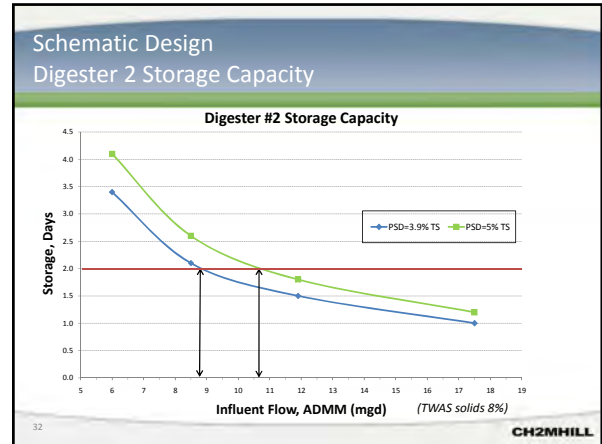
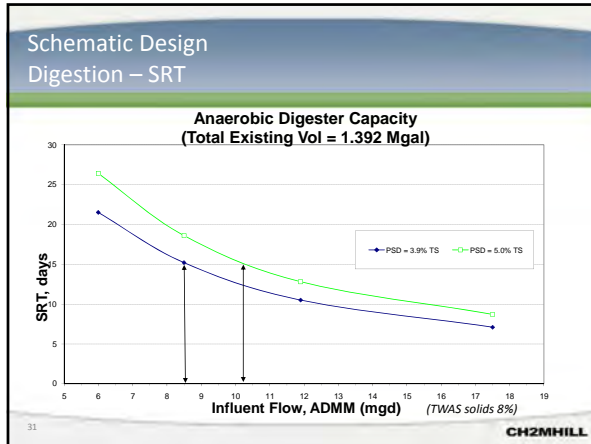
Schematic Design Digestion – Cont)

- Critical assumptions
 - Digester operations: Feed to Digester 3, overflow to Digester 1, overflow to Digester 2. Digester 2 is BFP feed tank with SWD 15' and 13' of storage
 - Primary Sludge solids: 4% versus 5%
 - TWAS solids: 8%
 - Digester volumes:


Digester 1	800,000 gallons
Digester 2	375,616 gallons
Digester 3	216,690 gallons
Total	1,392,306 gallons

From Bends biosolids management plan, April 2010


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- ### Schematic Design Digestion – Cont)
- Additional discussion topics
 - Primary Sludge pumping flow measurement issues
 - Digester Feed pump: Ability to pumping thick sludge?
 - Redundancy/reliability:
 - Digested Sludge in Degas beds
 - Drying bed storage time
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- ### Schematic Design Digestion – Cont)
- Recommendations
 - Thick sludge feed targets to extend Digester capacity:
 - Primary sludge 5% T.S.
 - TWAS – 8% T.S.
 - Build Gravity thickener or additional Digester capacity before influent flows reach 10 MGD
 - Upgrade digester feed suction line from feed tank (and possibly upgrade digester feed pump)
- 
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- ### Schematic Design Dewatering - BFP
- Summary
 - Existing BFP at current operations of 8 hr/day, 5 days/week is at or near current capacity.
 - Adding a second BFP (and operating in parallel), continuing to operate at 8 hr/day, 5 days/week provides dewatering capacity through 8.5 MGD Max Month Influent flow.
 - Adding a second BFP and modifying operations to 8.5 hr/day, 6 days/week or 10 hr/day, 5 days a week will provide dewatering capacity through 2030 (11.9 MGD Max Month influent flow)
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- ### Schematic Design Dewatering - BFP
- Critical Assumptions:
 - 2 meter belt
 - Hydraulic Capacity of existing BFP: 75 gpm/m; **150 gpm**
 - Solids Loading Capacity BFP: 1,050 lb/hr*m; **2,100 lb/hr**
 - Capture efficiency: 95%
- 
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Schematic Design Dewatering – BFP cont)

- **Redundancy:**
 - With one BFP out of service, longer operating hours
 - Spare parts
 - Pump liquid to drying beds
- **Additional discussion topics**
 - O&M access issues:
 - Crane access issues
 - Odorous air curtains and hood conflict
 - Other O&M Issues:

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Schematic Design Dewatering – BFP cont)

- **Recommendations:**
 - Replace existing Centrifuge with a new BFP
 - Provide new Cake Pump associated with new BFP
 - Add bridge breaker to Cake pumps
 - Provide new Wash water pump associated with new BFP
 - Modify building HVAC, BFP Foul Air curtains, exhaust hoods.
 - Add control station to Upper level

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Schematic Design Filtrate

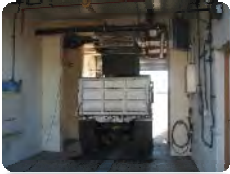
- **Today's system:**
 - BFP filtrate
 - Gravity flow to Degas Beds
 - GBT gravity flow to head of plant.
- **Future system:**
 - Return all filtrate to PI or PE box & bypass Degas Beds
 - Incorporate provisions for adding future phosphorus farming
- **Struvite prevention:** HDPE or Kynar piping
- **Future Ferric Addition** – City moving forward?



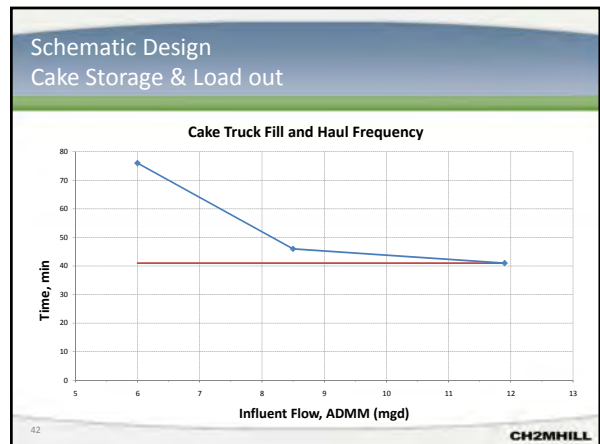
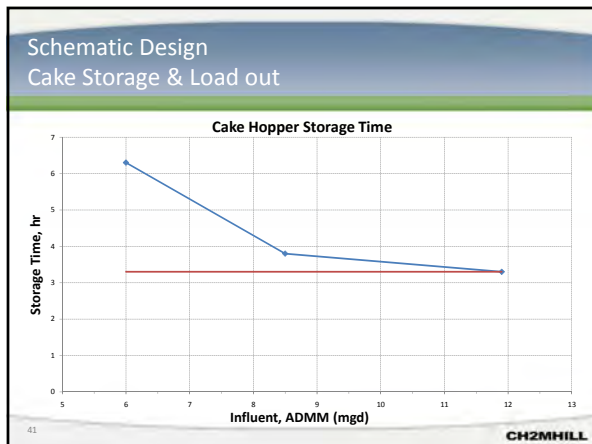
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Schematic Design Cake Storage & Load out

- **Summary**
 - Effective Cake storage volume: 49.5 cubic yards (1337 cubic feet)
- **Critical Assumptions:**
 - Cake % dry solids: 11% currently, assume polymer type and operations are adjusted to produce 17%
 - Cake Specific Weight: 0.95
 - Current cake production at 17% cake dry solids: 7.9 CY/HR
 - Cake Haul Truck Size: 10 CY
- **Additional discussion topics:**
 - Cake hopper Settlement issue




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Schematic Design Polymer System

- Current Polymer system feed issues:
 - Changes in pressures of the Plant water system
 - Changes in pressure of polymer feed tank
 - Control valves and polymer pump speed interaction
 - Clogging in polymer static mixers



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Schematic Design Polymer System

- Critical Assumptions:
 - Current Polymer: Clarifloc WE-1060
 - Polymer Big bag size: 1,650 lb
 - Dry Polymer storage volume: 3 bags, 4,950 lbs
 - Polymer Dose: GBT 13 lb/DT ; BFP 12 lb/DT
 - Make-up dilution ratio: 0.25%
 - Make-up Water: Potable water at 25 gpm
 - Post dilution ratios for GBT & BFP: 0.1%
 - Volume of polymer mix tank: 600 gallons (tank: 5' diameter, 4' tall)
 - Volume of polymer feed tank: 900 gallons (tank: 5' diameter, 6' tall)

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Schematic Design Polymer System – (continued)

- Additional Discussion Topics
 - Provide flexibility to use plant water for make-up water (potable or Plant water)?
 - Dedicated Polymer feed pumps to GBT, BFPs?
- Recommendations
 - Further Evaluation needed.
 - Rapid fill line on Polymer mix tank
 - Increase Polymer make up concentration from 0.25% to 0.4%

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Solids Building Recommendations – Near Term Improvements

- Existing solids building adequate for near term (& 2030) Max Month loadings, pending additional analysis of:
 - Electrical & HVAC space needs
 - Polymer system adequacy
 - Dewatering operational schedule constraints

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Solids Building Recommendations – Near Term Improvements

- Demo/salvage centrifuge. Add 2nd Belt Filter Press
- New cake pump from 2nd Belt Filter Press
- New Wash water Pump for new Belt Filter Press
- Modify existing cake pump with bridge breaker
- Foul air curtain, HVAC system evaluation
- Filtrate improvements (abandon degas beds)
- Solids building lighting evaluation and upgrades
- Include controls upgrades and modifications
- Paint building interior

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Workshop Agenda

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Schematic Design

- As Project Definition Report was being finalized, CH2M HILL started the Schematic Design work.
- Schematic Design will:
 - Further define the recommended project
 - Develop the design disciplines (struct, elect, etc)
 - Develop the P&ID's and preliminary drawings
 - Engage COB staff in further workshops
 - Progress the design to about 25-30% complete

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Work Products for Schematic Design

- Technical Memo's
 - Unit Process TM's
 - Design Discipline TM's
- Process and Instrumentation Diagrams (P&ID's)
- Civil: Overall Site Plan and Yard Piping Plan
- Architectural and Structural Drawings
- Process Mechanical: Process Plans and Major Sections
- Electrical: Motor Control Center One Line Diagrams and Electrical Site Plan

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Updated Schedule for Schematic Design

Schematic Design Phase	12th April
Schematic Design Kickoff	1 day
Internal Kickoff Meeting	1 day
Schematic Design	60 days
Preliminary Mtg - Solids	1 day
SD Workshop - Solids	1 day
SD Workshop No. 1 - Design AEs	1 day
SD Workshop No. 2 - SD Progress	1 day
Review Draft Schematic Design Report	20 days
Assemble Internal Review Copy	2 days
Draft Report ready for internal review	2 days
Internal Review	8 days
Complete Draft Comments	7 days
Deliver Review Comments to PM team	2 days
Final and Prepare Draft Report for Bend	3 days
Deliver Draft SD Report to Bend	3 days
City Review of Draft Report	12 days
Finalized Packaging	10 days
Final Drafting	10 days
Workshop to Review Draft Report (Bend)	1 day
Finalize Schematic Design Report	18 days
Deliver Final Schematic Design Report	1 day

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Updated Schedule for Schematic Design

- Key Dates:
 - Feb 2nd Schematic Design Kickoff
 - Mar 8th Solids Workshop
 - Mar 29th Workshop No. 1 – Alternatives
 - Apr 12th Workshop No. 2 – Progress Review
 - Early June: Draft SD Report to Bend
 - Late June: Draft Report Review Workshop
 - Mid July: Final Report

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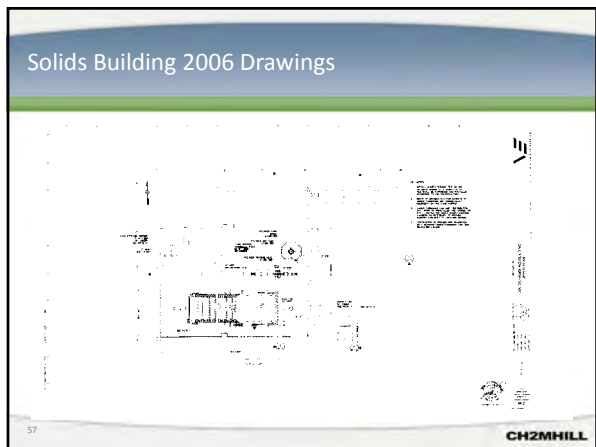
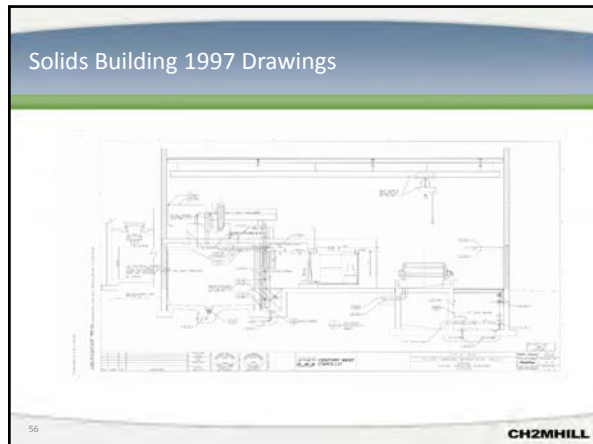
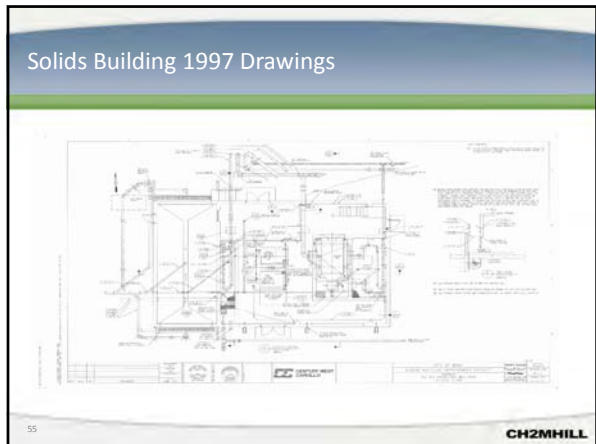
QUESTIONS??

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Extra slides

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Bend WRF Schematic Design Alternatives - March 29, 2011

ATTENDEES: Jim Wodrich/City of Bend
Paul Roy/City of Bend
Bill Leaf/CH2M HILL
Gregg Thompson/CH2M HILL
Dave Green/CH2M HILL

Jim Smith/CH2M HILL
Adrienne Menniti/CH2M HILL
Brady Fuller/CH2M HILL
Jim Griffiths/CH2M HILL

FROM: Brady Fuller

DATE: March 29, 2011

PROJECT NUMBER: 391657

- 1) Project Overview - Work to Date
- 2) Jim W to write a letter to DEQ requesting all \$34.6M, and DEQ will likely provide additional funds.
- 3) Preliminary P&ID's were provided for COB review, along with draft Fact Sheets:
 - a) Preliminary Table of Contents - Schematic Design
 - b) Primary Clarifier Mechanism
 - c) Sludge Pump Type
 - d) Cost analysis for UV and Hypochlorite for Plant Effluent
 - e) UV Disinfection for Reuse - Low Pressure vs Medium Pressure
 - f) Fouling of Ultraviolet Disinfection
 - g) Polymer System Evaluation
 - h) Existing Digester Volume, Capacity and Projected Life
 - i) Filtrate Return Process Evaluation
 - j) Pipe Schedule and Flow Stream ID's (DaveG)
- 4) Evaluations
 - a) Struvite, and ammonia load. CH2M HILL reviewed the process modeling and tech memo prepared last week. Note that the trends are the important observation from the results. Jim to discuss results of the filtrate routing and process modeling with Scott.
 - i) CH to provide future feed points for ferric in the design

- ii) CH to provide information about filtrate line location
- b) Filtrate Routing. City intends to design and install the new filtrate line themselves. City valving it to allow filtrate to still be conveyed to degas beds, but City looking at route for gravity line to degas beds. Try this, and then consider interior.

Brady to get Jim latest record drawings of the area. Assume that they cut PVC washbox water into the same lines to get more dilution. CH2M HILL showed preliminary drawings depicting new Primary Influent piping to splitter box on east side - City will need to coordinate filtrate line location/routing to avoid other piping.
- 5) Bill Leaf noted that with IFAS there could be more orthophosphate removal (due to larger unaerated mass), so this could remove more phosphorus which could show up in digester and cause increased struvite. CH2M HILL to provide taps for future chemical feed upstream of digester (ferric) as well as directly to filtrate (downstream of BFP's). Design Standards
 - a) Flow stream ID preliminary pipe schedule - design team reviewed all the flow stream ID's from all previous projects, including Headworks. City to review the flowstream ID list and confirm choices made are acceptable. There will be some hangover from previous naming conventions used from previous projects- current project will not affect all existing piping.
 - i) SCADA project has design drawings standards, specs, for process diagrams, abbreviations. Design team/City provide plant abbreviations to Harris Group.
 - ii) Paul asked if City had any color and banding recommendations. Jim confirmed that we should follow headworks project (however City bought the identifying devices..so it's not in the spec), use band/labels. Plan for a single pipe color (ship grey or similar) and band by process flowstream, and band locations are specified. Put in the specs. Only paint for corrosion reasons.
 - iii) Pipe schedule
 - (1) Food grade stainless was used for grease reasons in the Headworks - may not be suitable elsewhere in WRF. CH2M HILL will consider for solids building upgrades..
 - (2) CH2M HILL standards - PVC, HDPE, Steel. Jim prefers HDPE as a yard piping material. Jim/Paul OK with allowing multiple types of pipe materials allowed to be bid for a single flow stream. What about multiple types being furnished on the same job for same flow stream.
 - (3) Discussed W1 - Avion vs. well water. Labeling of pipe to clarify water connections for operators. The following service legends will be used. City of Bend to confirm flow stream naming conventions
 - (a) W1 - Avion
 - (b) W2 - Well

- (c) W3 – Reuse
 - (d) W4 – Plant Water
- (4) Plant Effluent will use designation PLE. FE will be deleted.
 - (5) Piping for all services will be a standard color except were there a code requirement for something else. The specification will provide for a pipe label at penetrations and at regular intervals. Label will be a wrap around, with a color designating service and the service legend on the label.
 - (6) Valve and gate actuators –
 - (a) Pneumatic actuators will be the standard
 - (b) Existing electric actuators in PE gallery. City needs to know how many existing valves might be converted and is compressor sizing is affected by the number of valves to retrofit. However, don't put pneumatic actuators in if there are problems with freezing. A dryer on the air system is essential. Put receivers in the nearby buildings. Traps could freeze in winter conditions. Consider 2 north compressors with dryer in blower building. Size to replace all electric actuators in the solids building over time.
 - (c) Sluice gates should be electric actuated.
 - (d) Put air receivers at every facility that would be expected to have air demand. Need hub drain and tank valving to drain condensate out of bottom of tank. Brady to ask Scott Thompson re: if they have ever seen condensate in the air system since the new air dryer was installed, and explain our approach decentralizing the receivers. .
- 6) Hot water loop.
- a) Excess digester gas is available – 40,000 scf per day. Refining calcs, but solids bldg is good candidate, but existing boilers can't serve much heating load beyond load from solids bldg. Extending to additional buildings may require additional boiler capacity. Tell City what heat is available, then City can prioritize (solids bldg, control building and lab for facilities plan footprint since it's closest to the digester complex, check that the heat loop line is big enough, extend to the north wherever we go now). Plan to extend hot water loop since we're digging up the yard now. With SCADA you can prioritize and cut off, or cut back heat to solids, or electric heat backup (in solids, for instance). Always have backup T-stat controlled unit heaters.
 - b) Paul asked about how to use all gas that we're making now. More efficient boilers, or larger capacity, possibly piping gas to where you need it, rather than piping hot water around the site..
 - c) Show HRR/HRS, show colors where there is hot water now, then show increasing capacity and how much more you can use. Maybe a series of colors or phased expansion. State assumptions. Determine heat loss from running it across the site, Goal – zero flare. Arctic pipe, with 3-inches of insulation with HDPE jacket.

- d) Use Facility plan assessment for heating facilities. Provide HRR/HRS pipes for fourth digester.

7) Electrical - Standby Power

- a) Reviewed list of what design team understands is connected, what's proposed to be added,
- b) Prioritize the list of standby power based on what's required for EPA (reliability), and then what's on-line now, then what would be nice for operators. Assume it's in winter, relying on air for actuators,
- c) Consider flow streams and support equipment that interfaces with equipment that's put on-line. (Paul mentioned previous experience with example of belt press, sludge feed provided on backup power, but not polymer feed). Critical ventilation must be on standby power, per EPA requirements and per NFPA 820.
- d) Standby power study needed at WRF to consolidate and document previous projects. Include the standby power system study (PowerTools) in final design scope.
- e) Electrical Coordination study often completed at end of design, so Contractor can set breaker settings at end of construction. CH2M HILL to prepare SOW for Electrical Coordination Study.
- f) Paul asked about use of digester gas to burn in generator, but team discussed how gas scrubbing would make this alternative to use digester gas less practical and uneconomic. Decision was made to utilize package generators with fuel tank integrated into base.
- g) Reviewed preliminary one-line diagrams.

- 8) Consider moving existing motorized strainer. Gregg to consider constructability before committing to relocate (maybe temp manual strainer?)

- 9) Brady to post the handout packages to EADOC for Jim/Paul/CH. Jim and Paul will decide what material, if any, to distribute to other COB team members.

10) I&C Standards

- a) Jim to call Rick Beecham and ask Vertical Projects and Harris Group, to ask about AWWU experience with smart MCC's.
- b) New tagging scheme proposed by Harris Group (maybe consider an overall note that shows that all facility prefixes are there). Jim to provide updated feedback in the next month (Brady to set reminder April 29th). Labeling conduit, wiring.
- c) Other items confirmed (UPS mounted external to Panels in electrical room; wiring diagrams and motor control concepts, receptacles)

11) Architectural approach to new block buildings

- a) Add additional translucent panels and skylights to blower building. Design won't be criticized for having too many translucent panel. Use translucent panels on walls, and skylights. It's a better place to work when you have natural light. All other recommendations confirmed.
- b) Hypochlorite storage building: Heat traced, and insulated tanks and piping, safety showers, manual sump pump to address blowing rain/snow, ramp the forklift or other up to level of grating, eye wash at metering pumps and another at loading station.
- c) Provide concrete or CMU columns (rather than steel columns), open sided structure, sloped roof to shed snow, architect to review hip roof style.
- d) All grating to be fiberglass (even over aeration basin) with UV protection.
- e) Chemical building to be concrete columns with a roof to match headworks architectural style. Provide access to replace chemical tanks.
- f) Fiberglass grating in all applications where required.

12) Yard Piping and facility layout

- a) City has proposed new filtrate return in same vicinity as new PI to existing Primary Clarifiers. Need to coordinate.
- b) From City, how much grit do we anticipate settling in the primary influent piping?
- c) How do the cleaning ports work? Sketch provided by Brady. Brady to look at cost/detailing of ports vs. blind flanges with WHPacific. Think through sequence of construction, installation of valves, gates.
- d) Are 42-in PIs flushable, or do we need dual 30-in PIs (on west side)? Possible to install smaller pipes now and make provisions for future pipes when required.
- e) Where do existing process drains/filtrate return to the front of the WRF? As per a), will the filtrate only be returned in the existing PC 1 and 2?

13) Solids Facilities

- a) Provided the digester capacity memo, documenting discussions from March.
- b) Discussed City preference for replacing existing BFP.
- c) Paul needs to see benefits of switching out existing machine, otherwise there is not sufficient justification. CH2M HILL will provide Paul some O&M reasons which can be translated into costs.
- d) Drop to cake pump directly, out of BFP if you use 2 BFP's.
- e) Show layout of the existing bldg, with side view. Show grating around it, curtains, foul air hood. This would help justify getting rid of existing units. (repainting, HVAC, air changes with and without a hood).
- f) Review of previous workshop recommendations. No additional comments

g) Polymer system recommendations

- i) Possible to bring both potable and non-potable (W4) water to mix tank, like the idea. W4 for rapid fill, potable for wetting head. CH2M HILL to confirm required piping upgrades. **PROVIDE FLEXIBILITY TO USE EITHER WELL WATER OR PLANT EFFLUENT W4 FOR WETTING HEAD. GETTING 125 GPM OF FAST FILL FROM POTABLE WELL WATER SYSTEM LIKELY NOT FEASIBLE.**
- ii) Questions regarding the use of polymer for both dewatering and thickening, cited examples of where this is used (Twin Falls, West Boise). Concern if existing PO is optimized for thickening or dewatering. PO should be optimized to maximize capture, limiting impact on liquids process. Capture is the most important treatment requirement, since solids concentration doesn't significantly affect operating/hauling costs
- iii) CH2M HILL recommended having an uninstalled spare polymer pump.
- iv) Discussed reliability/redundancy of polymer mix system. How to remove impeller of mixer?
- v) Could possibly use package emulsion makeup unit, for GBT, and keep dry system for BFP. Jim said not to provide an emulsion unit
- vi) Need to determine entire solids bldg electrical load and layout of electrical equipment in electrical room (drives, etc.).
- vii) The existing sludge hopper is smaller than preferred , but still has 3 hours of storage at 17 mgd ADMM flows
- viii) Jim said not to provide an emulsion unit. **NO NEED TO EVALUATE STANDBY/TRIAL POLYMER SYSTEM PER JIM WODRICH, AS THE RELIABILITY OF OTHER PLANTS OPERATING WITH ONE POLYMER SYSTEM WERE DISCUSSED AND JUDGED TO BE ADEQUATE.**
- ix) **WITH RESPECT TO BFP DEWATERING AND POLYMER USAGE, .** Capture is the most important treatment requirement, since solids concentration doesn't significantly affect operating/hauling costs.
- x) **PROVIDE FLEXIBILITY FOR DEDICATED POLYMER FEED PUMPS TO SIMPLIFY AND IMPROVE POLYMER FEED RATE CONTROL TO GBT AND BFP'S.**
- xi) The existing hopper is smaller than preferred , but still has 3 hours of storage at 17 mgd ADMM flows. Jim to write a letter to DEQ requesting all \$34.6M, and DEQ will likely provide additional funds.

14) Evaluations

a) Primary Clarifiers

- i) The secondary clarifier were retrofitted with stainless mechanisms when SC No. 3 was constructed.

- ii) Decision made to leave existing mechanisms in PC 1 and 2, and change the mechanisms out when they have to. The assumption of repainting the primary clarifier mechanisms every 20 years is optimistic. Paul feels an assumption of every 10 years is more realistic.
- iii) The primary clarifier analysis did not represent a “do nothing” option for the current primary clarifiers. In order to preserve available capital budget for higher priority areas in the current project, the existing mechanisms will not be replaced or repainted now. The mechanisms will be replaced as needed in the future CH2M HILL to update Fact Sheet to reflect the ‘do nothing’ alternative, and increase the frequency (and costs) for re-coating. The existing primary clarifiers have some deficiencies in the scum system. These issues will not be addressed in the current project. Features like flushing water, a larger scum trough, a more robust scum skimmer will be incorporated into the design of the Primary Clarifier 3A stainless steel mechanism will be installed on PC3. City will recoat PC#1 and PC#2 and replace in following expansion project.

15) Primary Sludge Pumps

- a) Bend would like to get rid of the mix tank. The mix tank allows plant staff to meter and measure the digester influent flow. Primary sludge and TWAS flows will be designed to be routed past the existing digester feed tank, directly to Digester 3. Keeping the mix tank would be helpful if plant was doing GBT thickening not 24/7. Removing the mix tank means that the ability to accurately measure flow and the ability to pump thick sludge to the digester are key design criteria for the new primary sludge pumps.
- b) The primary sludge pumps will be put on a timer for control. There is some concern that pumping primary sludge continually will cause “ratholing”..
- c) The 2 feet per second minimum velocity criteria is for pumping applications with large amounts of grit. Because the primary sludge is thick and because Bend has not observed significant grit accumulation historically, the primary sludge pumps will be put on variable speed drives to allow the flow to be decreased below the minimum velocity standard. However, the pump will also be designed to achieve a maximum flow rate of 180 gpm (resulting in a velocity of 2 ft/s) to provide the flexibility to address primary sludge grit settling issues should they arise in the future. Consider putting drives on the pumps and reduce speed of progressing cavity pumps. Utilize VFD for PS pumps. On/off with timer from SCADA
- d) Sludge density meters provide a continuous measurement of primary sludge concentration and provide operators the ability to optimize the timer control of the pumps. Sludge density meters will be investigated further. Automation - consider blanket readers. .
- e) The new and existing primary sludge pumps will be progressing cavity pumps with variable frequency drives. They will be control with on/off timers from SCADA.
- f) Piggy back motor is preferred over right angle drive.

- 16) 3D spinner views for primary clarifier, pump station and PE gallery
- a) Outboard launder - match existing. Paul asked CH2M HILL to provide cost differential for inboard, vs outboard.
 - b) Separation of wet well vs. pump station allows NFPA 820 advantage.
 - c) Sludge collection hopper. Will match existing.
 - d) CH2M HILL reviewed Aeration Basin gallery layout.

17)

- a) Plant Effluent:

18) P&ID's

Hypochlorite vs. UV - Gregg to add the in-vessel UV option in the memo showing that we removed it from consideration. City want to talk about this and review (power and chemical cost assumptions). City may choose to utilize UV disinfection based on Present Worth costs

19) Hypochlorite metering pump type. - did not review

20) Hypochlorite storage tank sizing/capacity. - did not review

21) Evaluations

- a) Water Reuse System
 - i) Reviewed evaluation of medium pressure vs. low pressure UV for reuse - Paul agreed that City would buy a 2nd on-line transmissivity analyzer. Decision made to move forward with medium pressure system
 - ii) Test transmissivity, fouling of UV - work in progress. Preliminary concentrations and impacts were discussed. Paul agreed that City would buy a 2nd on-line transmissivity analyzer.
- b) Schematic Design(information listed in ppt presentation)Products
- c) Schedule
- d) Key Dates

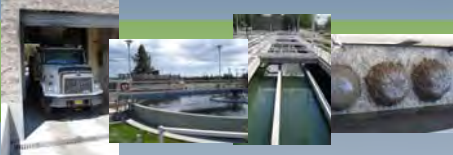
ACTION ITEMS

1. Jim W to write a letter to DEQ requesting all \$34.6M, and DEQ will likely provide additional funds
2. Jim to discuss results of the filtrate routing and process modeling with Scott.
3. CH to provide future feed points for ferric in the design
4. CH to provide information about filtrate line location

5. Brady to get Jim latest record drawings of the area. Assume that they cut PVC washbox water into the same lines to get more dilution
6. City to review the flowstream ID list and confirm choices made are acceptable
7. City of Bend to confirm flow stream naming conventions
8. Gregg to consider constructability before committing to relocate (maybe temp manual strainer?)
9. Jim to call Rick Beecham and ask Vertical Projects and Harris Group, to ask about AWWU experience with smart MCC's
10. Brady to post the handout packages to EADOC for Jim/Paul/CH
11. Jim to provide updated feedback in the next month (Brady to set reminder April 29th). Labeling conduit, wiring
12. CH2M HILL to update Fact Sheet to reflect the 'do nothing' alternative, and increase the frequency (and costs) for re-coating
13. Hypochlorite vs. UV - Gregg to add the in-vessel UV option in the memo showing that we removed it from consideration

PRESENTATION

Bend WRF Predesign: Schematic Design Alternatives



March 29, 2011

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Workshop Agenda

- Project Overview – Work to Date
- Evaluations
 - Struvite, Filtrate Routing and ammonia, nitrogen performance
 - Design Standards
 - Flow stream ID and preliminary pipe schedule
 - Electrical - Standby Power
 - I&C Standards
 - Architectural approach to new block buildings
 - Yard Piping and facility layout
 - Solids Facilities
 - Review of previous workshop recommendations
 - Polymer system recommendations

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Workshop Agenda (continued)

- Evaluations
 - Primary Clarifiers
 - P&ID's
 - Clarifier Mechanisms, Primary Sludge Pumps
 - Plant Effluent:
 - P&ID's
 - Hypochlorite vs. UV
 - Hypochlorite metering pump type
 - Hypochlorite storage tank sizing/capacity

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Workshop Agenda (continued)

- Evaluations
 - Water Reuse System
 - P&ID's
 - Medium pressure vs. low pressure UV
 - Test transmissivity, fouling of UV
- Schematic Design
 - Products
 - Schedule
 - Key Dates
 - Workshop participants

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Schematic Design

- Struvite Issues

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Struvite Issues

- Process Modeling
 - Summary of desktop modeling results
 - Recommendation
- Belt Filter Press Filtrate Piping
 - No equalization
 - New route direct to primary clarifier splitter box
 - Contract for design
- Options for removing struvite
 - Chemical bath
 - Mechanical means

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Schematic Design

- Process Modeling

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Process Modeling

- Process Modeling Goal
 - Determine plant effluent impacts from dewatering filtrate return with bypass of degas beds
 - Ammonia-N values are primary concern
- Methodology
 - Initial review in Pro2D™
 - Development of BioWin™ to provide dynamic simulation
- Influent Conditions
 - Average Annual Influent Flow = 5.5 mgd
 - Multiple scenarios with varying influent wastewater temperatures
 - Diurnal conditions from previous DB piloting work

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Process Modeling – Diurnal Influent Conditions

Bend WRF - Diurnal Flow

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Process Modeling – Results

Current Conditions – Filtrate Equalization

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Process Modeling – Results

Bypass Conditions – Filtrate Return, 8-hrs/day (starting at 8:00 AM)

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Process Modeling – Results

- Summary
 - Dynamic Trending from current to proposed bypass conditions are similar
 - Detrimental impact on overall plant effluent not anticipated
 - With filtrate bypass, close monitoring of plant effluent recommended

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Schematic Design

- Design Standards

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Schematic Design Standards
Flow stream ID and Pipe schedule

Flow Streams

- Integrated flow streams from Headworks project and recent Controls work (Kanyuch)
- Some duplication and consolidation
 - W1/W2/W3
 - Plant Effluent/Final Effluent
- Needs review from City of Bend staff

Pipe Schedule (handout)

- Integrated pipe materials from Headworks project
 - Food grade SST – applications?
- CH2M HILL standards – PVC, HDPE, Steel
- Recent Oak Lodge Value Analysis for Yard Piping

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Schematic Design Standards
Actuators and Hot Water Loop

Valve and Gate Actuators

- Pneumatic actuators will be the standard
- Some existing electric actuators (next to new pneumatic actuators)
- Pneumatic operators suitable for exterior locations?

Hot Water Loop Heating

- Excess digester gas is available
- Solids Building is nearby – good candidate
- Extending to additional buildings may require additional boiler capacity

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Schematic Design

- Electrical

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Schematic Design Standards
Electrical - Standby Power

Standby Power table developed, showing:

Existing equipment on standby power:

- Existing Primary Sludge PS (MCC-PSP)
- Existing Plant Water PS: (MCC-PW) – *To be dropped?*
- Digester Building (MCC-D and MCC-D1)
- Admin Building – *Currently connected*
- Maintenance Building – *Currently connected*
- Thickener Building (MCC-W) – *No longer in use?*
- Headworks Building (MCC-HW)
- Solids Handling Building (MCC-SH) – *Necessary?*

Proposing to add:

- New Primary Sludge PS
- New Solids Facility equipment

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Schematic Design Standards
Electrical - Standby Power Table

New equipment proposed for new generator/standby power (EPA minimum):

- **New Plant Water Pump Station:**
 - W4 Pumps No. 1-4 *Could limit number of W4 pumps?*
 - Motorized Strainer
- **New Chemical Building and New CCB's:**
 - Hypochlorite Pumps
 - Hypochlorite Mixer
 - Sample Pumps

Preliminary Sizing (new generator): 300-400 kW

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Schematic Design Standards Electrical - Standby Power

Other optional equipment on Standby Power (COB choice)?

- Aeration blowers – significant power demand
- Maintenance/Admin Bldg?

Preliminary one-line diagrams (handout)

ELECTRIC POWER SYSTEM			
Excludes Generation Class I, II, III			
Power Source - two separate and independent electric power sources from either two separate utility substations or one substation and one standby generator			
Capacity of backup power source	Class I	Class II*	Class III*
Mechanical bar screen or comminators	Yes	Yes	Yes
Main pumps	Yes	Yes	Yes
Degriting	Optional	No	No
Primary sedimentation	Yes	Yes	Yes
Secondary treatment	Yes	Optional	No
Final sedimentation	Yes	Optional	No
Advanced waste treatment	Yes	Optional	No
Disinfection	Yes	Yes	Yes
Sudge handling and treatment	Optional	No	No
Critical lighting and ventilation	Yes	Yes	Yes

* At least treatment equivalent to sedimentation and disinfection

Schematic Design Standards Electrical - Standby Power

Further study of standby power system?

- Create an electrical model of the entire system (*Power Tools* software)
- Create a document and electrical model for Bend that describes
 - how the Standby Power System operates,
 - how much capacity is on it currently,
 - how much capacity is remaining,
 - and maybe even recommendations if Bend would like to increase capacity.
- Could run different scenarios to see the effect on the system when Bend wants to add other loads in the future.
- Also documents system for future WRF projects

Schematic Design Standards Electrical -

- Preliminary one-line diagram

Schematic Design Standards Electrical/Instrumentation and Control

Harris has developed a draft standards document that identifies control system and EE standards:

- Smart motor control – confirmed?
- Handswitches and indicating lights at the MCC for local equipment control (instead of using local control stations).
- New tagging scheme - different than what the plant currently uses (and CH2M HILL P&IDs and TM's).
- UPS's will be mounted in the electrical room externally to the PLC panels.
- Wiring diagrams, motor control concepts, etc.
- Receptacles for motor connections
- Cable trays - utilize where possible (with drops to equipment)

Schematic Design


- Architecture

Schematic Design Standards Architectural Theme

- Same wall materials and textures as both buildings
- Wider pilasters similar to Training Center
- Do not extend the pilaster up past the parapet as in the Re-use facility
- No blue glazed CMU as in the Re-use
- Roll-up and man doors (neutral color)
- Daylighting preferences?
- Removable translucent skylights.
- Translucent wall panels or windows?

Schematic Design Standards Architectural Theme

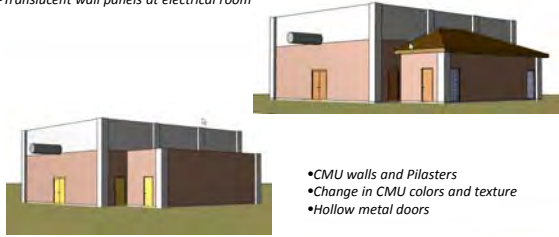
- Existing Headworks Building
 - Metal frame building with concrete panels
 - Translucent panels
 - Hip roof (20 ga. steel panels)



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Schematic Design Blower Building – Preliminary Arch Modeling

- Metal roof canopy over electrical room
- Translucent wall panels at electrical room



- CMU walls and Pilasters
- Change in CMU colors and texture
- Hollow metal doors

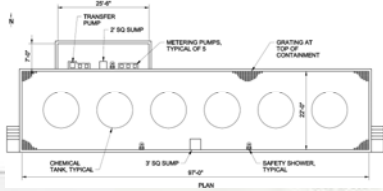
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Schematic Design Standards Architectural Theme

Chemical Storage Building

- Metal roof canopy
- CMU columns could replicate the building pilasters
- Least costly would be exposed metal columns, painted.
- Small pump building next to the chemical area also needs to be designed

- Proposed storage facility serves primarily as a sunscreen for tanks



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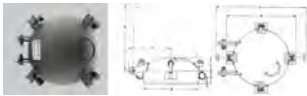
Schematic Design

- Yard piping and hydraulic design

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Schematic Design Yard Piping and Hydraulics Design

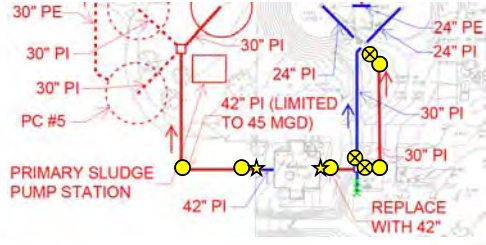
- Primary Influent pipe access
 - Cleaning provisions
 - Access port: SST locking T-bolt closure or blind flange in vault at end of pipe run.
 - Isolation of PI pipes (manual valve on 42-inch PI, manual gates on j-box)



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Schematic Design Yard Piping and Hydraulics Design

- Primary Influent pipe access
 - Cleaning port = ●, valve = ★, slide/sluice gate = ⊗



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Schematic Design Yard Piping and Hydraulic Design

- Flushing sediment from minimum flow in PI pipes
 - Daily diurnal peaks are 8 to 10+ mgd, existing velocity in 30-inch PI is 1 to 1.3 ft/s
 - Review resulting velocities in 42-inch and parallel 30-inch PI pipes

Diameter (inches)	42		30	
	1 42" pipe	1 30" pipe	2 30" pipes	
flow mgd	V ft/s	V ft/s	V ft/s	
1	0.07	0.13	0.07	
2	0.13	0.26	0.13	
3	0.20	0.40	0.20	
4	0.27	0.53	0.26	
5	0.34	0.66	0.33	
6	0.40	0.79	0.40	
7	0.47	0.92	0.46	
8	0.54	1.05	0.53	
9	0.60	1.19	0.59	
10	0.67	1.32	0.66	

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Schematic Design Yard Piping and Hydraulic Design

- Primary Effluent Pipe
 - 18 inch Layout in yard and discharge points (see 3D model)
 - Refine PE header sizing – 42-inch header OK for all flows to 50 mgd with 4 of 5 PC's in service (12.5 mgd each), and 30 mgd with 2 of 3 PC's in service
 - Extent of layout – review 3D model
 - Flow Meter and Control valve sizing – (2) 18-inch meters, (1) 12-inch
 - Most-open valve control scheme for minimum head (like Cleanwater Services Rock Creek AWTF PE flow split)

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Schematic Design Yard Piping and Hydraulics Design

- Non conventional Pipe connections
 - PI box – core hole in PI box and provide isolation slide gates
 - PC distribution box (retain existing 24" PI, cut in box wall)
 - SE piping (temp pumping and pipe replacement, cut in tees)
 - Outfall – pour new MH around outfall pipe
- ML Effluent Channel Hydraulic Refinement
 - Channel Depth 12-in lower than existing
 - Channel width (match existing)
 - 54 inch connection – drop box to match existing drop box concept
- Plant Drain and Tank Drain Routing (defer to April 12th)
- Yard Utility Routing and sizing (hot water loop, IA, W3, re-use) (Defer until April 12th)

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Schematic Design

- Solids process

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Solids Building Recommendations (Previous Workshop) Near Term Improvements

- Demo/salvage centrifuge. Add 2nd Belt Filter Press
 - Replace existing Belt Filter Press?
- Add new cake pump from 2nd Belt Filter Press
- Add new wash water pump for new Belt Filter Press
- Modify existing cake pump with bridge breaker
- Foul air curtain, HVAC system upgrade
- Filtrate piping improvements (abandon degas beds)
- Solids building lighting evaluation and upgrades
- Include controls upgrades and modifications
- Paint building interior

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Schematic Design Existing Dry Polymer System Capacity

- Evaluate Capacity of Existing of Existing Polymer System Based on Parallel Operation of:
 - One existing 2-m GBT (WAS thickening)
 - Two 2-m Belt Filter Presses (Digested Sludge Dewatering)



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Schematic Design Polymer System

- Critical Assumptions:
 - Current Polymer: Clarifloc WE-1060
 - Polymer Big bag size: 1,650 lb
 - Dry Polymer Hopper storage volume: 2.7 big bags
 - Polymer Dose: GBT 4 to 13 lb/DT ; BFP 8 to 15lb/DT
 - Make-up dilution ratio: 0.25% today. Up to 0.5% in future
 - Make-up Water: Existing potable water at approx 25 gpm (no existing fast fill)
 - Post dilution ratios for GBT & BFP: 0.1%
 - Volume of polymer mix tank: 600 gallons
 - Volume of polymer feed tank: 700 gallons
 - Minimum age time – 30 minute target

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Schematic Design Polymer System Capacity Evaluation – (continued)

- Capacity Evaluation Summary
 - The existing dry polymer system, with recommended modifications, has adequate capacity to support the parallel operation of one gravity belt thickener and two dewatering belt filter presses through the year 2030 planning criteria.

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Schematic Design Polymer System Capacity Evaluation – (continued)

- Recommended Modifications
 - Increase Polymer make up concentration from 0.25% up to 0.5% (extends batch cycle time)
 - Provide Rapid fill (125 gpm) dilution water line on Polymer mix tank (extends age time)
 - Additional Polymer Feed Pump for new BFP
 - Provide flexibility for dedicated polymer feed pumps to individual GBT and BFP's

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Schematic Design Polymer System Reliability & Redundancy

- Only one dry polymer system currently available to support both solids thickening and dewatering.
- GBT Thickening and BFP dewatering totally dependent on polymer addition
- If single polymer system failures options include:
 - Backup to WAS GBT Thickening
 - Store WAS in Liquids (2 days)
 - Use DAFT w/o Polymer (thicken to 3%)
 - Backups to Liquid Digested Sludge BFP Dewatering
 - Store Digested Sludge in Digester ? (2 days)
 - Use Degas Beds (supernate to extend storage in Digesters)

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Schematic Design Polymer System Reliability & Redundancy

- Improve Reliability/Redundancy of Existing Polymer Storage & Feed System
 - Maintain spares for critical components of the existing polymer system.
 - consider installation of an emergency standby emulsion packaged polymer system, which may also function for trial testing the effectiveness of alternate thickening and/or dewatering polymers.
 - Space within the existing Solids Building for a standby system requires further evaluation in addition to space needs for electrical and controls.

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Schematic Design

- Primary treatment improvements

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Schematic Design Primary Treatment Improvements

Existing Primary Clarifier Mechanisms

Condition Assessment Results

- Mechanisms approximately 30 years old, recoated 3 times
- Drive units replaced in 2005 with WesTech drives
- Mechanisms need some minor structural rehabilitation
- Mechanisms in adequate condition overall but need recoated
- Some evidence of dripped coatings and delamination
- Edges were not adequately stripe-coated and in worst condition

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Schematic Design Primary Treatment Improvements

Alternatives for Existing Primary Clarifier Mechanisms

- (1) Sandblast and recoat the existing primary clarifier mechanisms
- (2) Replace with new painted steel mechanisms
- (3) Replace with new stainless steel mechanisms.

Alternatives for New Primary Clarifier Mechanisms

- (1) Install painted steel mechanisms
- (2) Install stainless steel mechanisms.

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Schematic Design Primary Treatment Improvements

TABLE 1
Expected Lifetime of Primary Clarifier Mechanisms
City of Bend Water Reclamation Facility

Part	Expected Lifetime Based on CH2M HILL Experience
Gear box and drive assembly	~20 years if well maintained
Primary Clarifier Coating System	~20 years with good practices for sand blasting, painting and field quality control
Steel Primary Clarifier Mechanism	~40 years if well maintained and with recoating for painted mechanisms and minor structural rehabilitation over the lifetime of the mechanism.

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Schematic Design Primary Treatment Improvements

TABLE 3
40 Year Present Worth Analysis for the Existing Primary Clarifier Mechanisms
City of Bend Water Reclamation Facility

Alternative	Present Worth of Capital Costs	Present Worth of O&M Costs	Total 40 Year Present Worth
1 Recoat Existing Mechanisms	\$341,000	\$180,000	\$521,000
2 New Painted Steel Mechanisms	\$270,000	\$148,000	\$418,000
3 New Stainless Steel Mechanisms	\$376,000	\$0	\$376,000

TABLE 4
40 Year Present Worth Analysis for the New Primary Clarifier Mechanism
City of Bend Water Reclamation Facility

Alternative	Present Worth of Capital Costs	Present Worth of O&M Costs	Total 40 Year Present Worth
1 New Painted Steel Mechanisms	\$135,000	\$74,000	\$209,000
2 New Stainless Steel Mechanisms	\$188,000	\$0	\$188,000

Recommendation: Install new stainless steel mechanisms*

* . \$22,000 credit per clarifier if existing drive units are reused

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Schematic Design Primary Treatment Improvements

Alternatives for Primary Sludge Pumps

- (1) Air driven diaphragm pumps with improved controls
- (2) Progressing cavity pumps
- (3) ~~Screw-induced-centrifugal~~ Removed from consideration because manufacturer recommended maximum solids concentration is 5%. Not feasible for long term 5% operation.

Design Conditions

- (1) Design sludge concentration is 5%
- (2) Ability to pump to Digester #3

Design Constraints

Air Diaphragm Pumps - timed so only one pump fires at a time, 90 gpm max flow
 Progressing Cavity Pumps – 180 gpm min flow, timed so only one pump operates at a time

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Schematic Design Primary Treatment Improvements

Air Diaphragm Advantages	Air Diaphragm Disadvantages
Same as existing, familiar operation and known wear potential	Inability to measure primary sludge flow with a flow meter
	Normal operation at 5% solids is at a TDH close to the max – less contingency for pumping thicker solids
	Increased plant air demand, more compressor capacity required
	Less efficient than motor driven pump
Progressing Cavity Advantages	Progressing Cavity Disadvantages
Ability to measure primary sludge flow with a flow meter	More susceptible to abrasion, can be minimized with proper material and pump speed selection
Ability to pump at very high TDH, increased flexibility for varying head conditions now and in the future	Operation at 180 gpm minimum flow limits flexibility
More efficient than air diaphragm pumps	Space constraints in existing pump station may limit motor options

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Schematic Design Primary Treatment Improvements

TABLE 5
Cost Summary for Primary Sludge Pump Type (values are per pump)
Bend WRF Secondary Expansion

Item	Capital Cost	Annual Energy Cost	O&M Replacement Costs
Air Diaphragm Pump	\$28,000	\$570	2 check valve balls/yr @ \$300 1 diaphragm/yr @ \$200
Progressing Cavity Pump	\$39,900	\$140	1 stator every 5 yrs @ \$3,500

TABLE 6
20 Year Present Worth Analysis for Primary Sludge Pump Type
City of Bend Water Reclamation Facility

Alternative	Present Worth of Capital Costs	Present Worth of O&M Costs	Total 20 Year Present Worth
1 Air Diaphragm Pumps	\$112,000	\$60,000	\$172,000
2 Progressing Cavity Pumps	\$159,600	\$46,000	\$205,600

Recommendation: Install new progressing cavity pumps
b/c they can measure flow and pump thick sludge more reliably

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Schematic Design Primary Treatment Improvements

Required upgrades to existing ventilation system. Allows existing pump station to be declassified per NFPA 820.

Replace existing ventilation system to meet the 6 air changes per hour, push-pull configuration.

Provide new environmental monitoring system to monitor ventilation status and signal local alarms.

Provide interface between environmental monitoring system and SCADA to transfer alarm and trouble signals.

Provide audible and visual alarms inside.

Provide Go/No-Go entry lights outside each door.

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Schematic Design Primary Treatment Improvements

Replace exhaust fan

Install audible and visual alarms inside

Install go/no-go entry lights outside doors

Install new louver, filter, electric heater, ceiling mounted fan

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Schematic Design Primary Treatment Improvements

Questions for 3-D spinner overview/P&ID Discussion

Primary Clarification	Basin Area #1 / 2	3	Significant corrosion. Blowing is primary issue. Mechanism was adjusted after last installation. Revised mechanism detail. Sluam trough (high, high, high) detail. Check required at 2011.
Primary Clarification	Basin Area #2 / 1	4	Significant corrosion. Manual blowing issue. Mechanism was adjusted after last installation. Revised mechanism detail. Sluam trough (high, high, high) detail. Check required at 2011.
Primary Clarification	Primary Sludge Pump #1	4	Pumps #1 and #2 don't run well together. Original progressive cavity pumps were replaced with air diaphragm pumps in 1998.
Primary Clarification	Primary Sludge Pump #2	3	Pumps #1 and #2 don't run well together. Original progressive cavity pumps were replaced with air diaphragm pumps in 1998.
Primary Clarification	External Lighting Control and Control Room	4	Missing cover plates, rust and abandoned wiring, water intrusion.
Primary Clarification	MCC/PLP	4	Original construction, near end of expected useful life.
Primary Clarification	DCU / Control Panels	4	Original construction, near end of expected useful life.
Primary Clarification	Sample Pump Panels	4	Original construction, near end of expected useful life.
Primary Clarification	Internal Controls and Lighting	4	Control room/wiring near end of expected useful life.

What are the operational deficiencies in the existing scum system other than automation? Facility plan info pasted here for reference.

The current proposed primary sludge operational strategy is based on a timer. Any desire to increase instrumentation and install sludge density meters to optimize timer control?

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Schematic Design

• Plant Effluent Disinfection

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Plant Effluent Disinfection

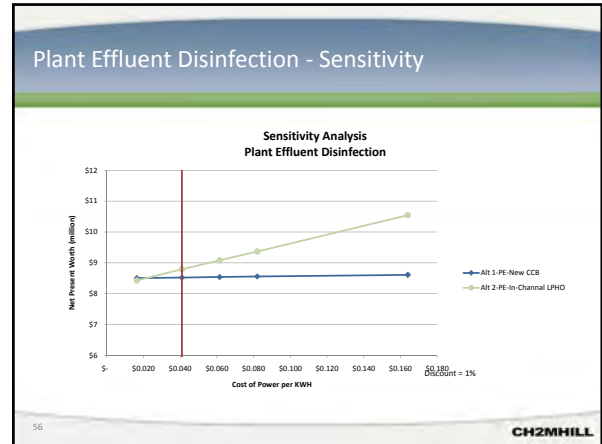
- Alternative 1 – Chlorine Contact Basin (CCB)
 - Advantages
 - Lowest capital cost
 - Familiar process for operators.
 - Simple to operate.
 - Disadvantages
 - Highest disinfection chemical costs
 - Must manage larger quantity of hypochlorite
- Alternative 2 – In-channel Low Pressure High Output (LPHO) UV
 - Advantages
 - Smallest footprint
 - Minimum requirements for sodium hypochlorite
 - Low energy requirements
 - Simple to operate
 - Disadvantages
 - More manpower and attention required.

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Plant Effluent Disinfection – Present Worth Analysis

Item	Alternative 1	Alternative 2
Alternative Title	New CCB	In-channel LPHO
Relative Capital Cost	\$4.6	\$7.4
Present Worth of Annual O&M Costs*	\$3.9	\$1.4
Total Present Worth	\$8.5	\$8.8

*Present worth based on a 20-year life and 1% discount factor.



Sodium Hypochlorite Storage

	Dose	Flow	Storage	Tanks*
	mg/L	mgd	days	#
Preliminary Design	7.5	11.9	60	5.9
Lower the Dose	5	11.9	60	3.9
Lower the Days	7.5	11.9	30	3.0
Lower the Flow	7.5	5.5	60	2.7

*Assumes 6,000 gallons of useful storage per tank

Schematic Design

- Reuse

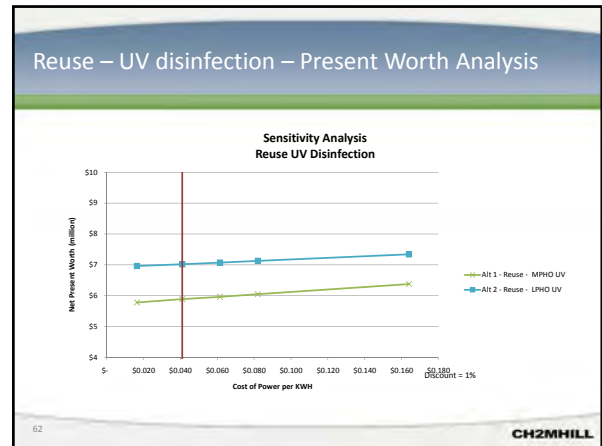
- ### Reuse – UV disinfection
- Alternative 1 – Low Pressure High Output (LPHO)
 - Advantages
 - Lower power consumption (more efficient)
 - Lower bulb temperature
 - Disadvantages
 - Higher initial cost
 - More bulbs to maintain
 - Larger building footprint
 - Alternative 2 – Medium Pressure High Output (MPHO)
 - Advantages
 - Lower initial cost
 - Fewer bulbs to maintain
 - Smaller building footprint
 - Disadvantages
 - Higher power consumption
 - Higher bulb temperature
 - Visible light from bulbs promotes algae growth

- ### Reuse – UV disinfection
- Alternative 1 – Low Pressure High Output (LPHO)
 - Alternative 2 – Medium Pressure High Output (MPHO)
 - Common items
 - Enclosed electrical room
 - Roof only structure for UV equipment
 - Disinfection for Reuse residual
 - Design dose = 80 mJ/cm²
 - Minimum 2 trains
 - 2.5 mgd average flow, 5.0 mgd max flow (no redundancy)
 - Auto wiper system

Reuse – UV disinfection – Present Worth Analysis

	Alternative 1	Alternative 2
Alternative Title	Low-Pressure Ultraviolet Disinfection	Medium-Pressure Ultraviolet Disinfection
Capital Cost	\$2.4	\$1.5
Annual Maintenance Costs	\$0.03	\$0.01
Annual Operations Cost	\$0.23	\$0.23
Net Present Worth	\$7.0	\$5.9

*Present worth based on a 20 year life and 1% discount factor.
Costs in Million \$



UV Fouling at Bend WRF

Wastewater Component	Addition Form	Dose (ppd)	Estimated Concentration at UV (mg/L)	Impact at Bend WRF
Iron	Ferric Chloride	TBD	0.1 mg/L	Minimal impact on UV disinfection
Aluminum	Alum	200 (approx)	~1 mg/L	Will precipitate if scaling present
Hardness	Lime	???	150-250 as CaCO3	High hardness at facility will cause scaling – Acid Treatment Recommended
Polymer	Polymer	40 (approx)	~1 mg/L	Minimal impact

- ### Water Quality Testing
- Transmissivity
 - Design
 - Secondary Effluent 55%
 - Filtered Effluent 65%
 - \$30 per grab sample (weekly plus full day profile)
 - Online monitoring
 - Hardness - Continue monitoring weekly
 - pH - weekly
 - Chemical additions at plant
 - Lime
 - Alum/Polymer
 - Other

- ### Other Items – Disinfection and Plant Water
- Selection of Hypochlorite Metering Pump Type
 - Plant Water Demands and Design Criteria Analysis
 - Abandonment/ Demolition phasing of CCB's

- ### Schematic Design
- Draft P&IDs

Draft PID's

- Primary Clarifiers and sludge pumping
- Reuse system
- Plant effluent disinfection with plant water
- Possibly solids facilities, including polymer

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Schematic Design

- Deliverables and Project Management

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Work Products for Schematic Design

- Technical Memo's
 - Unit Process TM's
 - Design Discipline TM's
- Process and Instrumentation Diagrams (P&ID's)
- Civil: Overall Site Plan and Yard Piping Plan
- Architectural and Structural Drawings
- Process Mechanical: Process Plans and Major Sections
- Electrical: Motor Control Center One Line Diagrams and Electrical Site Plan

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Updated Schedule for Schematic Design

Schematic Design Phase	128 days
Schematic Design Kickoff	1 day
Internal Kickoff Meeting	1 day
Schematic Design	50 days
Preliminary M&C Studies	1 day
SD Workshop - Basics	1 day
SD Workshop No. 1 - Design AEs	1 day
SD Workshop No. 2 - SD Progress	1 day
Develop Draft Schematic Design Report	20 days
Assemble Internal Review Copy	2 days
Draft Report ready for internal review	0 days
Internal Review	5 days
Develop Final Estimate	7 days
Deliver Review Comments to PM team	0 days
Final and Prepare Draft Report for Bend	3 days
Internal Draft SD Report to Bend	0 days
City Review of Draft Report	12 days
Finalized Packaging	10 days
City Packaging	10 days
Workshop to Review Draft Report (Bend)	1 day
Finalize Schematic Design Report	15 days
Deliver Final Schematic Design Report	1 day

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Updated Schedule for Schematic Design

- Key Dates:
 - ✓ Feb 2nd Schematic Design Kickoff
 - ✓ Mar 8th Solids Workshop
 - ✓ Mar 29th Workshop No. 1 – Alternatives
 - Apr 12th Workshop No. 2 – Progress Review
 - Early June: Draft SD Report to Bend
 - Late June: Draft Report Review Workshop
 - Mid July: Final Report

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QUESTIONS??

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Schematic Design
Secondary Treatment Improvements

- RAS/ WAS flow testing
 - Maximum flow = 6.2 mgd
 - Test installed Capacity to verify assumptions
- RAS/ WAS Pump Station Ventilation NFPA 820 (Krumsick)
- RAS Pipe Evaluation
 - Route to Aeration Basin
- Mixed Liquor Splitter Piping/ Box
 - Constructability assessment around existing
- *postpone RAS PS discussion until April 12th*

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Bend WRF Secondary Expansion Schematic Design Progress Workshop – Meeting Notes

TO: Jim Wodrich/City of Bend
Paul Roy/City of Bend

FROM: Dave Green/CH2M HILL
WRF Secondary Expansion Design Team

MEETING DATE: April 25, 2011

MEETING TIME: 12 noon – 330 pm

DIAL-IN INFORMATION: 866-203-7023 x1898351119

VENUE: Boyd Acres Road Facility

Attendees:

City - Jim Wodrich, Paul Roy, Paul Rheault

CH2M HILL – Dave Green, Jim Griffiths, Jim Smith, Bill Leaf, Brady Fuller (Adrienne Menniti, Jason Krumsick, Gregg Thompson via phone)

- 1) Aeration Basin/IFAS
 - a) Review PE Gallery, PE Bypass lines (12" and 18")
 - b) Review new AB #4, flow distribution, location of MLR pumps, effluent boxes
 - i) Review of flows thru exist 12" PE and new 18" PE
 - c) Coarse Bubble diffusers – reviewed comparison to fine bubble, comparison of MLE air demand vs IFAS air demand at startup.
 - d) Reviewed MLR pump options – Additional cost for vertical turbine pumps. Need to address crane access issues. Jim W will discuss with plant staff and provide direction. Pump capacity is nearly 2 times existing MLR pumps. 2 pumps provided for redundancy and maximum turndown. Consider provisions to minimize dissolved oxygen return to anoxic zone. Discussed nitrate based flow control, and also total flow control to manage peak flows through basin. Crane access for MLR pumps to be addressed in design.
 - e) Scum handling concept reviewed.
- 2) Plant drain evaluation and approach

- a) Need to accommodate future PC #4. Pump types: Submersible, Prerostal, and dry pit - Jim W will discuss with plant staff and provide direction. Basis of design for gravity drain lines should be no more than 8 to 10 hour to drain AB.
- b) Screened openings for IFAS zones. Need to accommodate head loss through screens.
- 3) Media Transfer – Temporary pumping solution may be preferred. Need to return water (without media) to basin so that media removal has enough liquid. Jim W will discuss with plant staff and provide direction.
- 4) RAS/WAS pump station – No upgrades to existing RAS/WAS pump station. NFPA 820 upgrades will be deferred to a later project. Pull slides from existing ppt presentation for final presentation to staff, but include Fact Sheet in SD Report.
- 5) Blower Building – Reviewed new layout and architectural features. Electrical layout includes future MCC space for future blowers, MLR pumps, air compressors, etc. New air compressors will serve north end of site. Will interconnect with existing air compressors in digester building.
 - a) Preference is to raise grade around the new blower building. City will help to identify other projects that may have excess material that could be hauled to WRF.
 - b) Overhead door vs. bi-fold door. Jim W will discuss with plant staff and provide direction.
 - c) Discussed energy code restrictions on building envelope materials and heat transfer. (ie, the design as-shown provides the allowable area of translucent panels and skylights).
- 6) Disinfection
 - a) Plant Effluent – Discussion of PW costs. Some concern about escalating costs associated with petroleum costs and therefore hypo costs. Recommended UV disinfection. PLE disinfection is in operation year-round.
 - b) Reuse – In vessel. PW costs favor the medium pressure UV system. Intermittent use for reuse system. Units would be drained in winter. Reuse UV would be covered with roof structure but not fully enclosed.
 - c) Some fouling possible due to water hardness. Acid bath provisions to help manage that fouling. If ferric is also added, impact at plant effluent/reuse should be minor but need to monitor COB plans to add ferric.
 - d) Draft Testing Plan – CH2M HILL needs to provide draft plan to COB. CH2M HILL has developed draft plan – going through internal review. City needs

- recommendation on instrument manufacturer for wastewater transmittance.
Pumped unit versus flow through?
- 7) Hypo Storage for minor chlorine uses (assuming UV disinfection of plant effluent) – Remaining hypo uses allow consideration of totes or full tank storage. City agreed with recommendation for two 3000 gallon tanks.
 - 8) Plant Water – CH2M HILL needs minimum and maximum flow data to help size pumps, etc. Vertical turbine pumps to be used, with a flow-thru well prior to Parshall flumes. No decision yet on abandonment of existing CCB's. Assume that existing automatic strainer is relocated to new facility.
 - 9) Utility Systems – City staff need to assist with confirming and verifying existing utility water systems.
 - i) Plant water distribution – any concerns about connection of Solids building to 6" W4?
 - ii) W1 & W2 – Potable Water – Size of water line east of Digester Bldg? Sizing not clear from Headworks project record drawings.
 - iii) Hot water distribution – Confirm hot water over to Admin Bldg? Hot water is also stubbed out north of the Headworks building? 40,000 cubic feet per day being flared.
 - iv) Compressed Air – Carry space for two compressors and dryers at blower building, but elimination of air-diaphragm primary sludge pumps will reduce demand. May decide to defer at least one compressor. Determine during final design.
 - 10) Solids Facilities – Reviewed BFP layout with 2 new BFP's. Need to provide capital cost information requested by COB. Need to evaluate constructability issues, rental cost for a trailer mounted unit, options for using drying beds, etc. Need to identify extra costs associated with HVAC air changes (with existing BDP unit). Review biosolids management plant and confirm how plan allows hauling/applying liquid biosolids. Potable water is not available for fast-fill on polymer tank. City agreed with dedicated polymer feed pump approach (vs. pressurized loop).
 - 11) Electrical Standby Power – Need to look at the possibility of a second electrical feed from Central Electric Coop. Jim W will review existing standby power system with plant staff and provide review/corrections. Discussed that backup of secondary process is a policy decision for City.
 - a) Need to discuss Smart MCC options.

- 12) Pipe schedule and flow stream ID - Jim W will review existing system with plant staff and provide review/corrections. Jim suggested that City could provide clamp-on pipe labels as was done with success on headworks project.
- 13) Updated equipment data sheets and overall equipment list
- 14) Loop Numbering and Equipment numbering – Jim W will provide final direction on loop and device numbering scheme from SCADA project (Harris). CH2M HILL to proceed with existing numbering scheme for now. Schematic Design report will utilize existing numbering scheme.
- 15) Need to schedule Draft Report Workshop (mid-June) and procurement/Preselection discussion.
- 16) Fire hydrants – discussed potable vs. non-potable. Brady to follow up with Fire Marshall to confirm use of plant water as supply to hydrants.

Action Items

- 1) Reviewed MLR pump options – Additional cost for vertical turbine pumps. Need to address crane access issues. Jim W will discuss with plant staff and provide direction.
- 2) Need to accommodate future PC #4. Pump types: Submersible, Prerostal, and dry pit - Jim W will discuss with plant staff and provide direction.
- 3) Media Transfer – Temporary vs. permanent installation. Jim W will discuss with plant staff and provide direction.
- 4) Overhead door vs. bi-fold door. Jim W will discuss with plant staff and provide direction.
- 5) Disinfection
 - a) Draft transmittance testing Plan – CH2M HILL needs to provide draft plan to COB.
 - b) City needs recommendation on instrument manufacturer for wastewater transmittance. Pumped unit versus flow through?
- 6) Plant Water – Jim to help obtain minimum and maximum flow data to help size pumps, etc. See email from Brady.
- 7) Utility Systems – City staff need to assist with confirming and verifying existing utility water systems.

- i) Plant water distribution – any concerns about connection of Solids building to 6” W4?
 - ii) W1 & W2 – Potable Water – Size of water line east of Digester Bldg? Sizing not clear from Headworks project record drawings.
 - iii) W4 – Plant water – Are the 6-inch and 4-inch line tied together near NW corner of degas beds?
 - iv) Hot water distribution –Hot water routed over to Admin Bldg? Hot water is also stubbed out north of the Headworks building?
- 8) Solids Facilities –
- a) Jason/Jim Smith to provide capital cost information requested by COB.
 - b) Jason/Jim Smith develop two separate construction phase approaches for temporary dewatering, re-coating of building, and upgrades for BFP replacement. Need to review biosolids management plant and confirm how plan allows hauling/applying liquid biosolids.
- 9) Electrical Standby Power –Jim W will review existing system with plant staff and provide review/corrections.
- 10) Pipe schedule and flow stream ID – Jim W will review proposed flow stream ID’s with plant staff and provide review/corrections.
- 11) Loop Numbering and Equipment numbering – Jim W will provide final direction on loop and device numbering scheme from SCADA project (Harris).
- 12) Jim W to verify with plant staff and fire department that continued use of W4 for fire hydrants is desired and acceptable.

PRESENTATION

Bend WRF Secondary Expansion - Schematic Design Progress Meeting



Dave Green, CH2M HILL
Jim Griffiths, CH2M HILL
Jim Smith, CH2M HILL
William Leaf, CH2M HILL
Brady Fuller, CH2M HILL

April 25, 2011 **CH2MHILL**

Workshop Agenda

- Aeration Basin/IFAS
- RAS/WAS pump station – ventilation fact sheet
- Plant drain evaluation and approach
- Blower Building
- UV Disinfection for Plant Effluent
- Reuse disinfection
- Hypo Storage for minor chlorine uses (assuming UV disinfection of PE)

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Workshop Agenda, continued

- Utility Systems:
 - Plant water distribution
 - Hot water distribution
 - Air compressors
- Solids Facilities:
 - Electrical Standby Power
 - Updated equipment data sheets and overall equipment list

Other Discussion Items

- Pre-selection of equipment vendors

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- Aeration Basin/IFAS

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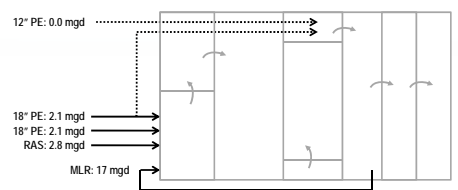
Aeration Basin/IFAS

- Present 3D Model for IFAS Basin and PE Gallery

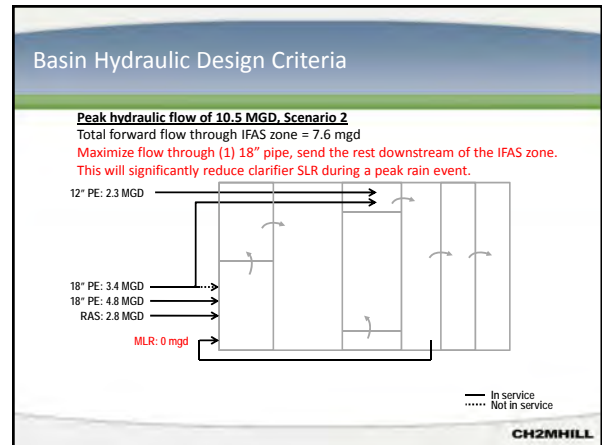
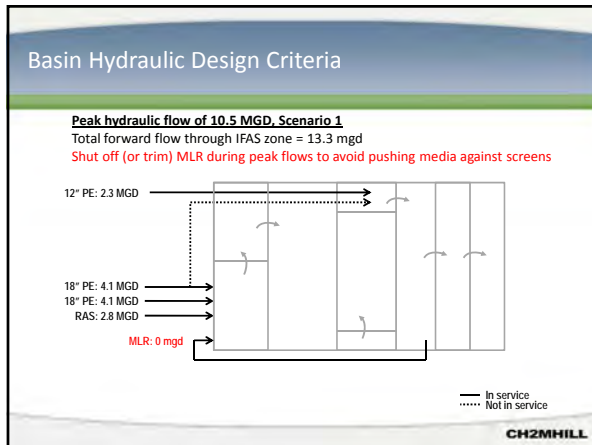
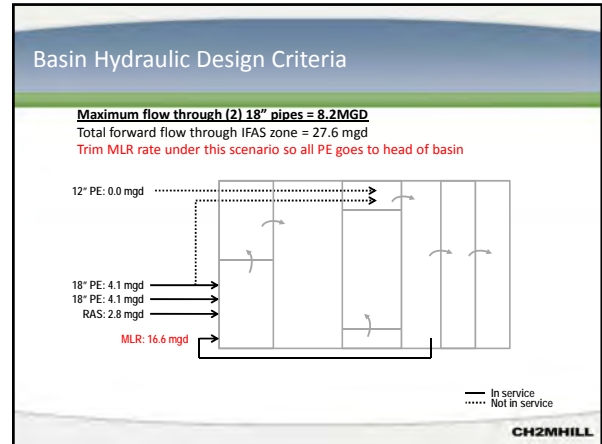
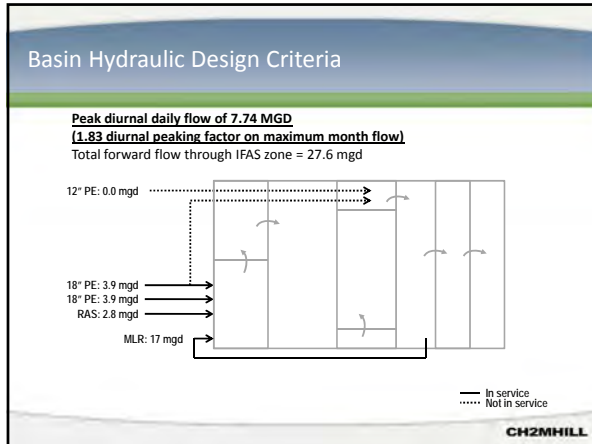
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Basin Hydraulic Design Criteria

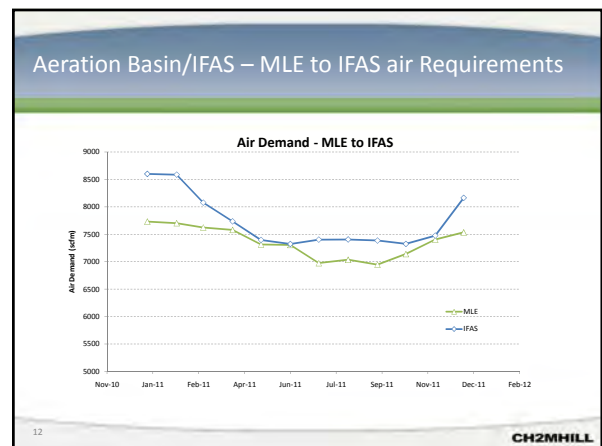
Maximum month flow of 4.25 MGD
Total forward flow through IFAS zone = 24 mgd



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- ### Aeration Basin/IFAS – Aeration Concept
- Propose use of coarse bubble diffusers throughout basin
 - Required in IFAS zone
 - Minimal impacts to air demand
 - 70-80% of total air demand in IFAS zone
 - Comparison for coarse bubble vs fine bubble
 - Coarse Bubble = 10-15% increase in capital cost over Fine Bubble
 - No significant increase in energy demand
 - Significant reduction in maintenance requirements with Coarse Bubble
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Aeration Basin/IFAS – New ML Effluent Box (AB 3, 4)

AB 4
AB 3
AB 2
AB 1

New ML Effluent Box
Mixer, typ
Existing ML Effluent Box
IFAS Screen, typ

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MLR Pumping Concept – Option 1

Axial-flow Pumps

- MLR Design Flow = 400% ADMM = $4 \times 4.25 = 17$ mgd
- MLR Design Flow = 12,000 gpm per basin
- (2) Wall Pumps, each @ 0.5 design flow = 6,000 gpm/pump
- Flow rate estimated based on pump speed
- MLR pump speed adjusted based on an online nitrate measurement in the anoxic zone

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MLR Pumping Concept – Option 2

Vertical Line-Shaft Type Pumps

- MLR Design Flow = 400% ADMM = $4 \times 4.25 = 17$ mgd
- MLR Design Flow = 12,000 gpm per basin
- (2) Pumps, each @ 0.5 design flow = 6,000 gpm/pump
- Direct Cost Increase over Option 1 \$400,000
- Possible to configure with flow meter

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MLR Pumping – Rock Creek AWTF (Hillsboro)

- Vertical turbine
 - Axial flow propeller type

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Scum Handling Concept

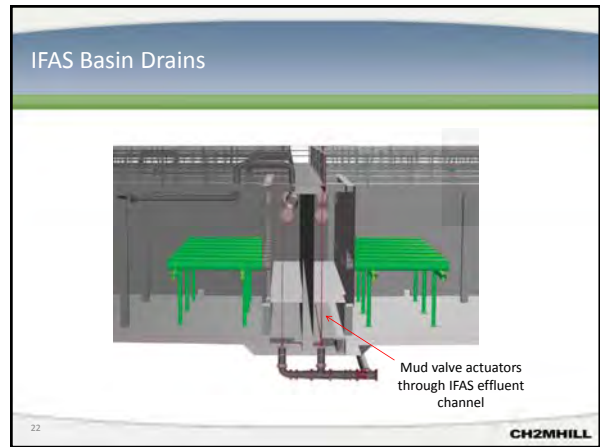
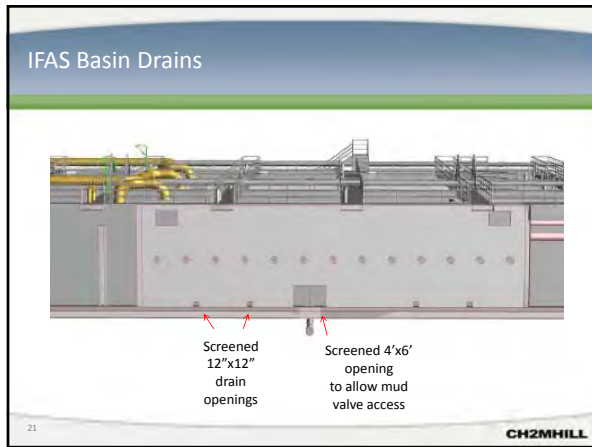
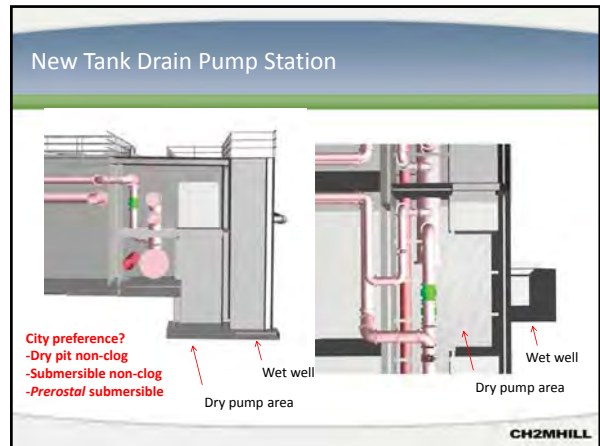
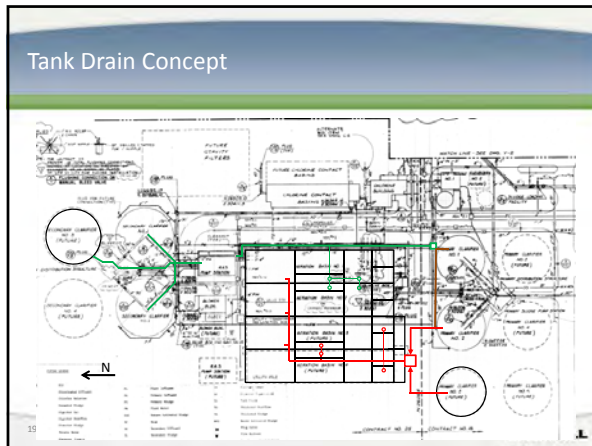
- Screened wall openings and sprays in IFAS zone allow scum to enter IFAS effluent channel
- Scum travels to the aeration basin effluent with mixed liquor
- New scum box adjacent to mixed liquor effluent box
- Automated gate drops periodically to collect scum
- Scum box connected to WAS piping system by gravity
- Sprays clean the walls of the scum box as it empties

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Plant drain evaluation and approach

- Schematic design layouts of plant-wide plant drains (existing and new)
- Solution for new and existing AB's,
- Use of RAS PS for final draining of basins (AB 1 and 2)
- Link to media movement between basins, etc.

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IFAS Media Transfer

Frequency of Media Transfer

- After start up and performance testing, media transfer is an infrequent event
- Basin/Screen/Diffuser inspection and maintenance

Approach

- Option 1 – Temporary
 - Installation of rails for recessed impeller pump is each IFAS zone
 - Provide one pump for transferring media
- Option 2 – Permanent, Fixed Installation

- RAS/WAS Pump Station

RAS/WAS pump station – ventilation fact sheet

- Existing RAS/WAS pump station constructed before NFPA 820
- To meet NFPA 820 the existing pump station would have to be upgraded to meet all of the following:
 - 6 Air changes per hour
 - Push-Pull, Supply and Exhaust (current: Exhaust only)
 - Required status monitoring: Supply fan, exhaust fan, entry, space alarms
 - Required Alarms: Audible and visual inside space
 - Entry Alarms: Go/No-Go entry lights at each entry to building
 - Required monitoring: SCADA interface with environmental monitoring system

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RAS/WAS pump station – ventilation fact sheet

- No other upgrades are planned in the RAS/WAS pump station, therefore no triggers to update ventilation to comply with NFPA 820
- Recommendation:
 - Defer cost of ventilation improvements until modifications to the pump station trigger compliance with NFPA 820.

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Blower Building

- Blower Building

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Blower Building

- Architectural with translucent panels and skylights
- Electrical room
- Accommodate new air compressors
- Blower sizing and layout
- 3D Model
- Elevate grade around blower building
- Equip. Access: **Overhead or Bi-fold Doors?**

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Blower Building

- Architectural
 - Natural lighting by the use of translucent panels and Skylights

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Blower Building

- Blower Building Layout
 - EQUIP ACCESS
 - AIR DRYERS
 - TURBO BLOWERS
 - AHP COMPRESSORS
 - ELECTRICAL ROOM
 - ALP TO BASINS
 - NORTH

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Blower Building

- Electrical Room
 - Adequate room for current construction and future expansion.
 - Line of gear on interior wall, double row of gear in the center of the room, space for future gear on exterior wall

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Blower Building

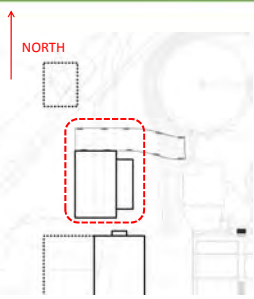
- Blower Sizing for near term
 - (4): 300 hp (5,800 – 3,500 SCFM/each)
 - (1): 100 hp (1,700 – 1,000 SCFM/each)
 - Small blower provides turn down for startup and near term minimum week and annual average annual conditions

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Blower Building – Elevated Grade

- New Blower Building Grade Elevation
 - Could be built at same grade as existing
 - Significant amount of fill material required
 - Imported to the site?
 - Available from SE Interceptor Project?
 - Available from WRF site?



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- Disinfection
 - Plant Effluent
 - Reuse
- Hypochlorite Storage

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Disinfection

- Plant Effluent (PLE) disinfection
- Class A Reuse (W3) disinfection
- Sodium Hypochlorite Use
 - Usage
 - Dose rates
 - Storage volume and approach
- Ultraviolet disinfection fouling
- Water Quality Testing
- Plant Water Pumping

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Plant Effluent Disinfection

- Alternative 1 – Chlorine Contact Basin (CCB)
 - **Advantages**
 - Lowest capital cost
 - Familiar process for operators.
 - Simple to operate.
 - **Disadvantages**
 - Highest disinfection chemical costs
 - Must manage larger quantity of hypochlorite
- Alternative 2 – In-channel Low Pressure High Output (LPHO) UV
 - **Advantages**
 - Smallest footprint
 - Minimum requirements for sodium hypochlorite
 - Low energy requirements
 - Simple to operate
 - **Disadvantages**
 - More manpower and attention required.

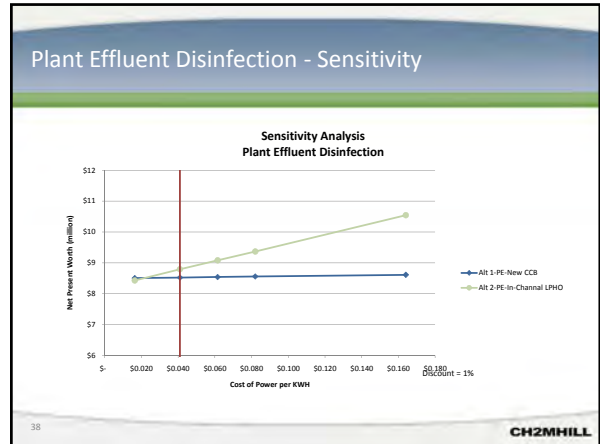
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Plant Effluent Disinfection – Present Worth Analysis

Item	Alternative 1	Alternative 2
Alternative Title	New CCB	In-channel LPHO
Relative Capital Cost	\$4.6	\$7.4
Present Worth of Annual O&M Costs*	\$3.9	\$1.4
Total Present Worth	\$8.5	\$8.8

*Present worth based on a 20 year life and 1% discount factor.



- ### Plant Effluent Disinfection Recommendation
- Schematic Design Report
 - Select Alternative 2 – Low Pressure In-Channel
 - Has a competitive present worth cost
 - Minimizes the handling of sodium hypochlorite
 - Has the fewest number of bulbs and other equipment
 - Characteristics
 - In-channel unit
 - Final design must include material handling equipment
 - Automatic sleeve cleaning
 - Low Pressure High Output bulbs
 - Provide Sodium Hypochlorite as a secondary disinfectant (residual) at 3 mg/L for Plant Water (side stream)
 - Will be on standby power

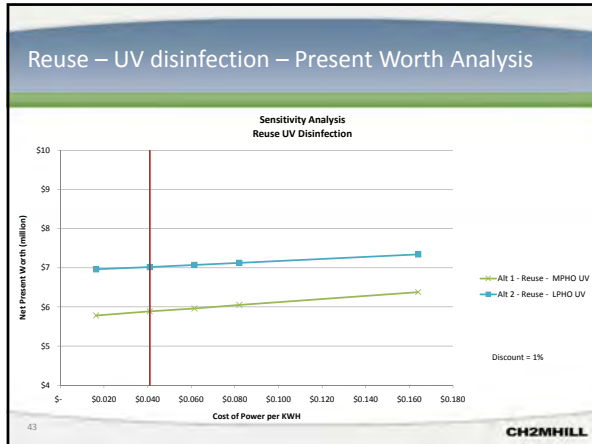
- ### Reuse – UV disinfection
- Alternative 1 – Low Pressure High Output (LPHO)
 - Advantages
 - Lower power consumption (more efficient)
 - Lower bulb temperature
 - Disadvantages
 - Higher initial cost
 - More bulbs to maintain
 - Larger building footprint
 - Alternative 2 – Medium Pressure High Output (MPHO)
 - Advantages
 - Lower initial cost
 - Fewer bulbs to maintain
 - Smaller building footprint
 - Disadvantages
 - Higher power consumption
 - Higher bulb temperature
 - Visible light from bulbs promotes algae growth

- ### Reuse – UV disinfection
- Alternative 1 – Low Pressure High Output (LPHO)
 - Alternative 2 – Medium Pressure High Output (MPHO)
 - Common items
 - Enclosed electrical room
 - Roof only structure for UV equipment
 - Disinfection for Reuse residual
 - Design dose = 80 mJ/cm²
 - Minimum 2 trains
 - 2.5 mgd average flow, 5.0 mgd max flow (no redundancy)
 - Auto wiper system

Reuse – UV disinfection – Present Worth Analysis

	Alternative 1 Low-Pressure Ultraviolet Disinfection	Alternative 2 Medium-Pressure Ultraviolet Disinfection
Capital Cost	\$2.4	\$1.5
Annual Maintenance Costs	\$0.03	\$0.01
Annual Operations Cost	\$0.23	\$0.23
Net Present Worth	\$7.0	\$5.9

*Present worth based on a 20 year life and 1% discount factor.
Costs in Million \$

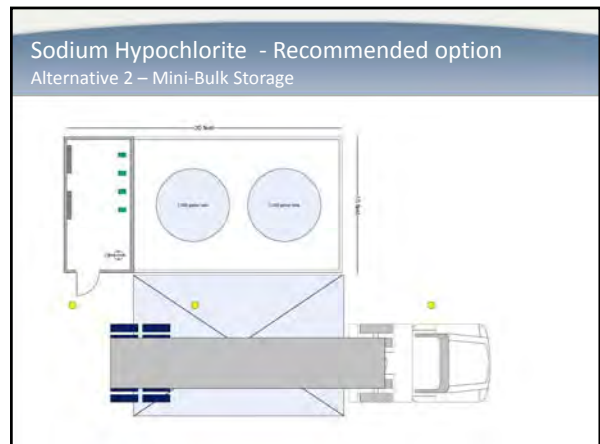


- ### Reuse – UV disinfection Recommendation
- Schematic Design Report
 - Select Alternative 2 - Medium Pressure Ultraviolet Disinfection
 - Has the lowest present worth cost
 - Has the smallest equipment
 - Has the fewest number of bulbs and other equipment
 - Characteristics
 - In-pipe or in vessel unit
 - Final design must include management of scaling
 - Automatic sleeve cleaning
 - Medium Pressure High Output bulbs
 - Provide Sodium Hypochlorite as a secondary disinfectant (residual) at 2 mg/L
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- ### Sodium Hypochlorite Uses with UV Disinfection for Plant Effluent
- Secondary Disinfectant
 - Reuse Water (W3) - chlorine residual
 - Plant Water (W4) - chlorine residual
 - Return Activated Sludge (RAS) – biological control (700 gallons over a two day event)
 - Offsite - drinking water point uses (724 gallons per year)
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- ### Sodium Hypochlorite - Storage
- Alternative 1 – Tote Storage
 - 300 gallons totes
 - Alternative 2 – Minibulk Storage
 - 3,000 gallon tanks
 - Alternative 3 – Bulk Storage
 - 6,000 gallon tanks
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- ### Sodium Hypochlorite Uses with UV Disinfection for Plant Effluent
- Secondary Disinfectant
 - Reuse Water (W3) - chlorine residual
 - Plant Water (W4) - chlorine residual
 - Return Activated Sludge (RAS) – biological control (556 gallons over a two day event)
 - Offsite - drinking water point uses (724 gallons per year)
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UV Fouling at Bend WRF

Wastewater Component	Addition Form	Dose (ppd)	Estimated Concentration at UV (mg/L)	Impact at Bend WRF
Iron	Ferric Chloride	TBD	TBD	May impact UV disinfection
Aluminum	Alum	200 (approx)	~1 mg/L	Will precipitate if scaling present
Hardness	Lime	1,400	150-250 as CaCO3	High hardness at facility will cause scaling – Acid Treatment Recommended
Polymer	Polymer	120	~1 mg/L	Minimal impact

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Sodium Hypochlorite Storage Winter Storage Calculations

Usage	Dose mg/L	Flow mgd	Storage days	mass flow ppd	daily flow gpd	storage gallons
Reuse*	n/a					n/a
Plant Water - Winter	3	1.5	60	37.53	38	2,252
Drinking Water System						362
RAS Control						556
WINTER TOTAL					38	3,169

*Reuse is off-line during winter

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- ### Water Quality Testing
- UV Transmittance
 - Design
 - Secondary Effluent 55%
 - Filtered Effluent 65%
 - \$30 per grab sample (weekly plus full day profile)
 - Online monitoring
 - Hardness - Continue monitoring monthly
 - pH - Monthly
 - Chemical additions at plant
 - Lime, Alum, Polymer
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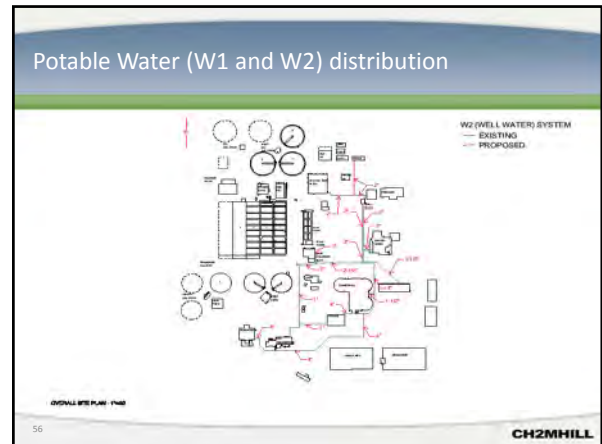
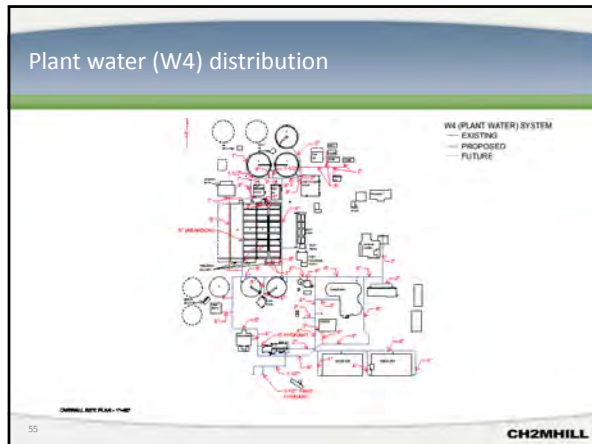
Water Quality Testing Plan

Flow Stream	Characteristics	Frequency	Testing	Lab	Purpose
PLE (Plant Effluent)	pH and Hardness	Monthly	Grab	Bend WRF	Fouling of UV sleeves
	UV Transmittance	Continuous	Continuous (Alternating) Grab	Bend WRF	Design criteria for LPHO system
	UV Transmittance	Monthly	Grab	CH2M HILL	Calibration
W3 (Reuse Water)	TSS	As currently sampled	Compliance testing	Bend WRF	Design criteria for LPHO system
	Iron (Ferric and Total)	Twice	Grab	Bend WRF and CH2M HILL	Design criteria for LPHO system
	pH and Hardness	Monthly	Grab	Bend WRF	Fouling of UV sleeves
W4 (Plant Water)	UV Transmittance	Continuous	Continuous (Alternating) Grab	Bend WRF	Design criteria for MPH0 system
	UV Transmittance	Monthly	Grab	CH2M HILL	Calibration
	Iron (Ferric and Total)	Twice	Grab	Bend WRF and CH2M HILL	Design criteria for MPH0 system
	Aluminum	Twice	Grab	CH2M HILL	Design criteria for MPH0 system

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- ### Other Items – Disinfection and Plant Water (Dependent on Plant Effluent Disinfection Decision)
- Plant Water Demands and Design Criteria Analysis
 - Flow meter status
 - Review of Plant Water Pump Station
 - Layout
 - Vertical Turbine Pumps
 - Abandonment/ Demolition phasing of CCB's
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- ### Plant water (W4) distribution
- Plant water sizing
 - Schematic drawing shows plant water distribution
 - Need review and confirmation with Bend staff
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Heating Water

- Heating Water

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Heating Water Distribution

Heating Water Availability

- Daily excess digester gas of 40,000 scfm
- Existing boiler #3 capacity 2069 mbh
- Current connected peak HVAC load 1850 mbh
- Total connected load (process and HVAC) far in excess of boiler #3 capacity
- Peak loading conditions rarely realized
- Additional load may be added to utilize excess digester gas when backup is provided on a facility level and utilized during peak conditions

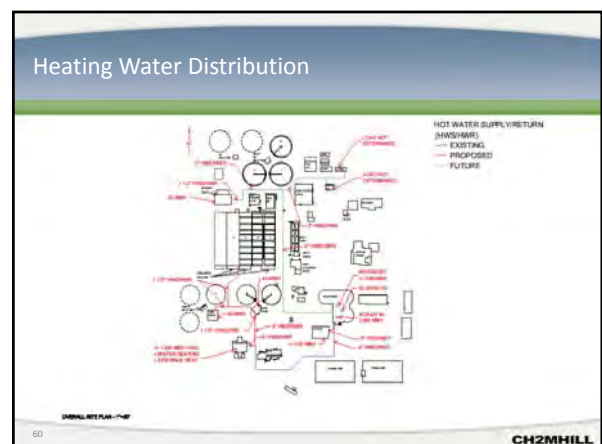
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Heating Water Distribution

Heating Water Configuration

- Extend the existing system to include the solids building, primary sludge pump stations and primary effluent gallery
- Configure each facility to utilize electric heating as a backup to the heating water
 - Already provided at the solids building
- Full SCADA integration of HVAC controls allows overload to be detected at boiler #3, triggering HVAC load shedding

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Air compressors

- Air Compressors

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Air compressors

- CH2M HILL refined sizing of new compressors to address existing electric actuators, and removal of existing air diaphragm pumps
- Schematic drawing shows site wide compressed air distribution
- Need review and confirmation with Bend staff

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Air compressors

- Existing Compressors 200 SCFM
 - Existing load close to 140 cfm, 70%
 - Deletion of PS pumps will free up 60 -40, cfm resulting in 50% – 40% of capacity.
- Space provided in new blower building for additional Compressors, air dryers
 - Sizing will be refined in final design

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AHP Site routing

HIGH PRESSURE AIR (HWP OR LA)
 — EXISTING
 — PROPOSED
 — FUTURE

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Solids Facility

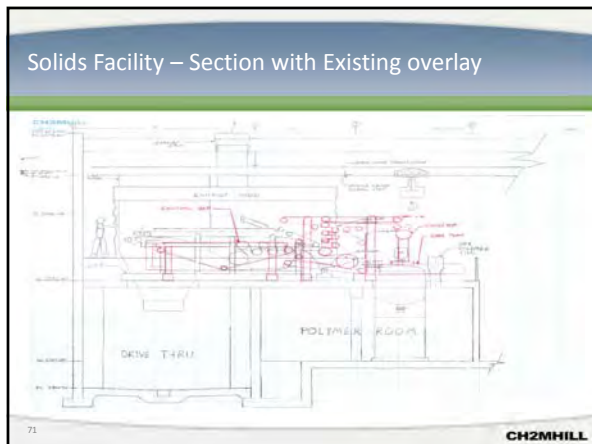
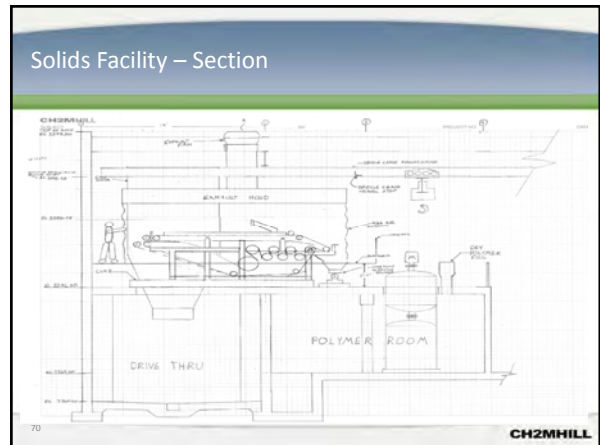
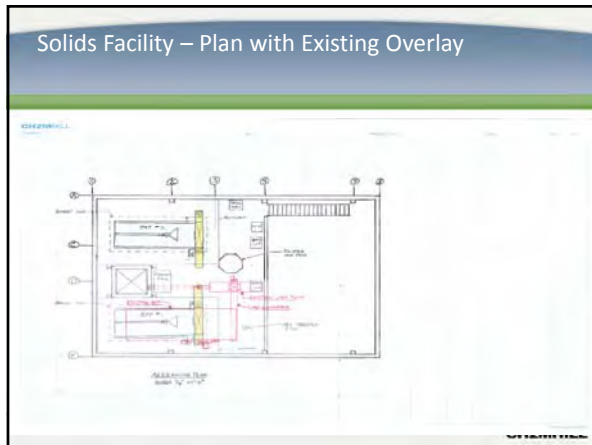
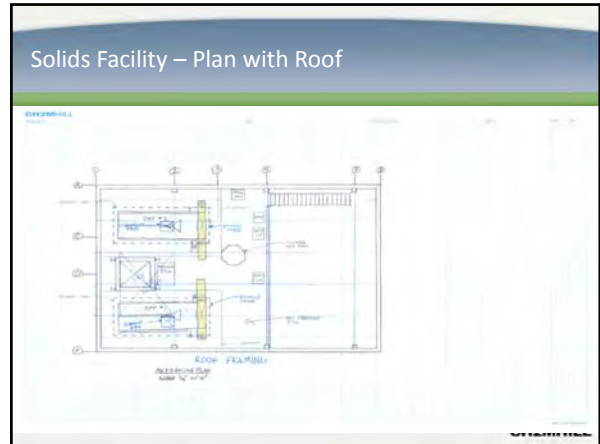
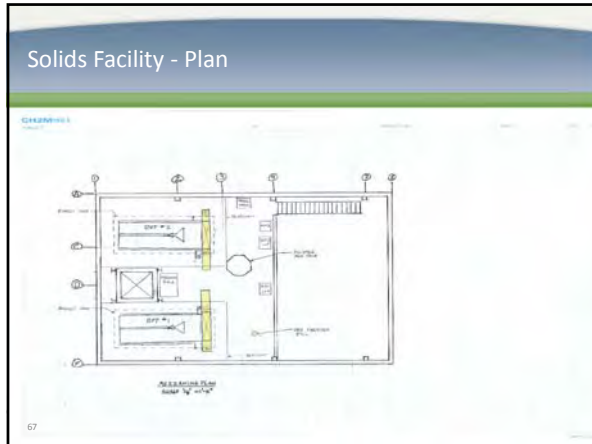
- Solids Facility

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Solids Facility

- Layout sketch for new BFP's
- List of benefits of removing existing BFP
- W2 (Well) and W4 (Plant Water) water supply
- Ventilation issues – HVAC sizing
- Electrical room layout/sizing/expansion

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- ### Solids Facility
- **Benefits of replacing existing BFP**
 - Increased access to dry polymer fill
 - Eliminate conveyor
 - Cake pump improvement with bridge breaker
 - Centralize maintenance access in center of building, Left/Right hand machine setup.
 - Pneumatic Vs. existing hydraulic tensioning: Reduced maintenance
 - Platforms for improved access and inspection
 - Standardization operations, instrumentation and spare parts
 - less maintenance associate with pneumatic belt tensioning versus hydraulic belt tensioning
 - New BFP layout facilitates exhaust hoods and curtains
 - Reduced building corrosion

Solids Facility

- Water supply to Solids Facility
 - W2, well water line size:
 - Original construction 1997, line size = 1" & 4"
 - Upgrade 2006, line size = 2"
 - **No upgrades proposed for W2**
 - W4, Plant water line size:
 - Existing line size = 3"
 - Proposed New line size = 6"

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Solids Facility

- HVAC
 - Sizing: 6 ACH (air changes per hour) for the whole facility
 - BFP Hoods and curtains increases effective air change rate for area inside curtains
 - Multiple air flow rates inside curtains, with higher rates tied to process operation (~ 20 Air changes per hour)

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Solids Facility

- Electrical Room
 - Electrical feed is adequate for the solids building modifications.
 - Existing Drive Cabinet: space is limited some VFDs may need to be placed in MCC.
 - New I/O cabinet
- Existing Electrical Room appears to have adequate space to accommodate planned improvements

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Solids Facility – Polymer feed

- Polymer demand
 - GBT:
 - Max polymer dose: 13 lb/DT; Max sludge feed (2030): 810 lb/hr
 - Max Polymer feed rate
 - $13 \text{ (lb/DT)} * [810 \text{ (lb/hr)} / 2000 \text{ (lb/DT)}] = 5.26 \text{ lb/hr dry polymer}$
 - 3.1 gpm @ 0.5% polymer concentration
 - Min polymer dose: 4 lb/DT; Min sludge feed (start-up): 340 lb/hr
 - Min Polymer feed rate
 - $4 \text{ (lb/DT)} * [340 \text{ (lb/hr)} / 2000 \text{ (lb/DT)}] = 0.68 \text{ lb/hr dry polymer}$
 - 0.4 gpm @ 0.5% polymer concentration
 - BFP (2 total):
 - Max polymer dose: 15 lb/DT; Max sludge feed (2030): 2,200 lb/hr (each)
 - Max Polymer feed rate
 - $15 \text{ (lb/DT)} * [2,200 \text{ (lb/hr)} / 2000 \text{ (lb/DT)}] = 16.5 \text{ lb/hr dry polymer}$
 - 9.7 gpm @ 0.5% polymer concentration
 - Min Polymer dose: 8 lb/DT; Min Sludge feed (start-up): 1,125 lb/hr (each)
 - Min Polymer feed rate
 - $8 \text{ (lb/DT)} * [1,125 \text{ (lb/hr)} / 2000 \text{ (lb/DT)}] = 4.5 \text{ lb/hr dry polymer}$
 - 2.6 gpm @ 0.5% polymer concentration

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Solids Facility – Polymer feed

- Polymer feed Options
 - Pressurized loop with Control valves
 - Three equally sized Polymer pumps
 - total system capacity 22.5 – 0.4 gpm
 - Dedicated Polymer feed pumps
 - Three individually sized polymer pumps
 - BFPs polymer pumps (two): 9.7 – 2.6 gpm/each
 - GBT polymer pump: 3.1 – 0.4 gpm
- Progressive cavity polymer pumps have a 10:1 turn down
 - Unable to make both polymer feed options work with one set of pumps
 - Need to decide one polymer feed option

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Solids Facility – Polymer feed

Polymer Feed Recommendation:

- Dedicated Polymer feed pumps to the points of use (GBT, each BFP)
- Spare pumps on shelf for redundancy

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Electrical Standby Power

- Electrical, Standby Power

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Electrical Standby Power

Review Existing and Proposed Standby Generator Systems:

- Equipment table of existing generator and new generator
 - Need review and confirmation with Bend staff

Preliminary Schematics:

- Existing standby generator system
- Proposed system with two standby generators

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Electrical Standby Power – Existing System

EXISTING WRF FACILITY FACILITIES CURRENTLY SERVED BY EXISTING STANDBY POWER GENERATOR

- STDBY GEN
- EXIST STDBY GEN POWER

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Electrical Standby Power - Proposed

POST-WRF EXPANSION FACILITIES SERVED BY EXISTING AND NEW STANDBY POWER GENERATORS

- STDBY GEN
- EXIST STDBY GEN POWER
- NEW STDBY GEN POWER

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Other topics

- Pipe schedule, flow stream ID
- Equipment list

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Pipe Schedule and Flow Stream Identification

Preliminary Pipe Schedule and Flow ID Table provided to City of Bend at March 29th Workshop

Any comments or changes?

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Equipment List

- Equipment List
- Equipment Data Sheets

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Updated Schedule for Schematic Design

Schematic Design Phase	12/14/2010
Schematic Design Kickoff	1 day
Internal Kickoff Meeting	1 day
Schematic Design	80 days
Preliminary Bids - Solids	1 day
BD Workshop - Solids	1 day
BD Workshop No. 1 - Design A/E's	1 day
BD Workshop No. 2 - SD Progress	1 day
Develop Draft Schematic Design Report	20 days
Assemble Internal Review Copy	2 days
Draft Report ready for internal review	2 days
Internal Review	5 days
Develop Draft Estimates	7 days
Develop Revised Comments to PM team	3 days
Finalize and Prepare Draft Report for Bend	3 days
Deliver Draft SD Report to Bend	3 days
City Review of Draft Report	12 days
Cracked Preparing	10 days
Cost Estimating	10 days
Workshop to Review Draft Report (Bend)	1 day
Finalize Schematic Design Report	1 day
Deliver Final Schematic Design Report	1 day

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- Schedule

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Updated Schedule for Schematic Design

- Key Dates:
 - ✓ Feb 2nd Schematic Design Kickoff
 - ✓ Mar 8th Solids Workshop
 - ✓ Mar 29th Workshop No. 1 – Alternatives
 - ✓ Apr 25th Workshop No. 2 – Progress Review
 - Early June: Draft SD Report to Bend
 - Late June: Draft Report Review Workshop
 - Mid July: Final Report

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QUESTIONS??

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Pre-selection of equipment vendors:

Equipment for consideration:

- IFAS Media and Equipment
- Plant Effluent UV disinfection – low pressure in-channel
- Reuse UV disinfection – medium pressure in-vessel
- Belt Filter Press(es)

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Pre-selection of equipment vendors:

Objectives for IFAS Procurement:

- CH2M HILL will control process design (with input from the manufacturers) while holding the manufacturers responsible for the quality and performance of their product and the system it supports,
- Owner will maintain maximum control over who is given serious consideration during bid and Owner receives a solid process performance guarantee from the Supplier
- Create a highly competitive bid platform that will help this team fulfill its vision of implementing IFAS as the low-cost alternative while providing a design of superior quality, and
- Maximize the protection of manufacturers trade secrets from competitive manufacturers as it will impact cost.

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Pre-selection of equipment vendors:

Design-Bid-Build Procurement Options

1. Conventional Procurement: Write spec around A-named supplier, part of lump sum bid (Grand Chute, MI)
2. Owner pre-selects equipment supplier (quals and price), contracts directly for Engr and equipment, and authorizes Engr services
 - a) With fixed price and scope, transfer equipment purchase contract to low bid contractor, or
 - b) Owner purchased equipment with Contractor installation and coordination
3. Process guarantee for IFAS would be a direct contract with City of Bend

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Pre-selection of equipment vendors:

CM-GC Procurement Options

1. Owner selects equipment supplier (quals and price), contracts directly for Engr and equipment, and authorizes Engr services
 - a) With fixed price and scope, transfer equipment purchase contract to CM-GC contractor, or
 - b) Owner purchased equipment with Contractor installation and coordination
2. If CM-GC Contractor is on board early enough, they could manage the pre-selection and procurement process

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IFAS Pre-Selection – Preliminary Schedule

Task	Time Required (days)	Start Date	Completion Date
CH2M HILL develops proposed IFAS procurement	11	15-May	26-May
Present IFAS procurement approach to Bend	1	27-May	28-May
Finalize IFAS procurement documents	14	29-May	12-Jun
COB prepare IFAS procurement documents	30	13-Jun	13-Jul
IFAS Bid Period	28	14-Jul	11-Aug
Selection of IFAS vendor	14	12-Aug	26-Aug
Execute agreement with IFAS vendor	30	27-Aug	26-Sep

Additional Equipment packages (UV, Belt Press) could be pre-selected on a similar schedule

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City of Bend Review Comments

Dept
Reviewer

Utlities/Engr
JW/ST/SP

Project Name: Secondary Expansion Project SW0802
Submittal: DRAFT - Schematic Design (June 2011)

Item #	Dwg Shy/ Spec Paragraph	Comments	Type	Consultant Response
1	General	This is a very thorough, well written, well thought out Schematic Design Report that captures the extensive amount of work completed through a series of workshops over the past several months. There are just a few outstanding issues noted below that need clarification and a re-look prior to proceeding too far beyond 30%. Additionally, we typically like to see Process Loop Descriptions in preliminary form by 30% or very early in the next phase.		Comment. No change required.
				Acknowledged. This issue will be addressed during the next stage of design
2	General	Need discussion on Construction mgt and staffing for COB and Consultant, Office or Trailer needs, power, etc.		Acknowledged. This issue will be addressed during final design.
3		Ned to finalize discussion on pre-selection off eqt IFAS BFP Blowers UV in vessel UV in channel Others?		Acknowledged. This issue will be addressed during the next stage of design
4	TM 1 p. 4	Add In Channel UV Disinfection to 3 rd para.		Paragraph refers to Project Definition Report and was accurate for that stage of design. TM 2 indicates that In-channel UV has been selected for plant effluent disinfection.
5	General	Will lime usage be greater or less than current usage. Is there potential for relocating the lime system or some system that provides the alkalinity necessary but less maintenance?		Lime usage will be approximately the same as currently required at the WRF. While there may be the possibility of increased denitrification (and associated alkalinity recovery) it is not anticipated that this will reduce the lime addition requirements. We can look at the potential for relocating the lime addition system during the Design Development phase if desired.
6	TM 1 p. 6	Note that the Siphon Structure hydraulic limit on the plant is approx. 30 mgd so the reader and designers will know this hydraulic restriction but the yard piping is designed for higher flows assuming the siphon will be replaced in the future.		Comment incorporated in Final SD Report.
7	TM 1 p. 6, 7	WPCF Permit not an NPDES (Table 2 calls it out correctly)		Comment incorporated in Final SD Report.
8	TM 2 table 3	Plant Effluent Disinfection Info lower right missing		Comment incorporated in Final SD Report.
9	"	Hot water loop info missing		Comment incorporated in Final SD Report.
10	"	Air compressor info missing		Comment incorporated in Final SD Report.
11	TM 2 p. 10	COB wishes to use MLR Pump Vertical turbine type		Acknowledged. Vertical, mixed-flow MLR pumps, similar to those installed at CWS's Rock Creek facility, will be incorporated into the next phase of design.
12	TM 2 p. 17	Scum and Grease concerns around screens, is there a way to clean remotely, sprays, hot water?		The passage of secondary scum through the IFAS system will be developed during the next phase of design to address this concern.
13	"	Note the WEMCO Preo system is modeled and should match the successful Headworks Project Drain Sump System		Acknowledged. This issue will be addressed during the next stage of design

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14	"	Is 12 hours too much to drain? Or during one 8 hr shift-Ask Scott and crew.		Acknowledged. This issue will be addressed during the next stage of design
15	TM 2 p.18	Media transfer was via a shelf submersible pump placed on permanent rail system.		Acknowledged. This issue will be addressed during the next stage of design
16	"	Add that the cOB is considering the potential for replacing two existing, centrifugal blowers currently in need of repair with turbo blowers		Comment incorporated in Final SD Report.
17	TM 2 p.20	2 nd para: Note that the current gravity belt drainage piping is reduced near the PC splitter structure, thus reducing the capacity of the GBT to operate at the eqt design conditions.		Comment incorporated in Final SD Report.
18	TM 2 p. 21	Note that this work should be coordinated with the SCADA Project Stds. Note also that the Fiber Optic System and Server hardware are currently being relocated, designed to the existing DAFT building.		Acknowledged. This issue will be addressed during the next stage of design
19	TM 2 Eqt List	Primary Sludge Pumps show 180 gpm. See later comments regarding the need to relook at the design criteria for sludge pumping and additional senior review needs.		Acknowledged. See response to Comment 20.
20	TM 3-General	Primary Sludge pumping design criteria based on minimum velocity of 2 fps. The TM suggests this is the driver for pumping sludge at 5% and the COB feels this is erroneous and misses basic sludge hydraulic/pumping understanding. This TM needs to be reviewed by Jim Smith/Senior Reviewer. The impacts of this effect the ability for the operator to choose whether to turn down the pumps to run at a slow, continuous pumping speed or pump on an intermittent basis. It forces us to use the intermittent if they are oversized. This also impacts the ability to slow the speed of the progressing cavity pump enough to reduce wear due to grit, another important design consideration. This is a serious fatal flaw and needs to be reconsidered as pointed out several workshops ago. It is disappointing to the client, the fact that the consultant did not follow up, get assistance from the senior reviewer as requested by the client and let this get this far into the schematic design report.	F	Acknowledged. Design of the primary sludge pumping systems will take care not to over-size the pumps. The design criteria will meet the following conditions: (1) Maintain solids concentration targets, 2) Feed the digester as nearly continuous as possible consistent with (1). 3) Minimize wear on pumping equipment. Comment incorporated in Final SD Report. Further evaluation of the design criteria during Design Development may allow reducing the pumping range and meet objectives.
21	TM 3 p. 7, 9	Scum Pumping – Control of the scum pumping operation, consider the addition of hot water sprays and ways to eliminate the manual washdown of the scum pits.	S	Acknowledged. This issue will be addressed during the next stage of design
22	TM 3 p. 9, 10	See previous comments on Primary Sludge Pumping System.	F	Acknowledged. See response to Comment 20. The addition of primary sludge blanket meters may be necessary to automatically control pump operation and achieve the target solids.

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		The pump speed, type of pump, flow rate and control system should allow the operator to develop the necessary sludge blanket to maintain the 5% sludge. Needs more discussion. Possibly tie the operation to the sludge density meter also for flow control loop.		
23	TM 3 Eqt data sheet	Primary sludge pumping design criteria 180 gpm needs further consideration		Acknowledged. See response to Comment 20.
24	Draft Fact Sheet 2	See previous discussion on primary sludge pumping. Page 8 notes that the pump is too large to allow continuous pumping and forces the operation to be intermittent.	F	Acknowledged. See response to Comment 20.
25	TM 4 Table 4	Add WW Flow Condition for Startup, Near Term, Design Buildout-See TM 5 p.2 table 1 for an example. Typical for all tables in TM 4 discussing aeration		Incorporated in Final SD Report. Table 4 is updated
26	TM 4 p. 7 IFAS Ari Demand	Sim comment to Table 4 discuss conditions/flow, sim comment on Figure 1		Incorporated in Final SD Report. Air Demand conditions/flows are updated
27	TM 4 p.11	Add discussion of results of COB site visit to Clean Water Services to review the vertical turbine pumps, maintenance, access, ability to monitor flow, pressure, etc, access		Incorporated in Final SD Report. Discussion is updated
28	RAS Fact Sheet 1 TM 4	p.2 Discuss the need to automate the cleaning of the RAS pipe if needed, if it is something the operations does on a manual, consistent basis.		Incorporated in Final SD Report. Discussion is updated
29	TM 6	Good to see the decision modified info on NaOCl ad Plant Water Flow measurement captured.		Comment. No change required.
30	TM 6 p.9	In the next phase we need to decide about demo to exist facilities that are being abandoned, ie CCB, Chlorine gas blg, etc		Acknowledged. This issue will be addressed during design.
31	TM 7-General	Reuse Disinfection – We should add a section that describes the capital costs, O&M costs of this work in comparison to the revenue from selling the water to Pronghorn. Recommend we look at the payback period resulting from adding \$1.5 to \$2.0 million worth of infrastructure to the Reuse Facility. Considering the original cost fo the facility and the payback for this work, etc.	F	The existing system does not meet current reuse regulations and standards and the current design addresses those required modifications. UV disinfection was selected because of simpler construction and the small footprint. CH2M HILL can provide support to Bend staff if Bend is evaluating the economics of providing reuse water to customers. Jim Wodrich has collected data and City is evaluating the data.
32	TM 7-Table 3	See comment above and reflect this info in this table possibly.		See response to comment 31.
33	TM 8 p. 5	Filtrate Return-Discuss the pros and cons of returning the GBT and BFP filtrate directly to the head of the AB's. Note that the GBT gravity flow HGL may require the additional 4 to 5 ft of head available downstream of the PC's.		Incorporated in Final SD Report. Discussion is updated

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34	Draft Fat sheet 4 Replace Exst BFP	It would be beneficial to show the existing BFP performance compared to the design criteria or typical BFP performance interms of solids loading, hydraulic loading, Capture and polymer usage #/DT.		The belt filter press design criteria, which is representative of typical BFP performance, is included in TM 8 Table 1. The actual performance of the existing BDP belt filter press was not documented during schematic design, as the existing performance is speculated to be less than optimal due to existing polymer feed instability issues which also results in less than optimal sludge feed loadings and other dewatering performance parameters. Assuming the sludge and polymer feed control support systems were identical, the optimal performance of the existing 2-m BFP is expected to be similar to a new 2-m BFP. If desired by COB, the existing BFP performance could be more thoroughly stress tested and documented during early Design Development to ascertain solids loading (lbs TS/hr/m), hydraulic loading (gpm/m), TS capture efficiency, and polymer usage (lbs PO/DT), and cake dryness (% TS).
35	TM 9 p.1 and Table 1	Note in this TM the existing siphon stucture limits hydraulic loading to the plant to <30 mgd. This would help future engineers and operators reviewing the needs to understand that we are placing 50 mgd yard piping in currently but the plant flows will be less than 30 mgd until the siphon flow constriction is replaced.		Acknowledged. Incorporated in Final SD Report.
36	TM 10	General Comment-Needs Loop Descriptions General comment-Follow SCADA Stds for all future work General-Outstanding Issues to be discussed with SCADA Project Team		Acknowledged. This issue will be addressed during the next stage of design
37	TM 12	Consider discussing potential future coordination requirements with a Second Power Feed		Acknowledged. This issue will be addressed during the next stage of design. See response to Comment 97.
38		Discuss the location, site and pros/cons of using the old mining site for fill		Acknowledged. This issue will be addressed during the next stage of design. Survey and geotechnical field work covered in Design Development.
39	TM 13	Code Analysis, please locate the code analysis on all future drawing packages on the cover sheet for ease of reviewer (County and City)		Acknowledged. This issue will be addressed during the next stage of design.
40	TM 14	Are there potential IBC and UBC, or other codes that may be issued and have significant changes that may impact design or construction. Note the Special Inspection Needs as this assists the COB with budgeting outside Inspection Services.		The next version of the governing structural code, the Oregon Structural Specialty Code, is likely going to be available for adoption in 2013. This issue will be addressed during the next stage of design.
41	TM 16	Prefer not to have gate valves, consider butterfly, ball or other valve types in lieu of gate valves.		Incorporated in Final SD Report. In addition, discussion modified to indicate that vented ball valves will be used in hypochlorite service in lieu of diaphragm valves.
42		COB std at the WRF is to eliminate or minimize the use of swing check valves. On most pumping systems, prefer to use actuated valves, flow monitoring and Pressure as a standard for mechanical backflow prevention. CH2M HILL designed the digester mix and feed pumping systems on previous work at the COB, follow this lead on the Secondary Expansion Project		Acknowledge. This issue will be addressed during the next stage of design. Avoiding swing checks where applicable, will be stated in Schematic Design report. Use of actuated backflow prevention valves in lieu of passive swing check or possibly ball check valves will be performed on a case by case basis during Design Development. The Design Development analysis should include a evaluation of potential failure of automated backflow prevention valve due to power failure, loss of air, etc.
43		Prefer to minimize the use of seal water systems and instead use double mechanical seals to reduce maintenance and complexity.		Incorporated in Final SD Report

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44	TM 17 p. 10	Hot Water Supply/Return Piping should be HDPE/PEX insulated Arctic Pipe as used in the Headworks Project.		Incorporated in Final SD Report. To be coordinated with Headworks project.
45	TM 18 p. 8,9	The use of Smart MCC's is a good direction for the project and should be coordinated with the SCADA Project stds. COB is nervous about using newer smart MCC's without further explanation. Needs more discussion, pros, cons, etc.		Acknowledged. This issue will be addressed during the next stage of design.
46	p. 11	Coordinate lighting with Operations current high efficiency lighting energy saving project-See Scott for details. Also, make sure there are a percentage of lights in each area that have strikers that light up immediately while the others are energizing. Lights should be photocell in all areas.		Acknowledged. This issue will be addressed during the next stage of design. Will coordinate lighting design with current high efficiency lighting energy saving project. For areas that have HID lighting, a percentage of the fixtures will include instant on quartz lamps to provide minimal lighting while HID fixtures warm up. Exterior lighting will include photocell control.
47	TM 20	p. 2 note in the cost Table 1 that these are Project , OOM costs estimates and what the contingency and markup's were.		Incorporated in Final SD Report. Footnote added to the table that includes the Facility Plan assumptions.
48	p.7	Construction cost trending-Consider noting the project cost increase is approximately 11% and how that relates to the Cost Estimating Accuracy Range figure		No change required. A summary of the project changes driving the increase costs is included in the TM. Changes in cost are not related to accuracy or original estimate but rather the upward trend in project scope.
49	p. 8	Consider the pros/cons costs for replacing the plates on the band screens to match the single 3mm plate unit, impacts tot IFAS, etc		See the response to comment 87. 6 mm screens are suitable for IFAS systems being considered.
50	p.11	Add discussion of blgs/areas for potential demo by the contractor		Acknowledged. This issue will be addressed during the next stage of design.
51	Drawings	General Comment: A very good 30% cut at the drawings, P&ID's, 3D views, etc. Very helpful to the team and reviewers thanks		Comment. No change required.
52	01-G-011,028	Tagging of instruments, eqt, valves, etc should reflect finalized SCADA tagging system std		Acknowledged. This issue will be addressed during the next stage of design.
53	08-I-007	See previous note on elimination of swing checks and using the COB pump std used on the digester work		Acknowledge. This issue will be addressed during the next stage of design. Avoiding swing checks where applicable, will be stated in Schematic Design report. Use of actuated backflow prevention valves in lieu of passive swing check or possibly ball check valves will be performed on a case by case basis during Design Development. The Design Development analysis should include a evaluation of potential failure of automated backflow prevention valve due to power failure, loss of air, etc.
54	43-M-140	Preference is to have FIT and PIT on all pumping systems for startup, performance, trending, maintenance info.		Acknowledge. This issue will be addressed during the next stage of design. FIT and PIT will be added to drain pump station. Narrative added to Final SD Report, TM 16.
55	08-I-026	Consider replacing the exst hydraulic actuator with pneumatic type		This issue will be addressed during the next stage of design.. Conversion of existing valves to pneumatic will be made on a case-by-case basis. See TM 16.
56	08-I-023	Yes, replace centrifuge and exst BFP with two similar BFPs for this work.		Acknowledged. This issue will be addressed during the next stage of design.
57		END of JVW Comments		

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58	Scott/Operations Comments			
59	TM 1 PG 6	WPCF.....NOT NPDES PERMIT		Comment incorporated in Final SD Report.
60	TM 2, TABLE 3	PRI. CLAR. FLOW@% CALCCULATION?		The design flow rate is based on process modeling predictions at the minimum day influent flow and the design maximum week influent flow. The values are for different primary sludge concentrations.
61	TM 2, TABLE 3	PRI. SLUDGE PUMPS- CAN THEY ALL BE THE SAME 180@181FT.?		The primary scum pumps need to pump the primary scum wet well dry. So, they see a different head condition than the primary sludge pumps.
62	TM 2, TABLE 3	NO DATA ON PLANT EFFLUENT DISENFECTION.		Comment incorporated in Final SD Report.
63	TM 2 PG. 15	HOW TO MATCH FLOW AS UNIFORMLY POSSIBLE WITH DIFFERENT SIZE PIPES?		Flow meters and control valves should provide sufficient accuracy and control to properly split the flow between the aeration basin/cells. A "most open valve" control strategy and flow control valves will be used to split flow.
64	TM 2 PG. 16	FLOW SPLIT ACCURACY- UNDERSTAND 5 UPSTREAM/ 3 DOWNSTREAM. THIS WOULD BE EXTENSIVE WORK, IS % ACCRACY WORTH EFFORT FOR THIS APPLICATION? VERIFIE CURRENT ACCURACY.		This issue can be addressed further in the next stage of design, if desired. During the schematic design phase, we elected to follow the standard guidance for flow meter installation.
65	TM 2, PG. 16	MLR PUMPS- INTERESTING TO RELIE ON NITRATE PROBE FOR CONTROL WITH FLOW AS SECONDARY.		Comment. No change required.
66	TM 2 PG. 17	NEED MORE DISCUSSION ON FOAM/SCUM CONTROL. SUCCESSFUL EXPERIENCE?		Acknowledged. See Comment 12. This issue will be addressed during the next stage of design
67	TM 2 PG. 19	WHAT IS THE EXPECTED USAGE OF WATER DEPT. FOR HYPO?		This information has been incorporated in Final SD Report. 724 gallons per year.
68	TM 2 PG. 20	W4 RAPID FILL- COULD THIS BE ACCOMPLISHED WITH POTABLE TO INSURE EFFECTIVE POLY REACTION?		This has not been considered so far in the design. This issue can be addressed further in the next stage of design, if desired.
69	TM 2 PG. 21	SUGGEST NEED TO UPGRADE RAS PLC.TO NEW PLATFORM. COULD CONSIDER AUTOMATED CHECK VALVES FOR RAS/WAS PUMPS FOR CONTROL PLUS ADDED EFFENCIENCY.		This issue can be addressed further in the next stage of design, if desired
70	TM 3 PG. 3	PRIMARY SLUDGE PUMP- CONSIDER ANALYSIS OF OUR SLUDGE FOR GRIT. FOR EXPECTED MAINTENANCE.		This issue can be addressed further in the next stage of design, if desired
71	TM 3 PG. 10	CONSIDER STAMFORD BAFFELS- INCREASED PRIMARY EFFENCY = LESS LOAD ON AB PROCESS. CHEAP INVESTMENT WITH POTENTIAL HIGH VALUE?		This issue can be addressed further in the next stage of design, if desired
72	TM 4 PG. 13	AB OVERVIEW- WHY WILL WE EXPECT HIGHER AMMONIA VALUES AND LOWER NITRATE VALUES?		We do not expect higher effluent NH3-N as the system can be operated to provide nitrification year-round. With the IFAS system operations will have the option to control the effluent NH3-N to a specific value (the benefits of having the biofilm provide nitrification) - nitrification by the biofilm is a direct, linear relationship with the bulk-liquid DO introduced into the IFAS reactor. There may be a setting that will allow for a slightly higher effluent NH3-N value (as a result of lower DO), associated with a slightly lower effluent NOx-N value, all while still meeting the TN limit. This could provide some level of energy savings at the facility, given the reduced air demand.

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73	TM 4 PG. 14	VENDOR PACKAGE PLC CONTROL OF IFAS- ULTIMATE RESPONSIBILITY – VENDOR OR CH2M-HILL?		The vendor will have responsibility for the package control system as they will need to meet the associated process guarantee for the IFAS system. CH2M HILL will have the overall responsibility of coordinating/integrating the vendor package PLC control system into the existing plant-wide control system.
74	TM 4 PG. 15	AB SYSTEM- FAVOR COMPOND LOOP CONTROL BASED ON FILTRATE LOADING.EXPERIENCE?		The control system will be designed to accommodate filtrate loading - our experience is that the IFAS system will be better suited to handle these filtrate loads given the stability inherent with the biofilm process.
75	TM 4 PG. 16	MLR PUMPS- TWO PER BASIN, WOW!		Two pumps are incorporated to provide the wide range of MLR flows anticipated and warranted at the WRF. This will provide operations additional flexibility within the system.
76	TM 4 PG. 16	TANK DRAIN- WHY ONE PUMP?		We do not anticipate basin drainage to be a regular occurrence, so only one drainage pump is proposed. This pump will be sized to provide the associated drainage time warranted by operations.
77	TM 4 PG. 16	EXPLAIN IFAS SELECTION IMPACTS UV SELECTION.		TM is clarified in final Schematic Design. The reference refers to the procurement approach only (nothing treatment related). If we elect to pre-select the IFAS system, it may be beneficial to include the UV equipment within the associated RFP developed. This will be one of the initial tasks during the design development phase - working with the City to determine the appropriate equipment procurement approach.
78	TM 5 PG. 5	TURBO BLOWERS- DO THEY NOT ALL PROVIDE AIR FLOW RATE AS A FUNCTION OF CONTROL.		Turbo blowers do calculate flow rates based on equipment performance. However, blower system will measure applied air at the aeration basin to provide proper distribution.
79	TM 5 PG. 5	WHY IS PLANT AIR DISCUSSED IN TM 5 BLOWERS? NEED MORE SCADA CONTROL OF CURRENT PLANT AIR SYSTEM. SUGGEST TM ON PLANT AIR.		Plant air is discussed in this Technical Memorandum because the equipment is located in the same room/building.
80	TM 6 PG. 6	CONSIDER REDUNDENT RAS HYPO PUMP.		This issue can be addressed further in the next stage of design, if desired. A redundant RAS hypo pump can be installed if desirable. Given the infrequent use, it appeared that a shelf spare would provide appropriate redundancy
81	TM 6 PG. 8	WHERE IS PLANT WATER STRAINER BACKWASH DIRECTED TO?		Backwash will be directed to plant drain. Correction to 08-I-032 will be made during the next stage of design.
82	TM 8 PG. 6	A THIRD OPTION IS TO WASTE TO PRIMARY CLARIFIERS.		Comment incorporated in Final SD Report. WAS can be wasted on an emergency basis to the existing primary clarifiers.
83	TM 8 PG. 7	GOAL IS TO OPERATE BFP UNATTENDED AUTOMATICALLY, UTILIZING HOPPER INTO THE EVENING.		Acknowledged.
84	TM 8 PG. 9	BFP EQUIPMENT- EFFECTS UV SELECTION?		Acknowledged. Comment incorporated in Final SD Report. Reference deleted. There is not a direct connection. A similar procurement method will be used for major equipment procurement.
85	TM 8 TABLE 2	24 HOUR FLOW RATES ARE NOT REPRESENTATIVE.		The flow data provided in the table were used in a process evaluation to confirm that aeration basins would have sufficient buffering to prevent ammonia bleed through with the addition of filtrate under current and 8 hour application. City of Bend has provided additional flow data for 9/20/11 and 9/21/11. During the next phase of design, the process evaluation will be run again to confirm the return point for BFP filtrate and GBT filtrate. The revised flow data will be used during this evaluation
86	TM 9 PG. 2	INTERESTING DESIGN CRITERIA- NO SURCHARGE OF WEIR AT WET WEATHER PEAK HOUR.		Comment. No change required.

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87	TM 9 PG. 3	IN RELATION TO IFAS MEDIA- OUR EXPERIENCE IS VERY GOOD WITH 3MM SCREEN. SHOULD WE EVALUATE WITH ALL SCREENS AT 3MM? WOULD THIS NOT MAXIMIZE/PROTECT THE IFAS SYSTEM?		Comment. No change required. Per page 2 of Facility Plan TM 8 - Hydraulics, with (3) 3mm screens in service, and fourth channel out of service, the headworks can pass 30 mgd. The Schematic Design hydraulic analysis, assumes (3) 6mm screens in service. Agree that finer screening can protect IFAS investment by reducing solids, plastics, that could potentially clog IFAS screens. However, this approach would require investment in additional headworks capacity sooner. IFAS has been successfully applied at facilities with 6mm (and larger, typically up to 12 mm maximum) screens with primary clarifiers. WEF document has established this as the minimum design requirement for IFAS. Without primary clarification, 3 mm screens are recommended. City/Consultant should develop SOP to address bypass around IFAS zone when headworks bypass occurs. See this document. (McQuarrie, J.P., and Boltz, J.P. (2011). Moving bed biofilm reactor technology: process applications, design, and performance. Water Environment Research. 83(6). 560-575.)
88	TM 9 PG. 4	EVALUATIONS- ISOLATION VALVES: COULD WE ACCOMPLISH THE SAME RESULTS WITH THE SIPHON STRUCTURE FOR FLUSHING?		Comment. No change required. Existing siphon structure is provided with isolation gates and we confirmed on August 18, 2011 with collections staff that the gates were exercised in Spring 2011. City could establish SOP for surcharging the interceptor and then "flushing" the siphon to potentially remove accumulated material. SOP should consider typical diurnal flows, expected flushing velocities and required staffing/monitoring to avoid hydraulic capacity limitations and risk of peak flows causing overtopping during periods of gate isolation. No further work by Consultant is assumed to be required.
89	TM 9 PG. 11	AB EFFLUENT CHANNEL- NEW AB 4/5 CHANNEL EVL. 3354. EXISTING SECONDARY DIST. BOX ELV. 3354.36?		This issue will be addressed further during the next stage of design. These elevations are as intended. AB effluent channel floor is required to be set lower than ML splitter box overflow weir to address maximum hydraulic capacity issues. Final design to address any provisions needed to facilitate maintenance in the effluent channel, and address backwater from ML splitter box.
90	TM 10 PG. 4	POTABLE WATER PLC CONTROL- THE CURRENT PLANT WATER BLDG. WILL BE DECOMMISSIONED.		Acknowledged. This issue will be addressed during the next stage of design.
91	TM 11 PG. 2	COMPRESSED AIR- NO RECIEVER IN PRI. BLDG. ONE COMP. AND DRYER LOCATED BEHIND MAINT. BLDG. ON THE GRID. NOT LISTED.		This comment has been incorporated in Final SD Report.
92	TM 13 PG. 1	NEED TO CONSIDER ALL METAL ROOF DESIGN VS. MEMBRANE ROOF. JUSTIFIE MEMBRANE ROOF SYSTEMS.		Acknowledged. This issues will be addressed during the next stage of design. Each of the facilities function will be evaluated for the appropriateness of having either the sloped metal roof or the flat/low slope roofing.
93	TM 17 PG. 1	WITH EXTENSIVE EXCAVATION PROPOSED-CONSIDER EXPANSION OF HOT WATER LOOP AS MUCH AS FEASABLY POSSIBLE.		Acknowledged. This issue will be addressed during the next stage of design.
94	TM 17 PG. 1	CONSIDER PLANT WATER SOURCE FOR HEAT PUMP APPLICATIONS.		Acknowledged. This issue will be addressed during the next stage of design. Water source heat pumps will be considered where heat pumps are required.
95	TM 18 PG. 1	PROVIDE SCADA CONTROL FOR OUTSIDE LIGHTING.		Acknowledged. This issue will be addressed during the next stage of design. New Exterior lighting added as part of this project will include the capability of being controlled on/off from the SCADA system.
96	TM 18 PG. 1	EXPAND CURRENT ELECTRICAL VAULT SYSTEM.		Comment will be discussed directly with Scott Thompson. Will resolve during the design.
97	TM 18 PG. 16	SECURE C.E.C. SECOND FEED- VERY IMPORTANT!		A second C.E.C. feed will be evaluated as part of the Standby Power Study in the next stage of design.
98	TM 18 ATTACHMENT	CURRENT GENERATOR FEED- ADD DEGAS, TIN SHEDS, SEPTAGE STATION AND FUEL PUMPS.NOT LISTED.		This comment has been incorporated in Final SD Report.

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99	TM 18 ATTACHMENT	NEED TO EVALUATE CURRENT AND FUTURE GENERATOR LOAD ON EXISTING GENERATOR.		This comment will be addressed in the Standby Power Study during the next stage of design.
100	DRAWING 1-G-41	LIST MAX FLOW RATE THROUGH SIPHON STRUCTURE.		This comment has been incorporated in Final SD Report.
101	DRAWING 31-M-303	WHY 42" BUTTERFLY VALVE ON HEADER?		The butterfly valve on the header will allow construction staging to occur while maintaining plant operation.
102	DRAWING 44-M-140	WHERE IS THE MOST ADVANTAGEOUS SAMPLE POINT FOR COLIFORM ANALYSIS..		This issue will be addressed during the next stage of design. A sample point in the header after the "Future Connection" is the most practical.
103	GENERAL	PROPOSED DEMO DAFT BLDG. FOR IT/SCADA/SERVER ROOM. WASTING REDUNDUNCY WILL BE SPARE PARTS GBT AND PRIMARY CALRIFIERS. SUGGESTIONS?		Acknowledged. This issue will be addressed during the next stage of design. Further discussion of the level of redundancy will be required.
104	Fact sheet 3 pg. 3	Alt. 2, at what flow rate for 12,600 gal. Hypo.		More than 90% of volume is to provide RAS chlorination in 2 days. 700 pounds or 350 pounds per day.
105	Fact sheet 3 pg. 3	Cost -Need detailed cost to accurately compare.		The evaluation for Onsite Hypo has a conclusion typical of evaluations at other plants: on-site generation is not the most cost-effective method of providing hypochlorite. Sites that have selected on-site generation typically have extreme delivery issues or chose on-site for reasons other than economics. Capital costs (equipment costs) for on-site are high. Equipment quotes are incorporated into the cost evaluation. The Schematic Design Report now includes this cost info.
106	Fact sheet 3 pg. 3	Cost -Need detailed cost to accurately compare.		See response to Comment 105.
107	Fact sheet 3 pg. 4	Disadvantage – Higher elect. Cost compared to delivered Hypo?		Correct. Note that while operational costs for delivered hypochlorite are twice that of on-site hypochlorite generation, but on-site generation requires greater electrical power.
108	TM 20 PG. 5	High cost for Misc. yard piping?		This area will be developed further in the next stage of design. At this point, cost of misc. yard piping is an allowance. Not enough detail for smaller piping to estimate more accurately. Subsequent design will provide a better understand of needs and the associated costs.
109	TM 20 Pg. 6	4.66 mil. To retrofit 3 basins to IFAS.		The costs include substantial changes to piping, mechanical equipment, and walls are required. Also includes the cost to provide IFAS system and media.
110	TM 20 Pg. 7	Blower bldg. space for air comp.- possible old H.W. bldg.		Old HW is a possible location for compressors. Blower building was chosen to provide distance between air compressors to improve reliability.
111	TM 20 Pg. 8	Indeed, this project will involve significant construction constraints.		Comment. No change required.
112	STEVE PRAZAK Comments			
113	TM 4 Att B 2eiii	Existing Permit does not require TP	C	Acknowledged. Comment incorporated in Final SD Report. Reference to TP removed
114	TM 6	Monitor NaOCl 12.5% for correct dosage? Consider any degradation in the product over time or delivery	N	Comment. No change required. Agreed that NaOCl should be regularly monitored improve treatment process performance and to minimize cost of hypochlorite by managing hypochlorite storage duration.
115	general	Please note all sampling locations exst and new, automatic sampler, composites, etc		Acknowledged. This issue will be addressed in the next stage of design. Will work with operations staff to verify recommendations

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Reviewer JW/ST/SP

Item #	Dwg Shy/ Spec Paragraph	Comments	Type	Consultant Response
116	TM 17 Table 4	Chemical Bilg only has a supply air fan, not and exhaust fan. With 12.5 NaOCl storage, I would think an EF would be required, please verify. Will a chlorine sensor be installed for any off-gassing? Is it necessary or required by code? What about venting outside of blg?	C	No exhaust is required as the total quantity of chemical is below the exempt quantity limits. A chlorine gas sensor is not required. Exterior venting, exhaust fans and gas detection are not required by code but can be added at your request.
117	Secondary Clarifier's	Currently feed chlorine solution ring for algae control, what should we replace with?		This issue will be addressed in the next stage of design. Existing lines can be connected to the new feed system. Are there other needs for chlorine on the site? There is currently no work in the scope within the secondary clarifiers (e.g. pump spray like at BOI).
118	Solids Handling	Consider TM for this process in light of "DAF" not available for redundancy.		Acknowledged. Partially incorporated in Final SD Report. Reference to DAFT modified to state that there is no backup beyond the GBT shelf spares, 2 days storage in the secondary system, and temporary storage in existing primary clarifiers.
119	IFAS	Would there be value to pilot test vendors, possible staff training???		There are no plans for a pilot test. From a treatment process perspective, there is high confident with the performance of these type of systems on full scale plants. The pre-selection document will have detailed specifications and criteria requiring a performance guarantee from the IFAS system. However, during the initial part of the design development we can meet with operations to determine if staff training is needed. Training could be provided during sequential startup of aeration basins. Additionally, staff could visit operating sites to gain insight from other operations.
120	Energy	Need to include our electrical provider on EDOC to realize benefits.		Comment. No change required. City has determined that methods other than EDOC are more appropriate for external other means of communication are EDOC.
121	Powerpoint	Miscellaneous Comments by Scott Thompson Scum Handling Concept - Automated gate drops - "Interesting. More Discussion. Tested Success." Blower Building - Elevated Grade - Fill available from WRF? - "Very possible." Plant Effluent Disinfection Alternative 1 - Chlorine Contact Basin Lowest capital cost "Large footprint/more excavation/more concrete" Plant Effluent Disinfection - Present Worth Analysis - In Channel LPHO - "Less excavation, less concrete" Plant Effluent Disinfection - Sensitivity "Cost of Hypo? Cost for Hauling?" Plant Effluent Disinfection - Low Pressure In Channel UV - Will be on standby power - "Or 2nd feed from CEC" Reuse - UV Recommendation - Characteristics - Provide residual at 2 mg/L - " Seems High?" Sodium hypochlorite uses with UV for Plant Effluent - Secondary Disinfectant - "What is the industry standard residual? Our experience is 5 lbs/1,000 lbs of volatile. Most effective 24-48 hours." Sodium hypochlorite - "What is the maximum tanker volume? How do we manage tanks 'hypo' when we service them?"		Will be reviewed during the next phase of design Borrow pit on the site will be evaluated during the next phase of design. Compared to the UV facility, a chlorine contact basin has a large footprint, similar excavation requirements and additional concrete. The capital costs are planning cost estimates and match our experience with these facilities. Uv equipment is more expensive and includes protection (a roof) for the equipment. See response to previous comment. Costs for hypochlorite are included in TM 6 Fact Sheet 2. See response to comment 97. Acknowledge comment. Dosing pumps will be sized to handle a range of flows at a range of hypochlorite doses. 2mg/L is likely on the high end of your needs. Chlorine residual are not required for reuse but is highly recommended. Some residual should be measured at the customers end. Adjust dose to meet demand and decay needs to the end of the pipe. Common doses are between 0.5 mg/L and 2 mg/L Tankers commonly deliver hypochlorite in loads of 5,000 to 6,000 gallons for full loads. The selected alternative will not allow a full tanker delivery. When a tank must be serviced, the remaining tank will have to be refilled more frequently at the cost of additional hauling.

City of Bend Review Comments

Project Name: Secondary Expansion Project SW0802

Submittal: DRAFT - Schematic Design (June 2011)

Dept Utilities/Engr
Reviewer JW/ST/SP

Item #	Dwg Shy/ Spec Paragraph	Comments	Type	Consultant Response
		<p>Heating Water Distribution - Heating Water Availability - Total connected load far in excess of boiler #3 capacity - "Interesting. Should we consider connecting the other two boilers."</p> <p>Air compressors- "Have they come out with turbo compressors?"</p> <p>Electrical standby power - Review existing and proposed standby generator systems- "Currently 70% loaded."</p> <p>Electrical Standby power - Existing System - Miscellaneous comments to include/exclude buildings on sketch.</p> <p>Could we add Turbo now so we can begin capture of benefits?</p>		<p>Comment will be discussed directly with Scott Thompson. Will resolve during the design.</p> <p>Turbo centrifugal air compressors are available but, they are generally larger capacity than the compressors required on this project. We would not recommend use of a Turbo centrifugal compressor for this application.</p> <p>Comment will be discussed directly with Scott Thompson. Will resolve during the design.</p> <p>Incorporated in final Schematic Design.</p> <p>There is limited benefit because the existing blowers are on standby status in the new design and thus will not consume large amount of power.</p>
122	TM-6	Should we evaluate the use of 150lb. chlorine cylinders for on-site use? As long as we stay under 2000lb. threshold for Risk Management Plan.		<p>Predesign and Schematic Design criteria included abandoning the chlorine gas system. City to confirm the use of hypochlorite or chlorine gas.</p> <p>With the current design criteria (to meet all chlorine demand requirements), 20 cylinders equals about 3,169 gallons of hypochlorite (based on requirements for days of storage); 36 cylinders equals about 6,000 gallons of hypochlorite (based on hypochlorite delivery trucks).</p>