murraysmith

CITY OF PENDLETON

WWTRRF Facility Plan Update

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June 2020

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City of Pendleton

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Acknowledgements

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Executive Summary

Introduction

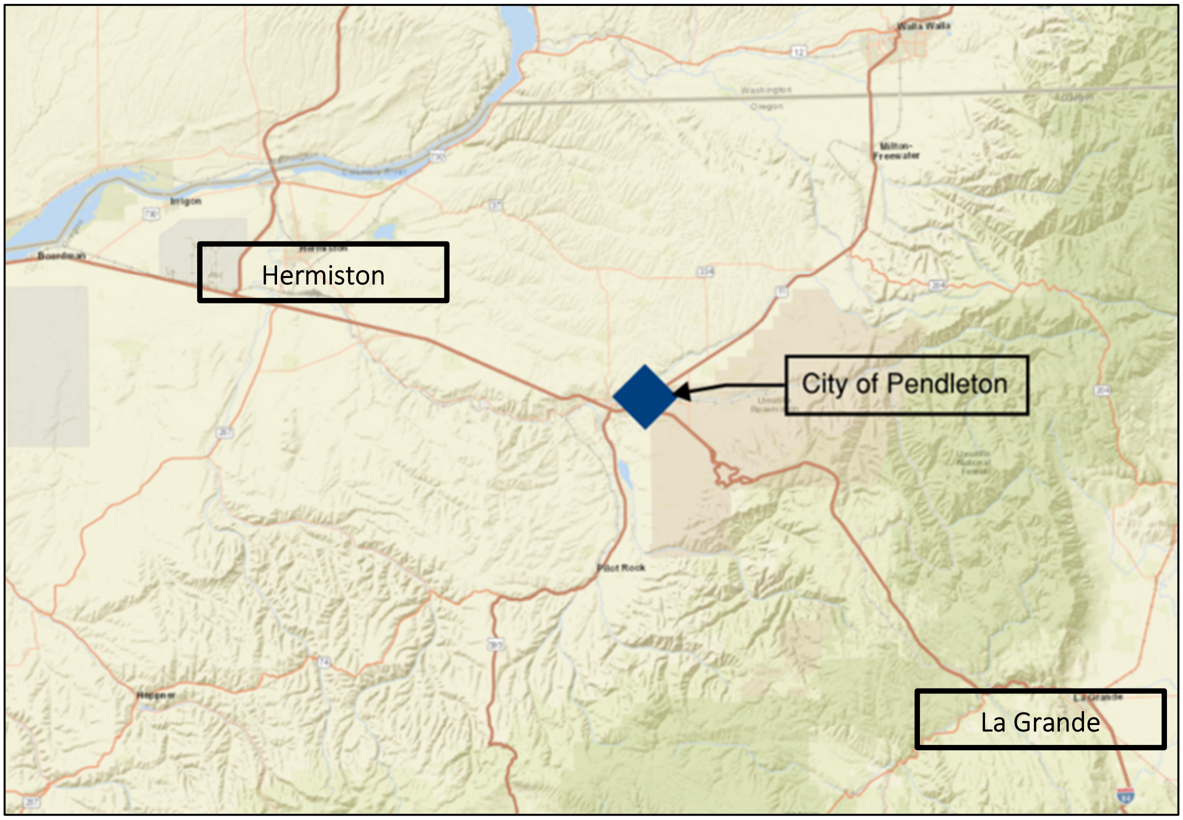
The purpose of this document is to evaluate the existing City of Pendleton (City) Wastewater Treatment and Resource Recovery Facility (WWTRRF) and provide a 20-year plan to guide facility upgrade investments. The facility plan covers the following elements:

- Study Area Characteristics;
- Regulatory Requirements;
- Basis of Planning;
- Wastewater Characteristics;
- Existing WWTRRF Evaluation;
- Unit Process Option Evaluations;
- Combined Alternatives Evaluation; and
- Recommended Plan and Phased Implementation Plan.

Study Area Characteristics

The City is located in Umatilla County in the valley of the Umatilla River within the southeastern part of the Columbia Basin as shown in Figure ES-1. According to the 2010 United States Census Report, the City has a total area of 10.5 square miles. The altitude of Pendleton is 1,069 feet above mean sea level.

Figure ES-1
Vicinity Map



Regulatory Requirements

The City of Pendleton National Pollutant Discharge Elimination System (NPDES) Permit #100982 was renewed February 3, 2005. Based on the City's inability to meet the permit requirements for temperature, the city entered upon a Mutual Agreement and Order (MAO) with the Oregon Department of Environmental Quality (DEQ). As part of the MAO and a modified NPDES Waste Discharge Permit issued on August 31, 2007, the City was required to develop a temperature management plan and to perform a mixing zone study to evaluate alternative discharge points. The mixing zone study was submitted to DEQ in 2009 to evaluate moving the outfall from McKay Creek upstream of the confluence (outfall 001) to an alternative outfall within the Umatilla River downstream of McKay and Umatilla confluence (outfall 002). Based on the mixing zone study results, the outfall 002 was installed in 2012.

NPDES Permit

Table ES-1 is a summary of estimated 2040 Pendleton WWTRRF biological oxygen demand ($BOD_{5)}$, total suspended solids(TSS), and Ammonia mass loads discharged to the Umatilla River based on the Design 2040 average dry weather flow (ADWF), average wet weather flow (AWWF), or peak day flow (PDF) of 3.18 million gallons per day (MGD), 3.19 MGD and 4.22 MGD, respectively, and concentration limits as summarized. As shown, the estimated 2040 BOD_5, TSS, and ammonia mass loads are lower than the mass load limits included in the City's existing NPDES Permit. Based on these load projections for 2040, there is no need for increasing the current permitted BOD_5, TSS, and Ammonia mass load limits included in the City's NPDES Permit. The most recent NPDES Permit expired on January 31, 2010 and has not been renewed. DEQ staff conveyed to City staff at the 2019 ACWA Conference that the City's permit may be reviewed and reissued within three years in 2022. The 2022 NPDES Permit Renewal timing has also been confirmed in the Oregon DEQ Statewide Permit Issuance Plan for Federal Fiscal Years 2020-2025.

Table ES-1
Calculated BOD_5 & TSS Mass Loads

Parameter	Permit Limit			Projections		
	Monthly Average Concentration (ppd)	Weekly Average Concentration (ppd)	Daily Maximum Concentration (ppd)	Monthly Average Load (ppd)	Weekly Average Load (ppd)	Daily Maximum Load (ppd)
Summer Season (May 1 through October 31)						
BOD_5	920	1,400	1,800	531	796	1,056
TSS	920	1,400	1,800	531	796	1,056
Ammonia	48	NA	96	27	NA	70
Winter Season (November 1 through April 30)						
BOD_5	1,400	2,100	2,800	799	1198	1585
TSS	1,400	2,100	2,800	799	1198	1585
Ammonia	140	NA	240	80	NA	183

Notes:
ppd= pounds per day
NA = Not applicable

Temperature Compliance

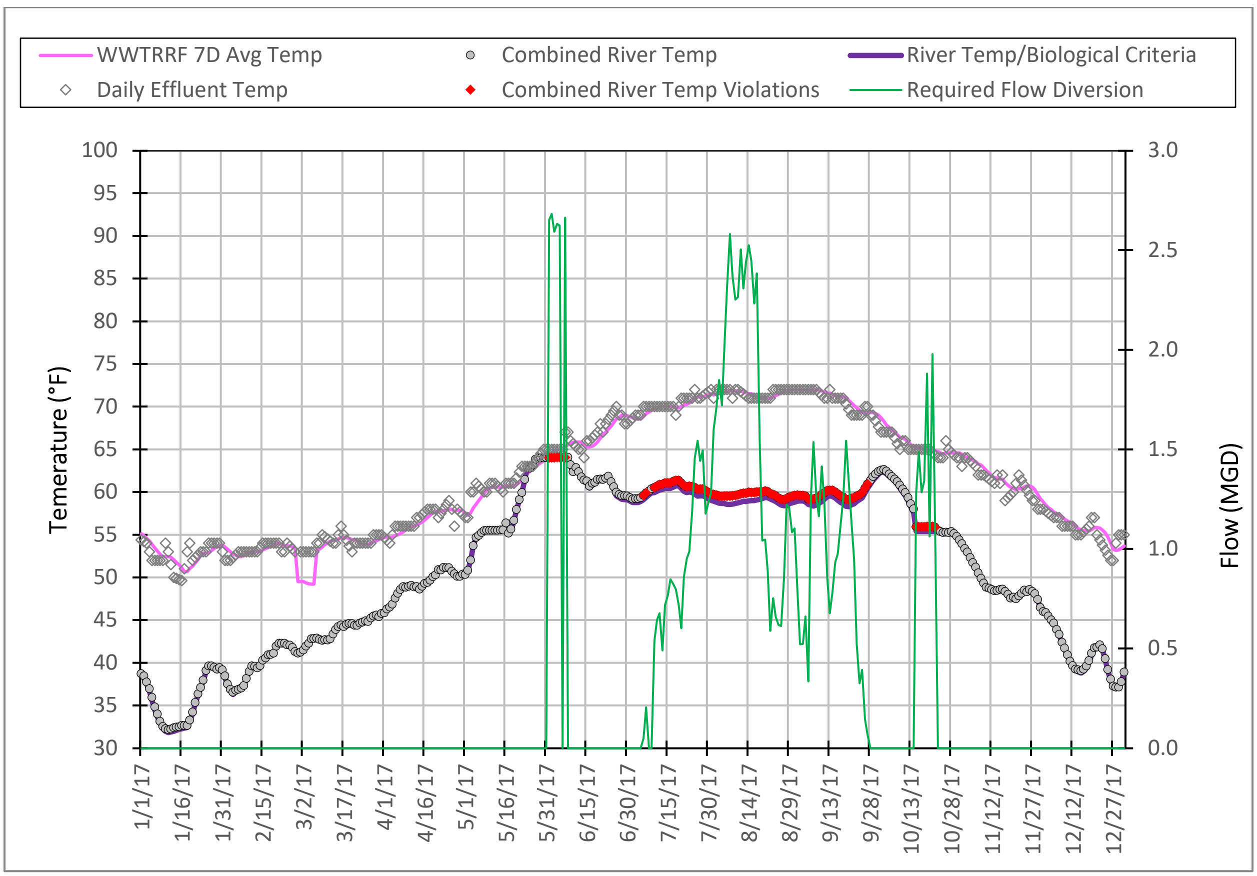
Effluent temperatures in the City's NPDES Permit were based on requirements in the current Oregon Temperature Standard and the Umatilla River Basin Temperature TMDL; however, the City was not able to meet the new temperature limits. In addition, a lawsuit by the Northwest Environmental Associates (NWEA) sued the EPA over the approved Temperature total maximum daily load (TMDL) limits. Because City was unable to meet the permit criteria, the City and DEQ entered into a Mutual Agreement and Order, which allowed for temporary removal of the temperature limit.

While the City does not currently have a temperature discharge criterion, a recent judge order requires DEQ to prepare new temperature TMDLs for all basins in Oregon in the next 8 years. The schedule for each basin is based on population, which puts the Umatilla Temperature TMDL update last on the list. The required completion date for the updated TMDL is November 28, 2027.

There is potential for effluent temperature requirements to be included in the City's next NPDES Permit renewal before the Umatilla Temperature TMDL is updated in 2027. Therefore, an analysis of the historical discharge data was completed the current Oregon Temperature Standard without the natural conditions criteria that has been the subject of the lawsuits driving the TMDL updates. Based on the review of data from 2015 through 2017, there are 379 "potential" violations in 1096 days, or 35 percent of the evaluation period. Figure ES-2 shows the results for 2017 which is typical for the study period of 2015-2017. The majority of the potential violations are during the summer months.

Based on Murraysmith's evaluation and the high potential cost of complying with temperature options long term, we have recommended the City proceed with the development of a water recycling program to produce Class A or Class C recycled water with summer season irrigation. Following this approach, the City would continue to discharge high quality water to the Umatilla River up to the allowable limit based on effluent temperature and the remaining flow would be irrigated locally. Options may include irrigating the I-84 highway median and then extending a pipeline up near the airport. An option could be to use the same site for biosolids land application and recycled water irrigation.

Figure ES-2
2017 Potential Temperature Standard Criteria Violation Results



Biosolids Management

The City's WWTRRF Biosolids Management Plan was updated in July 2005 and approved by the DEQ. The current Biosolids Management Plan provides for production of Class B Biosolids that is land applied on sites authorized, primarily near the Pendleton Airport. Class B pathogen reduction and vector attraction reduction regulatory requirements are met through the existing anaerobic digesters followed by solids dewatering and additional drying in the existing solids drying beds. During 2017, pathogen reduction requirements were met with an average mean cell residence time of 42 days at an average temperature of 98 degrees Fahrenheit. Volatile solids reduction averaged 56 percent with the lowest average monthly reduction of 47 percent. This meets the minimum 38 percent volatile solids reduction requirements of 40 CFR §503.33(b)(1).

Because some of the City's land application sites are near the Eastern Oregon Regional Airport, the new UAS development restricts using this land for biosolids application in the future. As a result, Murraysmith recommends the City identify and obtain site authorization for new biosolids land application sites so that any future limitations related to the UAS development do not impact the City's ability to land apply biosolids. DEQ has recently started to allow additional site authorizations for Class B biosolids without needing a permit modification. Permit holders now no longer have to negotiate a change in land application sites as part of their permit renewal.

Future consideration is also recommended to produce Class A Biosolids, as there continues to be concern in Oregon about application of Class B Biosolids given emerging concerns about contaminants like per- and polyfluoroalkyl substances (PFAS) and other contaminants commonly present in municipal biosolids.

Wastewater Characteristics

WWTRRF daily operating data and monthly Discharge Monitoring Reports (DMRs) were reviewed to establish current flows for the WWTRRF. Current per capita flow factors are used to project estimated future flows. Future population projections have been multiplied with the per capita flow factors to develop estimates of future flow events in 5-year increments as presented below in Table ES-2.

Table ES-2
Future Projected Flows (MGD)

Flow Event	2017	2020	2025	2030	2035	2040
ADWF	2.14	2.51	2.78	2.91	3.05	3.18
AAF	2.15	2.51	2.79	2.92	3.05	3.18
AWWF	2.15	2.51	2.79	2.92	3.06	3.19
MMDWF	2.32	2.71	3.01	3.15	3.29	3.44
MMWWF	2.34	2.73	3.04	3.18	3.32	3.47
PWF	2.75	3.21	3.57	3.74	3.91	4.08
PDF	2.85	3.33	3.70	3.87	4.05	4.22
PIF	3.35	3.91	4.35	4.55	4.76	4.96

Like the current flow estimation methodology, WWTRRF DMRs were analyzed for monthly average and maximum month influent BOD_5 and TSS concentrations, and mass loads. The calculated average and maximum monthly loads were divided by the 2017 population of 16,890 people to establish population loading factors for the Pendleton WWTRRF. Population loading factors developed and used in conjunction with estimated population projections for 2040 to estimate future BOD_5 and TSS loads. These projected loads were converted to average and maximum monthly concentrations by using the projected 2040 ADWF and AWWF. Table ES-3 presents the 2040 BOD_5 and TSS loading projections for the summer (dry) and winter (wet) weather seasons.

Table ES-3
2040 BOD_5 and TSS Loading Projections

Parameter	2040 Population	Flow (MGD)	Monthly Average		Monthly Maximum	
			Load Factor (ppcd)	Load (ppd)	Load Factor (ppcd)	Load (ppd)
Summer Season (May 1 through October 31)						
BOD_5	25,006	3.18	0.260	6,511	0.288	7,197
TSS	25,006	3.18	0.258	6,451	0.312	7,810
Winter Season (November 1 through April 30)						
BOD_5	25,006	3.19	0.246	6,155	0.271	6,766
TSS	25,006	3.19	0.232	5,812	0.265	6,620

Note:
ppcd= pounds per capita per day

Existing WWTRRF Evaluation

The Preliminary List of Recommended Improvements includes upgrades identified in the condition assessment to maintain facility performance and improve operations and maintenance at the facility. Recommended WWTRRF condition-related improvements were grouped into categories based on estimate cost and complexity. Categories ranged from smaller operations and maintenance (O&M) related projects in categories A and B up to more complex and higher cost projects in category E.

Improvements identified in Category A and B are smaller O&M projects that could potentially be completed by City staff. The estimated total cost for these O&M projects is $4.4 million , or approximately $220,000 per year over a 20-year planning period. These projects are included in the Recommended Plan as a line item for each year over the 20-year planning horizon. Examples include improvements to the hot water loop, utility water system, motor control center (MCC) power monitoring, and miscellaneous Supervisory Control and Data Acquisition (SCADA) upgrades.

Slightly more involved or complex projects identified during the plant condition assessment are classified included in categories C and D and grouped as either O&M or capital improvement program (CIP) projects. The estimated total cost for these projects is $2.6 million, with many of the projects being addressed as part of a larger CIP project included in the Recommended Plan.

Projects falling in categories C and D that are not addressed a part of the Recommended Plan are included in the O&M Project List as part of the annual O&M upgrades.

The most complex WWTRRF plant condition-related projects are classified in Category E and are larger CIP projects that are included in the Recommended Plan. Category E projects include:

- Major structural renovations of the Secondary Clarifier East;
- Major renovations of the Secondary Digester Complex, including possible expansion;
- Addition of digester gas storage and Cogeneration improvements;
- Possible addition of an alternate disinfection method;
- Major structural renovations of the Chlorine Contact Chamber;
- New automatic site entrance gate;
- Addition of a new building to house chemicals stored all over the site;
- Expand Main Shop for parts storage and relocated Welding Shop; and
- Update plantwide SCADA system.

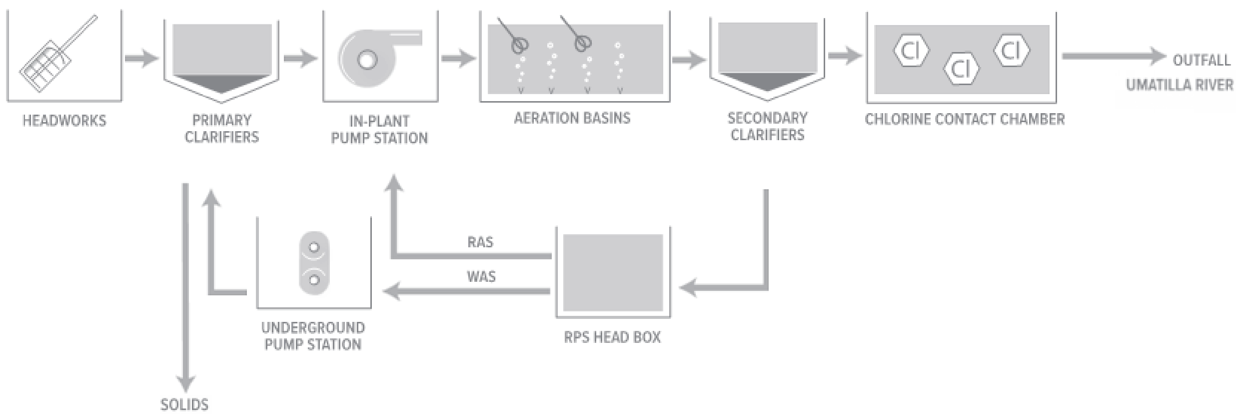
Unit Process Option Evaluations

Following is a summary of unit process options and evaluations completed as part of the facility plan update. The upgrades are broken out by liquids stream unit processes that produce the treated water that is ultimately discharge to the Umatilla River and the solids stream unit processes that produce the biosolids that is currently land applied locally.

Liquid Stream Unit Process Options

The liquid stream process flow diagram shown in Figure ES-3 below highlights the existing WWTRRF unit processes evaluated as part of the liquids stream unit process options evaluations. Unit process summaries provide an overview of deficiencies and recommendations for each liquid stream unit process.

Figure ES-3
Existing Liquid Stream Process Flow Diagram



Headworks and Dewatering Building Heat

Improvements are needed to provide heat to the Headworks and Dewatering buildings to improve heating and prevent water lines from freezing during the winter. Options considered include insulating and heat tracing water lines, adding additional natural gas/electric heating, or extending the hot water loop for heating. The recommended option is to use the hot water loop for heating.

The proposed system consists of skid-mounted makeup air units with a hot water coil for heat exchange, ducts, and blowers as necessary. The units will be installed on the building exterior, due to classified space restrictions, and connected to the hot water loop as the heat source.

RAS and IPPS Pump Stations

Alternatives to improve the Return Activated Sludge (RAS) and in-plant pump station (IPPS) hydraulics include replacing the existing RAS Pump Station (RPS) pumps, installing a new RPS force main, or conveying RAS back to the IPPS. The recommended option is to convey RAS back to the IPPS via gravity. The combined flow will be transferred to the headbox of the aeration basin using the existing force main. This upgrade eliminates the need for the RPS pumps and the headbox will be sealed to isolate the wet well.

Blower Upgrade

Multiple options for a blower upgrade were considered to achieve sufficient turndown of the aeration basin blowers during the winter months, to reduce energy consumption, and to adapt to seasonal oxygen demand fluctuations. Options include modifying the SCADA system, installing a new smaller blower, or installing a new smaller blower with a variable frequency drive (VFD).

The recommended option is to implement an independent SCADA system setting for the existing Aerzen hybrid blower to utilize the lower range of operation available and to install a second Aerzen hybrid blower as a redundant unit.

Disinfection Methods

Alternate methods for disinfecting final effluent are identified and evaluated for replacement of the existing chlorine gas system. The alternatives include maintaining the existing chlorine gas system, implementing onsite generation of sodium hypochlorite, switching to liquid sodium hypochlorite delivered in bulk, or converting to UV disinfection. The recommended alternative is to use to bulk liquid sodium hypochlorite.

WWTRRF Final Effluent Flow Measurement

A new effluent flow meter is necessary to more accurately measure effluent flow. Alternatives considered include a parshall flume, doppler radar-type flow meter or a magnetic flow meter. A 9-inch parshall flume flow meter with an ultrasonic level sensor connected to SCADA to record discharge flow rates is the recommended alternative.

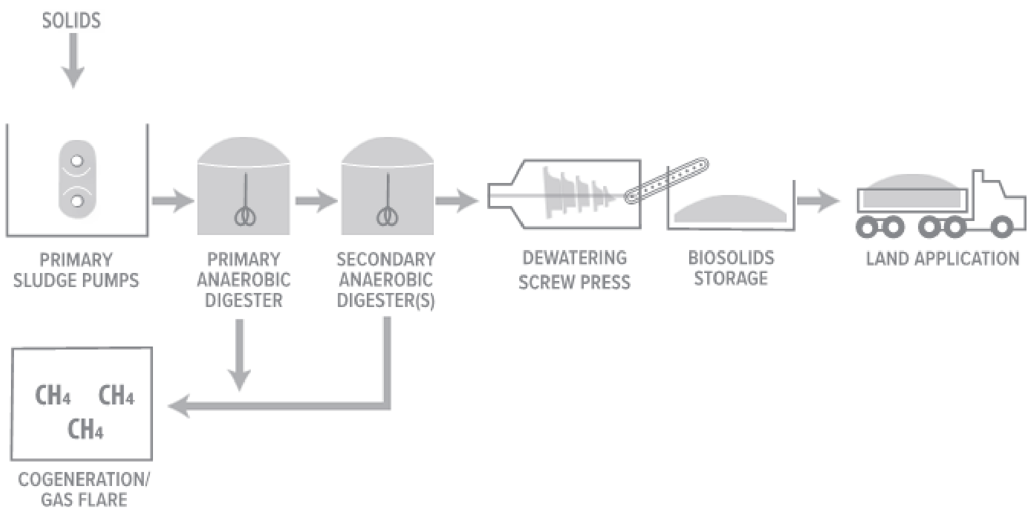
Long-term Temperature Compliance and Recycled Water Irrigation

Improvements may be needed to meet potential future permit conditions for discharging into the Umatilla River. Alternatives considered include an MBR conversion and reusing the secondary clarifiers for diurnal storage; hyporheic discharge; stage-based discharge with Class A or Class C recycled water; and mechanical cooling. The recommended option is the Class C recycled water program. Current prospective irrigation sites include the I-84 median and the airport industrial area.

Solids Stream Unit Process Options

The solids stream process flow diagram shown in Figure ES-4 below highlights the existing WWTRRF unit processes evaluated as part of the solids stream unit process options evaluations. Unit process summaries provide an overview of deficiencies and recommendations for each solid stream unit process.

Figure ES-4
Existing Solids Stream Process Flow Diagram



Primary Sludge Pumps

Improvements to the primary sludge pump stations are needed to replace aging equipment and facilitate easier maintenance. Alternatives include rotary lobe pumps and raised floors or new progressive cavity pumps and a maintenance hoist. The recommended option are the new progressive cavity pumps, with flow meters, a maintenance hoist and roll-up doors to improve access for pump maintenance.

Primary Digester Complex

Required upgrades include storage improvements, redundancy for critical systems, and ferric chloride injection. A redundant primary digester mixing pump will be installed to ensure normal function of the primary digester. A permanent injection port will be installed in the pipe gallery to improve the process of ferric chloride dosing.

Secondary Digester Complex

Improvements are needed to replace aging equipment, ensure redundancy, and address equipment-SCADA connectivity limitations. An external pump mix system, ferric chloride injection, new boiler, new booster pump, new heat exchanger, and new piping and valves was recommended for this unit process upgrade.

Cogeneration System Optimization

Improvements to the cogeneration system are required to optimize gas and power production. Microturbine operation can be optimized through SCADA and other modifications as necessary to allow the use of natural gas as an alternate fuel supply or allow the microturbines to be left idle while the system accumulates digester biogas. Options for optimizing the cogeneration system include ground-based gas storage or the installation of a new digester gas holder cover.

The recommended option is the digester gas holder cover. The digester gas holding cover will be installed on the South Secondary Digester. Gas from the primary digester will be routed through a new underground line where it will be stored with gas generated in the secondary digester. The combined digester gas will be routed to the gas handling room through underground piping before being conditioned and then supplied to the microturbines or the flare, when necessary.

To reduce moisture and improve cogeneration performance enclosing the gas conditioning skid, a float drain trap, and gas drying equipment were considered. The recommended option is enclosing the gas conditioning skid. The skid will be fully enclosed with insulated wall panels and a roll-up door will be included for access to equipment. An electric unit heater is proposed to keep the space heated.

The existing digester gas flare will be removed, and a new flare will be installed in its place. The two pipes running between the flare and the digesters will be replaced, and a new flow meter will be installed to monitor digester gas usage at the flare.

Class A Biosolids Production Options

Class A biosolids production options include a new screw press designed to produce Class A Biosolids using a heated screw for pasteurization, installing a solar greenhouse in place of the existing drying beds, installing a composting facility, installing an indirect dryer, or extending the dewatering building to install a lime stabilization unit.

The recommended option is to install a solar greenhouse for drying and Class A biosolids production. The biosolids storage greenhouse includes construction of 5 bays installed over the current location of drying beds (1 through 4). A conveyor to transport dewatered cake from the existing screw press to the green house for drying will also be installed. A new tractor with a front bucket and snowblower attachment are included for manual turning of the dewatered cake.

Architectural Evaluation, Access Control, and Protective Systems

The following areas were identified as needing improvements:

- Admin/Lab Building – ADA compliance upgrades and space programming;
- New Admin Annex Building – Construction of a new building to accommodate functions lost in the existing Admin/Lab Building remodel;
- New Storage Building – Construction of a centralized storage building for parts, chemicals, lawn equipment, and safety equipment;

- Main Shop Expansion – Addition to Main Shop including three bays to store equipment displaced from demolishing the parts storage/welding shop;

- Site Access Control – Installation of an automatic entrance gate, upgrade security fencing around the WWTRRF site, and install security cameras; and

- Protective Systems – Addition of emergency eyewash and drench showers in hazardous chemical storage and point of use locations.

Electrical, Instrumentation, and Controls Options

The following areas were identified as needing improvements during the Electrical, Instrumentation, and Controls evaluation:

- Perform routine maintenance on all MCCs; and

- Upgrade SCADA system to include modern, fully redundant servers and networking hardware. Additionally, the software platform will be upgraded to modern platforms and architecture. This will allow for added reliability, security, and versatility. Operations staff will be able to remotely monitor and operate SCADA-connected systems via tablet technology.

Combined Alternatives Evaluation

Alternatives were developed to address the plant condition, NPDES Permit and TMDL, growth and other requirements identified as part of the facility planning process. The five combined alternatives evaluated are summarized as follows:

Alternative A – Conventional Activated Sludge (CAS) Expansion: Continue current conventional activated sludge process with upgrades to address deficiencies identified in the Condition Assessment and Class C recycled water production to address long-term temperature compliance concerns.

Alternative B – CAS/Membrane Bioreactor (MBR) Expansion: Partial conversion of the aeration basin to polymeric MBR to produce Class A recycled water to address long-term temperature compliance concerns with upgrades to address deficiencies identified in the Condition Assessment.

Alternative C1 – Polymeric MBR Conversion: A 3-train conversion of the aeration basin to polymeric MBR with diurnal storage in the secondary clarifiers and Class A recycled water production to address long-term temperature compliance with upgrades to address deficiencies identified in the Condition Assessment.

Alternative C2 – Ceramic MBR Conversion: A 2-train conversion of the aeration basin to ceramic MBR with diurnal storage in the secondary clarifiers and Class A recycled water production to address long-term temperature compliance with upgrades to address deficiencies identified in the Condition Assessment.

Alternative D – CAS/Tertiary Filtration: Addition of tertiary filtration to the chlorine contact chamber south train to produce Class A recycled water to address long-term temperature compliance concerns with upgrades to address deficiencies identified in the Condition Assessment.

Table ES-4 summarizes the capital and lifecycle costs for the five combined alternatives. As summarized previously, capital cost and lifecycle cost represent 30 percent and 20 percent weighting in the overall evaluation, respectively.

Table ES-4
Combined Alternative Capital and Lifecycle Costs

Cost Type	Alt A	Alt B	Alt C1	Alt C2	Alt D
Capital Cost	$16.48 M	$19.30 M	$20.45 M	$26.21 M	$19.80 M
20-year NPV of Additional Labor	$2.64 M	$3.16 M	$2.94 M	$3.00 M	$3.33 M
20-year NPV of O&M – Chemical	$1.15 M	$1.30 M	$1.46 M	$1.46 M	$1.46 M
20-year NPV of O&M – Energy	$1.47 M	$1.84 M	$2.21 M	$2.21 M	$1.92 M
20-year NPV of O&M – Major Replacement	$0.37 M	$0.94 M	$1.91 M	$0.86 M	$0.67 M
20-year Lifecycle Cost	$22.11 M	$26.54 M	$28.97 M	$33.74 M	$27.17 M

Note:
NPV = net present value

The combined alternative scoring summary is presented in Table ES-5. Based on the evaluation, Alternative A has the highest scoring and is recommended for implementation over the 20-year planning horizon.

Table ES-5
Combined Alternative Scoring

	Weight	Alt A	Alt B	Alt C1	Alt C2	Alt D
Capital Cost	30%	4.0	3.5	3.0	2.5	3.0
20-year Life-Cycle Cost	20%	4.0	3.0	2.5	3.0	3.0
Regulatory Compliance	30%	4.0	3.0	3.0	3.0	3.0
Constructability	20%	3.5	3.0	2.5	2.5	4.0
Total	100%	3.9	3.2	2.8	2.8	3.2

Recommended Plan and Phased Implementation Plan

Based on the combined alternatives evaluation summarized in the previous section, it appears the best long-term solution for the City is a departure from the previous facility plan recommendation to proceed with full-scale implementation of a membrane bioreactor. The primary issues for the City are the unknowns related to long term compliance with temperature regulations.

As a result, Murraysmith recommends the City proceed with Alternate A to upgrade the existing Conventional Activated Sludge (CAS) treatment process along with development of a Class C water recycling program. Figure ES-5 at the end of this section shows the overall Recommended Plan overlaid on the WWTRRF site plan. Under the recommended plan, the City would retain its current Umatilla River outfall and discharge effluent up to the limits of Umatilla River Temperature TMDL updated planned for completion by 2028. Prior to implementation of a full-scale water recycled program, this recommendation should be revisited based on the actual requirements of the future TMDL.

Because the future requirements for both Umatilla River discharge and biosolids land application are currently unknown, these upgrades are included in the recommended plan in the later years of the 20-year plan, with "triggers" assigned for implementation if the need should arise prior to the planning year. Recommended plan phases are summarized as follows:

- Phase 1A (2020-2022) includes repairs to failing solids stream unit processes and upgrades required to meet near-term regulatory requirements. Site access control measures, protective systems, expansion of the main shop, and electrical improvements are also included in this phase.
- Phase 1B (2025-2027) includes repairs to failing liquids stream unit processes, a new storage building, and SCADA improvements.
- Phase 2 (2030-2032) includes dewatering upgrades and installation of a biosolids storage greenhouse for Class A biosolids production capabilities. A new admin annex building and primary sludge pumps are also included in this phase.
- Phase 3 (2038-2040) includes unit process upgrades required for production of Class C recycled water, digester gas storage, and architectural improvements to the existing admin/lab building.

It is recommended the City proceed with implementation of Phases 1A and 1B early in the 20-year planning horizon, as these upgrades are needed to address ongoing plant condition and O&M issues. Phases 2 and 3 would then be implemented based on "triggers", as discussed in the following section.

"Triggers" for Recommended Plan Phases

While the estimated timing for these phases has been provided in order to develop the 20-year WWTRRF CIP, the actual triggers for each phase, or portions thereof, will be as follows:

- O&M Upgrades (2020-2040): The recommended plan includes a separate budget line item that incorporates smaller annual O&M related projects.

- Phase 1A (2020-2022) and 1B (2025-2027) Immediate Needs: These upgrades are triggered by failing equipment and immediate operational needs. For example, secondary digester complex upgrades in Phase 1A are triggered by near-term operating requirements for redundancy and improved chemical dosing. Less immediate upgrades have been included in Phase 1B that could be triggered earlier than planned depending on O&M needs.

- Phase 2 (2030-2032) Biosolids Greenhouse and Dewatering Upgrades: The dewatering upgrades and greenhouse for Class A biosolids would be triggered by loss of local Class B biosolids land application sites and changes in biosolids management regulatory requirements. The City is unable to utilize approximately 1,426 acres of the existing 1,700 acres of approved Class B land application sites due to development or other restrictions at the Eastern Oregon Regional Airport and the Airport Industrial Park. Additional biosolids land application sites will need to be authorized in the near term to continue the City's Class B Biosolids land application program. If additional Class B sites are not secured the City would likely need to proceed with WWTRRF upgrades to produce higher quality Class A Biosolids.

- Phase 2 (2030-2032) Building Upgrades and Renovations: Construction of the new Administration Annex Building will be triggered by loss of the County lab and the need to provide a location for local testing of water quality for private wells and other private lab services re-established locally using the WWTRRF laboratory.

- Phase 3 (2038-2040) WWTRRF Recycled Water Expansion: Upgrades to produce Class C Recycled Water and implement a water recycling program would be triggered by an update of the Umatilla River Temperature TMDL eliminating the NCC criteria and potentially resulting in a much lower excess thermal load limit than currently anticipated. It is anticipated the Umatilla Temperature TMDL will be updated in the next 8 years, after which new temperature limits would be included in the City's next NPDES permit renewal.

Table ES-6 summarizes the Phased Implementation Plan with improvements tied to phases and associated project costs. Table ES-7 at the end of this section details the yearly costs by project and phase.

Table ES-6
Phased Implementation Plan Summary

WWTRRF CIP	Phase 1A (2020-2022)	Phase 1B (2025-2027)	Phase 2 (2030-2032)	Phase 3 (2038-2040)
O&M Upgrades[1]	$220,000 per year			
Headworks and Dewatering Building Heat	$ -	$ -	$ -	$ 160,000
Primary Clarifiers	$ -	$ 284,000	$ -	$ -
RPS and IPPS	$ 120,000	$ -	$ -	$ -
New Smaller Blower w/ VFD	$ 136,000	$ -	$ -	$ -
Secondary Clarifiers	$ -	$ 1,504,000	$ -	$ -
Disinfection Conversion	$ 84,000	$ -	$ -	$ -
Chlorine Contact Chamber	$ -	$ 368,000	$ -	$ -
Final Effluent Flow Measurement	$ -	$ -	$ -	$ 88,000
Class C Recycled Water	$ -	$ -	$ -	$ 3,256,000
Primary Sludge Pumps	$ -	$ -	$ 272,000	$ -
Primary Digester Complex	$ 136,000	$ -	$ -	$ -
Secondary Digester Complex	$ 1,016,000	$ -	$ -	$ -
Digester Gas Storage	$ -	$ -	$ -	$ 1,032,000
Digester Gas Moisture Reduction	$ -	$ -	$ -	$ 92,000
Digester Gas Flare	$ -	$ -	$ -	$ 568,000
Dewatering Upgrades	$ -	$ -	$ 1,243,000	$ -
Biosolids Storage Greenhouse	$ -	$ -	$ 2,292,000	$ -
Admin/Lab Remodel	$ -	$ -	$ -	$ 776,000
Admin Annex Building	$ -	$ -	$ 1,348,000	$ -
New Storage Building	$ -	$ 748,000	$ -	$ -
Main Shop Expansion	$ 280,000	$ -	$ -	$ -
Site Access Control and Protective Systems	$ 136,000	$ -	$ -	$ -
Electrical Improvements	$ 48,000	$ -	$ -	$ -
SCADA Upgrades	$ -	$ 488,000	$ -	$ -
Totals	**$ 1,956,000**	**$ 3,392,000**	**$ 5,155,000**	**$ 5,972,000**

Note:
1. O&M upgrades include $220,000 per year. See Table ES-7 for a complete CIP summary.

DEQ Review Comments

City received review comments from DEQ in February 2020. These comments will be addressed during the NPDES permit renewal process as the forthcoming permit requirements become clearer. The review comments can be found in Appendix M.

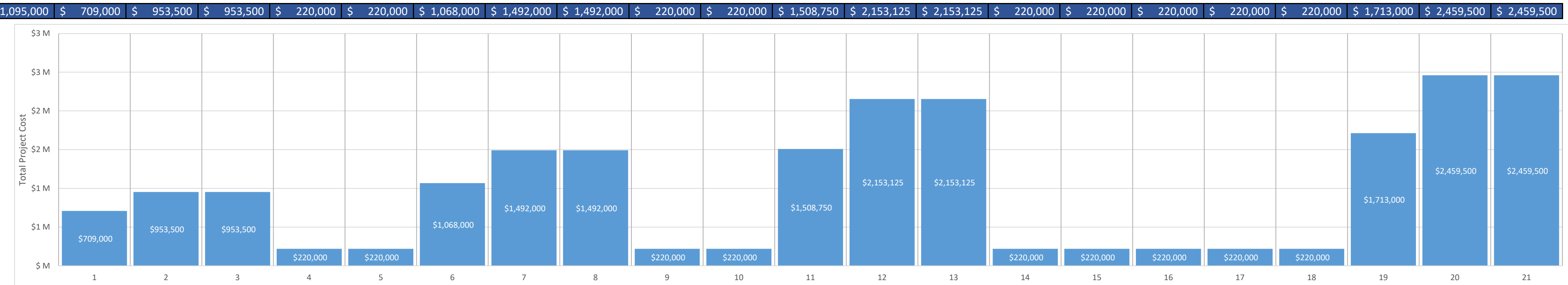
Table ES-7
Capital Improvements Program Summary

Description	O&M Upgrades	Phase 1 A Subtotal	Phase 1 B Subtotal	Phase 2 Subtotal	Phase 3 Subtotal	Total CIP Cost Estimate
Annual Condition Assessment O&M Upgrades	$ 4,620,000					$ 4,620,000
Headworks and Dewatering Building Heat		$ -	$ -	$ -	$ 160,000	$ 160,000
Primary Clarifiers		$ -	$ 284,000	$ -	$ -	$ 284,000
RPS and IPPS		$ 120,000	$ -	$ -	$ -	$ 120,000
New Smaller Blower w/ VFD		$ 136,000	$ -	$ -	$ -	$ 136,000
Secondary Clarifiers		$ -	$ 1,504,000	$ -	$ -	$ 1,504,000
Disinfection Conversion		$ 84,000	$ -	$ -	$ -	$ 84,000
Chlorine Contact Chamber		$ -	$ 368,000	$ -	$ -	$ 368,000
Final Effluent Flow Measurement		$ -	$ -	$ -	$ 88,000	$ 88,000
Class C Recycled Water		$ -	$ -	$ -	$ 3,256,000	$ 3,256,000
Primary Sludge Pumps		$ -	$ -	$ 272,000	$ -	$ 272,000
Primary Digester Complex		$ 136,000	$ -	$ -	$ -	$ 136,000
Secondary Digester Complex		$ 1,016,000	$ -	$ -	$ -	$ 1,016,000
Digester Gas Storage		$ -	$ -	$ -	$ 1,032,000	$ 1,032,000
Digester Gas Moisture Reduction		$ -	$ -	$ -	$ 92,000	$ 92,000
Digester Gas Flare		$ -	$ -	$ -	$ 568,000	$ 568,000
Dewatering Upgrades		$ -	$ -	$ 1,243,000	$ -	$ 1,243,000
Biosolids Storage Greenhouse		$ -	$ -	$ 2,292,000	$ -	$ 2,292,000
Admin/Lab Remodel		$ -	$ -	$ -	$ 776,000	$ 776,000
Admin Annex Building		$ -	$ -	$ 1,348,000	$ -	$ 1,348,000
New Storage Building		$ -	$ 748,000	$ -	$ -	$ 748,000
Main Shop Expansion		$ 280,000	$ -	$ -	$ -	$ 280,000
Site Access Control and Protective Systems		$ 136,000	$ -	$ -	$ -	$ 136,000
Electrical Improvements		$ 48,000	$ -	$ -	$ -	$ 48,000
SCADA Upgrades		$ -	$ 488,000	$ -	$ -	$ 488,000
Totals	$ 4,620,000	$ 1,956,000	$ 3,392,000	$ 5,155,000	$ 5,972,000	$ 21,095,000

	Phase 1 A					Phase 1 B					Phase 2		
Description	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Annual Condition Assessment O&M Upgrades	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000
Headworks and Dewatering Building Heat	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Clarifiers	$ -	$ -	$ -	$ -	$ -	$ 71,000	$ 106,500	$ 106,500	$ -	$ -	$ -	$ -	$ -
RPS and IPPS	$ 30,000	$ 45,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New Smaller Blower w/ VFD	$ 34,000	$ 51,000	$ 51,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Clarifiers	$ -	$ -	$ -	$ -	$ -	$ 376,000	$ 564,000	$ 564,000	$ -	$ -	$ -	$ -	$ -
Disinfection Conversion	$ 21,000	$ 31,500	$ 31,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Chlorine Contact Chamber	$ -	$ -	$ -	$ -	$ -	$ 92,000	$ 138,000	$ 138,000	$ -	$ -	$ -	$ -	$ -
Final Effluent Flow Measurement	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Class C Recycled Water	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Sludge Pumps	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 68,000	$ 102,000	$ 102,000
Primary Digester Complex	$ 34,000	$ 51,000	$ 51,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Digester Complex	$ 254,000	$ 381,000	$ 381,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Gas Storage	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Gas Moisture Reduction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Gas Flare	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dewatering Upgrades	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 310,750	$ 466,125	$ 466,125
Biosolids Storage Greenhouse	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 573,000	$ 859,500	$ 859,500
Admin/Lab Remodel	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Admin Annex Building	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 337,000	$ 505,500	$ 505,500
New Storage Building	$ -	$ -	$ -	$ -	$ -	$ 187,000	$ 280,500	$ 280,500	$ -	$ -	$ -	$ -	$ -
Main Shop Expansion	$ 70,000	$ 105,000	$ 105,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Site Access Control and Protective Systems	$ 34,000	$ 51,000	$ 51,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Electrical Improvements	$ 12,000	$ 18,000	$ 18,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SCADA Upgrades	$ -	$ -	$ -	$ -	$ -	$ 122,000	$ 183,000	$ 183,000	$ -	$ -	$ -	$ -	$ -
Totals	$ 709,000	$ 953,500	$ 953,500	$ 220,000	$ 220,000	$ 1,068,000	$ 1,492,000	$ 1,492,000	$ 220,000	$ 220,000	$ 1,508,750	$ 2,153,125	$ 2,153,125

						Phase 3		
Description	2033	2034	2035	2036	2037	2038	2039	2040
Annual Condition Assessment O&M Upgrades	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000
Headworks and Dewatering Building Heat	$ -	$ -	$ -	$ -	$ -	$ 40,000	$ 60,000	$ 60,000
Primary Clarifiers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RPS and IPPS	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New Smaller Blower w/ VFD	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Clarifiers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Disinfection Conversion	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Chlorine Contact Chamber	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Effluent Flow Measurement	$ -	$ -	$ -	$ -	$ -	$ 22,000	$ 33,000	$ 33,000
Class C Recycled Water	$ -	$ -	$ -	$ -	$ -	$ 814,000	$ 1,221,000	$ 1,221,000
Primary Sludge Pumps	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Digester Complex	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Digester Complex	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Gas Storage	$ -	$ -	$ -	$ -	$ -	$ 258,000	$ 387,000	$ 387,000
Digester Gas Moisture Reduction	$ -	$ -	$ -	$ -	$ -	$ 23,000	$ 34,500	$ 34,500
Digester Gas Flare	$ -	$ -	$ -	$ -	$ -	$ 142,000	$ 213,000	$ 213,000
Dewatering Upgrades	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Biosolids Storage Greenhouse	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Admin/Lab Remodel	$ -	$ -	$ -	$ -	$ -	$ 194,000	$ 291,000	$ 291,000
Admin Annex Building	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New Storage Building	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Main Shop Expansion	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Site Access Control and Protective Systems	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Electrical Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SCADA Upgrades	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 1,713,000	$ 2,459,500	$ 2,459,500

Notes:
- *All costs in 2019 dollars*
- *For planning purposes, future costs should be increased for cost escalation (inflation) based on Engineering News Record - Construction Cost Index or other index preferred by the City.*
- *Cost estimates represent a Class 5 budget estimate in 2019 dollars, as established by the American Association of Cost Engineers (AACE), with a level of accuracy range between -30 to +50 percent.*




PHASE 1A
1 RPS AND IPPS
2 NEW SMALLER BLOWER W/ VFD
3 DISINFECTION CONVERSION
4 PRIMARY DIGESTER COMPLEX
5 SECONDARY DIGESTER COMPLEX
6 MAIN SHOP EXPANSION
7 SITE ACCESS CONTROL AND PROTECTIVE SYSTEMS
8 ELECTRICAL IMPROVEMENTS
PHASE 1B
9 PRIMARY CLARIFIERS
10 SECONDARY CLARIFIERS
11 CHLORINE CONTACT CHAMBER
12 NEW STORAGE BUILDING
13 SCADA UPGRADES
PHASE 2
14 PRIMARY SLUDGE PUMPS
15 DEWATERING UPGRADES
16 BIOSOLIDS STORAGE GREENHOUSE
17 ADMIN ANNEX BUILDING
PHASE 3
18 HEADWORKS AND DEWATERING BUILDING HEAT
19 FINAL EFFLUENT FLOW MEASUREMENT
20 CLASS C RECYCLED WATER
21 DIGESTER GAS STORAGE
22 DIGESTER GAS MOISTURE REDUCTION
23 DIGESTER GAS FLARE
24 ADMIN/LAB REMODEL
AERATION BASIN
SECONDARY CLARIFIER WEST
SECONDARY CLARIFIER EAST
CHLORINE CONTACT CHAMBER
TO REUSE
ADMIN BLDG
PRIMARY CLARIFIER EAST
PRIMARY CLARIFIER WEST
MAIN SHOP
LEGEND
PHASE 1A
PHASE 1B
PHASE 2
PHASE 3
NEW
UPGRADE
N
40 20 0 40 80
SCALE IN FEET
FIGURE ES-5
CITY OF PENDLETON INCORPORATED 1880 OREGON
WWTRRF Facility Plan Update
Recommended Plan
WWTRRF Site Plan
JUNE 2020
murraysmith
17-2019.403

Section 1

Section 1

Introduction and Background

1.1 Introduction

The City of Pendleton (City) commissioned Murraysmith, Inc. (Murraysmith) to develop the Pendleton Wastewater Treatment and Resource Recovery Facility (WWTRRF) Facility Plan with a 20-year planning horizon. The purpose of the Facility Plan is to summarize current and future needs and to recommend a plan to upgrade the existing WWTRRF to meet the demands of the current and future flows and loads. This plan analyzed the current flows and loads, projected future flows and loads, evaluated existing mechanical equipment, evaluated alternatives for upcoming needs, and prepared a recommendation of facility improvements based on the above information with feedback from the City.

1.2 Purpose

This Facility Plan is a valuable tool to guide the City's orderly and efficient management of its WWTRRF over the next 20 years. The plan lays out a strategy to provide wastewater treatment services that accommodate population growth while staying in compliance with environmental regulations and permits. The recommendations presented here were made with consideration of the benefits of long-term investments that will continue to serve the community beyond the 20-year planning horizon.

The document serves as a "Public Facilities Plan" for wastewater treatment as required under Oregon Administrative Rule (OAR) 660, Division 11. This OAR stipulates that facility plans be developed as support documents for the City's Comprehensive Plan.

1.3 WWTRRF Overview

All of the City's wastewater is treated at the existing WWTRRF in a complete-mix secondary treatment process followed by chlorine gas disinfection. The WWTRRF was originally constructed in 1952. The WWTRRF has mechanical fine screens, two primary clarifiers, three aeration basin trains, two secondary clarifiers, and a chlorine contact chamber. The solids side of the facility utilizes one primary anaerobic digester, two secondary anaerobic digesters, a screw press for dewatering, and six drying beds for biosolids drying and storage.

The WWTRRF is located at river mile 52.0 on the Umatilla River, just below the confluence with McKay Creek. The last upgrade was in 2011 and included improvements on the headworks, secondary process, and solids dewatering equipment.

Currently, the WWTRRF treats annual average flow of 2.5 million gallons per day (MGD). Peak instantaneous flow projected for 2040 is 4.96 MGD. The current and projected design flows are summarized in Section 5 of this plan.

1.4 Facility Plan Organization

This Facility Plan summarizes the evaluation conducted by a team of Murraysmith engineers on the City of Pendleton WWTRRF. The Plan prioritizes issues at the existing WWTRRF and recommends upgrades necessary to meet effluent limits specified in the National Pollutant Discharge Elimination System (NPDES) Permit. Table 1-1 lists the organization of Volume 1 of the Facility Plan. Table 1-2 outlines the contents of Volume 2, which contains the appendices.

Table 1-1
Document Organization – Volume 1

Section Identifier	Title	Description
ES	Executive Summary	Provides a succinct summary of findings and recommendations for quick reference. More detailed information can be found in later sections.
1	Introduction and Background	Summarizes purpose, scope and organization of the Facility Plan.
2	Study Area Characterization	Describes the study area location and characteristics, including geography, topography, geology and soil conditions, land use.
3	Regulatory Requirements	Reviews the regulatory requirements related to treatment and discharge of wastewater, including review of the current NPDES permit and compliance evaluation.
4	Basis of Planning	Defines the methodology and criteria for alternative evaluation and cost estimating.
5	Wastewater Characteristics	Documents existing and projected flows and loads and wastewater characterization at the WWTRRF.
6	Existing WWTRRF Evaluation	Evaluates the condition of WWTRRF unit processes and summarizes required improvements.
7	Unit Process Option Evaluations	Evaluates options to address issues identified in the existing WWTRRF evaluation and to provide for a facility that meets NPDES permitting requirements and emerging regulations over the planning horizon.
8	Combined Alternatives Evaluation	Discusses the development and evaluation of each option and requirements necessary to meet future flow and load projections.
9	Recommended Plan and Phased Implementation Plan	Summarizes the recommended options and proposed schedule for implementation.

Table 1-2
Document Organization – Volume 2

Appendix Identifier	Title
A	NOAA Climate Data
B	Surface Water Flow Statistics
C	Soil Resource Report
D	NPDES Permit
E	Temperature Evaluation Technical Memorandum
F	Oregon NOAA Atlas 2, Volume X
G	Preliminary List of Recommended Improvements
H	Condition Assessment Technical Memorandum
I	Condition Assessment Field Notes
J	ADA Review Technical Memorandum
K	Hach WIMS Reporting Solution
L	Non-proprietary Reporting Solution
M	DEQ Review Comments

Note:

1. NOAA = National Oceanic and Atmospheric Administration

Section **2**

Section 2

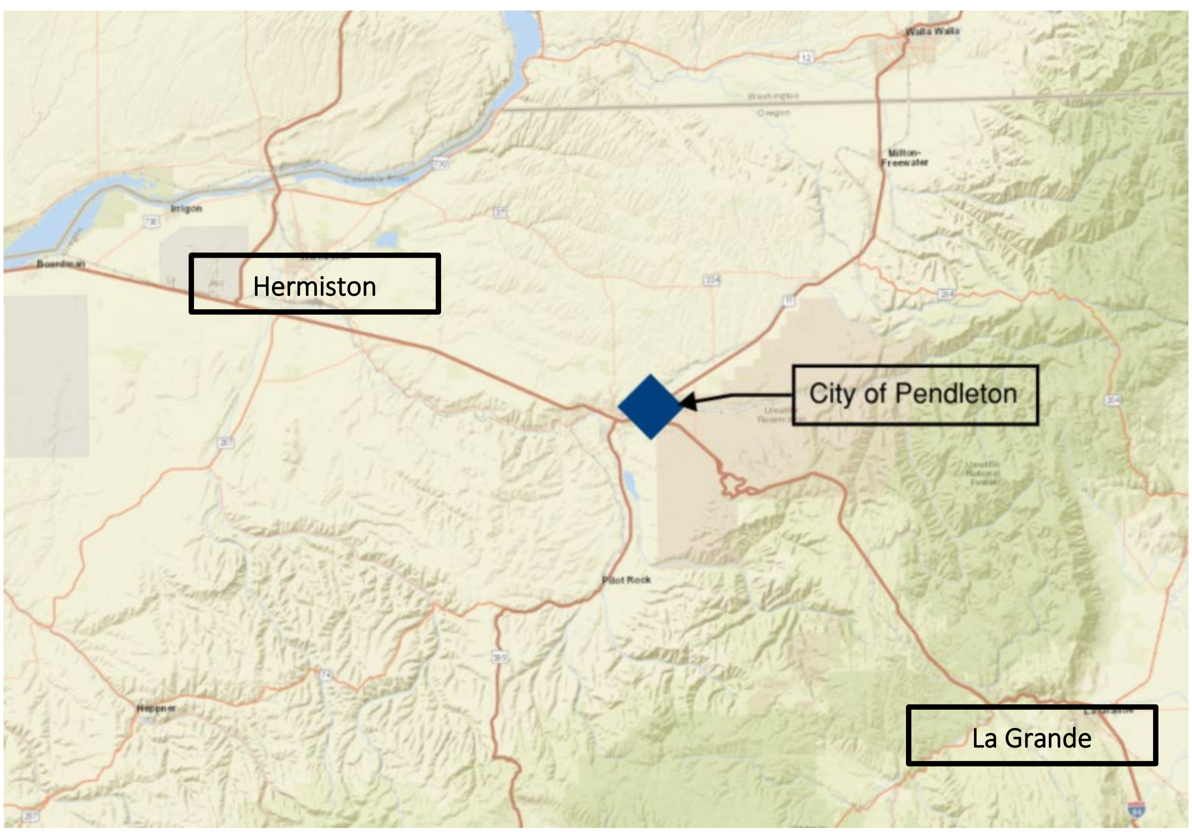
Study Area Characteristics

2.1 Planning Area

The City of Pendleton (City) is in Umatilla County in the valley of the Umatilla River within the southeastern part of the Columbia Basin (see **Figure 2-1**). According to the 2010 United States Census Report, the City has a total area of 10.5 square miles. The altitude of Pendleton is 1,069 feet above mean sea level.

Pendleton is located at the intersection of three major highways. Interstate Highway 84 is the primary east-west highway that connects with Interstate Highway 82 approximately 30 miles west of the City. Oregon State Highways 37 and 395 are the main north-south routes. Portland, Oregon is located 210 miles to the west; Spokane, Washington is located 205 miles to the northeast; and Boise, Idaho is located 230 miles to the southeast.

Figure 2-1
Vicinity Map



2.1.1 Climate and Rainfall

The Columbia Basin is bounded on the south by the high country of central Oregon, on the north by the mountains of western Canada, on the west by the Cascade Range, and on the east by the Blue Mountains and north Idaho plateau. The gorge through which the Columbia River flows is the most important break in the barriers surrounding this basin. These physical features have significant influences on the general climate of Pendleton and the surrounding territory.

The wettest month is typically November, and the driest is usually July. Precipitation is seasonal with an average of only 10 percent of the annual total occurring from July through September. Thunderstorms originating from the south or southwest can occur during the summer and occasionally cause flash flooding. Snow falls occasionally in the City during the winter, but rarely remains over a few days or accumulates to more than a few inches.

The lowest monthly average temperature typically occurs in December or January and the highest typically occurs in July or August. Temperature extremes range from below freezing in winter to over 100 degrees Fahrenheit in summer.

The National Weather Service monitors four weather stations in the area. Data from three of the stations are included in **Table 2-1** below. **Appendix A** contains additional Pendleton, Oregon Climate Summary Statistics.

Table 2-1
National Weather Service Data for Pendleton, Oregon

Station Name	Elevation	Max Temp (°F)	Min Temp (°F)	Average Temp (°F)	Annual Precipitation (inches)	Annual Snowfall (inches)
Downtown[1]	1040	65.8	40.4	53.5	11.72	2.6
Experimental Station[2]	1487	63.2	37.3	50.3	16.28	12.9
Regional Airport[2]	1486	63.0	41.2	52.1	12.67	13.7

Notes:

1. Data is averaged from 1987-2017.
2. Data is averaged from 1971-2017.

Pendleton is mostly unprotected from wind. Winds come predominantly from the west and southeast. Southeast winds are usually less than 10 knots and occur during spring and summer. West winds may exceed 10 knots and occur during the fall and winter.

U.S. Weather Bureau records indicate that the average annual growing season is 152 days long. This combined with low precipitation, results in farming of primarily dryland (non-irrigated) crops.

2.1.2 Surface Waters

Pendleton is in the Umatilla River watershed, which encompasses approximately 2,300 square miles. Within the Pendleton vicinity, the Umatilla River is intersected by five tributaries: Nelson

Creek, Wildhorse Creek, Tutuilla Creek-Patawa Creek, McKay Creek, and Birch Creek. Flows from Nelson Creek are negligible, and the Birch Creek confluence is located downstream from Pendleton near the community of Rieth.

After converging with Wildhorse Creek, the Umatilla River flows through Pendleton, receives drainage from McKay Creek, and continues westward. The Pendleton Wastewater Treatment and Resource Recovery Fac (WWTRRF) discharges to the Umatilla River after the confluence of McKay Creek.

Portions of the Umatilla River passing through the City limits are protected by a U.S. Army Corp of Engineers levee. The Umatilla River flood stage is 12.3 feet. Flows are seasonal, with the highest occurring in late winter and spring, and the lowest in summer and fall.

The nearest United States Geological Survey (USGS) monitoring station is located on McKay Creek. The Confederated Tribes of the Umatilla Indian Reservation also monitor a river gauge at the West Boundary. The Bureau of Reclamation monitors a gauge located at River Mile 55 in downtown Pendleton and a gauge immediately downstream of the McKay Reservoir Dam. A summary of Umatilla River and McKay Creek Surface Water Flow Statistics can be found in **Appendix B**.

The Umatilla River and its tributaries are subject to the Section 404 Federal Clean Water Act, which requires a permit for any activity in the waterway or its adjacent banks. The Division of State Lands requires a permit for any fill or removal of more than 50 cubic yards.

The Umatilla River and McKay Creek head waters are located east of Pendleton in the Blue Mountains. The McKay Creek waters are impounded at the McKay Reservoir, and flows from the McKay Dam are regulated. Flows from McKay Creek are used to augment Umatilla River flows during the growing season, when water is diverted from the river for agricultural use. The McKay Reservoir and land immediately surrounding it are designated as the McKay Creek National Wildlife Refuge. There are two wetlands delineated within the Pendleton City Limits, one near the WWTRRF and the other near Westgate Industrial Park.

2.1.3 Soil, Geology, and Habitat

Pendleton is positioned on the Umatilla valley floor, nearby hillsides, and adjacent valleys. Approximately 55 percent of the area is flat with slopes of 5 percent or less. Nine distinct hills are in the area. Tabulated National Resources Conservation Service (NRCS) data indicates slopes ranging from 2 percent to 15 percent are located within the area, but other information indicates slopes as steep as 45 percent are also present. The City and surrounding area are part of the Columbia River Basaltic Lava Flow. The depths of basalt flows range from hundreds to thousands of feet.

The NRCS classifies most soil types in the Pendleton vicinity as silty or stony loam, which are prime agriculture conditions. An NRCS soil survey of the Pendleton area is included in **Appendix C**.

Approximately 8 miles south of Pendleton is the McKay National Wildlife Refuge, which consists of 1,837 acres of open water (reservoir), marsh, and grasslands. The area is a common resting and feeding ground for migrating fowl. Other surrounding wilderness areas support elk and deer. The Umatilla National Forest supports one of the largest herds of Rocky Mountain elk found in any National Forest in the nation. The Umatilla River and its tributaries are sources of game and non-game fish species, both natural and stocked.

2.1.4 Air Quality

Pendleton has been proactive in addressing air quality issues. The Pendleton Air Quality Commission was formed in 1991, with the main goal of educating the public about air quality. The Pendleton Air Pollution Control Ordinance was passed in 2008 and governs both wood stove burning and open burning within the City. It requires the City to determine and issue a daily Air Quality Forecast from October 1 through June 15. The forecast is made available to the public, and limits or allows open burning and/or utilization of wood burning stoves for residential heat.

The City sponsored three wood stove replacement programs that provided no-interest loans to homeowners, encouraging them to replace older, less-efficient wood stoves with cleaner, more efficient sources of heat.

Oregon Department of Environmental Quality (DEQ) maintains an air monitoring station in the McKay area. Meteorological and atmospheric conditions are monitored during winter.

2.1.5 Public Health Hazards

The Department of Humane Health and Human Services Agency for Toxic Substances and Disease does not list Pendleton on their registry as a Public Health Hazard. Data from public health assessments classify sites according to the following categories:

- Category 1: Urgent Public Health Hazard: Sites that pose a serious risk to the public's health as the result of short-term exposures to hazardous substances.
- Category 2: Public Health Hazard: Sites that pose a public health hazard as the result of long-term exposures to hazardous substances.
- Category 3: Indeterminate Public Health Hazard: Sites for which no conclusions about public health hazard can be made due to lack of data.
- Category 4: No Apparent Public Health Hazard: Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.
- Category 5: No Public Health Hazard: Sites for which data indicate no current or past exposure or no potential for exposure and therefore no health hazard.

According to Oregon State Department of Human Services, no Super Fund Sites or Hazardous Waste Sites exist in the Pendleton vicinity.

The Department of Energy's Hanford Site is located approximately 130 miles from Pendleton, well out of the Plume Exposure Pathway Emergency Planning Zone (10-mile radius from Hanford) and Ingestion Exposure Pathway Emergency Planning Zone (50-mile radius from Hanford).

2.2 Land Use

2.2.1 Zoning

The original City Comprehensive Plan was adopted in 1964. After subsequent revisions and expansions, the most current edition was updated in 2011. See **Figure 2-2**, Zoning Map, for current City limit delineations, UGB, and land use designations.

The total area within the City limits and urban growth boundary (UGB) is presented in **Table 2-2**, City of Pendleton Area Characteristics. The current total acreage for all zone classifications within the current Pendleton Urban Growth Boundary is shown in **Table 2-3**, City of Pendleton Area within UGB.

Table 2-2
City of Pendleton Area Characteristics

Description	Acreage
Pendleton City Limits	6,433
Urban Growth Boundary	7,982

Table 2-3
City of Pendleton Area Within UGB

Zone	Description	Acreage
EFU	Exclusive Farm Use	1,704
R1	Low Density Residential	1,396
R2	Medium Density Residential	1,670
R3	High Density Residual	261
C1	Commercial Tourist	355
C2	Commercial Service	124
C3	Commercial	370
M1	Light Industrial	1,240
M2	Heavy Industrial	346
AA	Aviation Activities	516

2.3 Population

2.3.1 Existing Population

As of the 2010 census, there were 16,612 people living in the City and the population density was 1,579 per square mile. According to information available from Portland State University's Population Research Center, Pendleton's 2017 certified population is 16,890.

Table 2-4 and **Figure 2-3** summarize Pendleton's population growth from 1970 through 2017. The annual population growth rate over that time was approximately 0.70 percent.

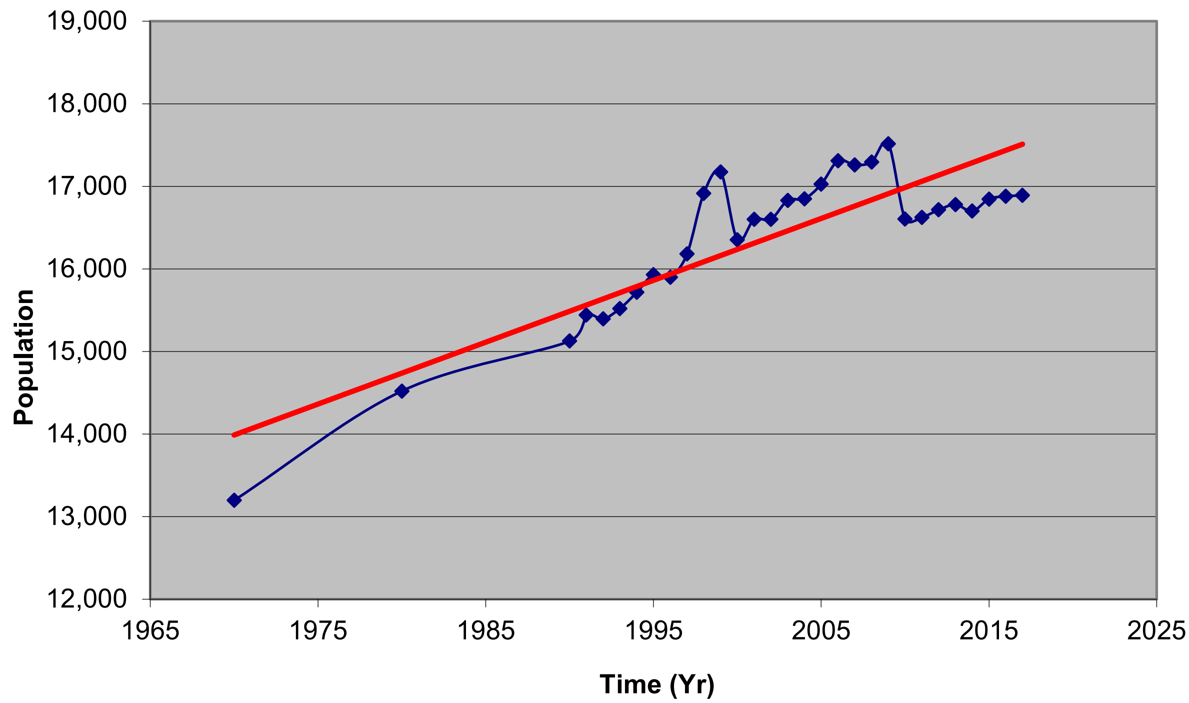
Table 2-4
Historical Population

Year	Population	Annual Growth Rate from 1970
1970	13,200	-
1980	14,520	0.96%
1990	15,130	0.68%
2000	16,350	0.72%
2010	16,610	0.58%
2017	16,890	0.52%
	Average Growth Rate	**0.69%**

Note:

1. Population data taken from Portland State University, Population Research Center, 2018 Annual Population Report.

Figure 2-3
Pendleton Population from 1970 to 2018



2.3.2 Population Projections

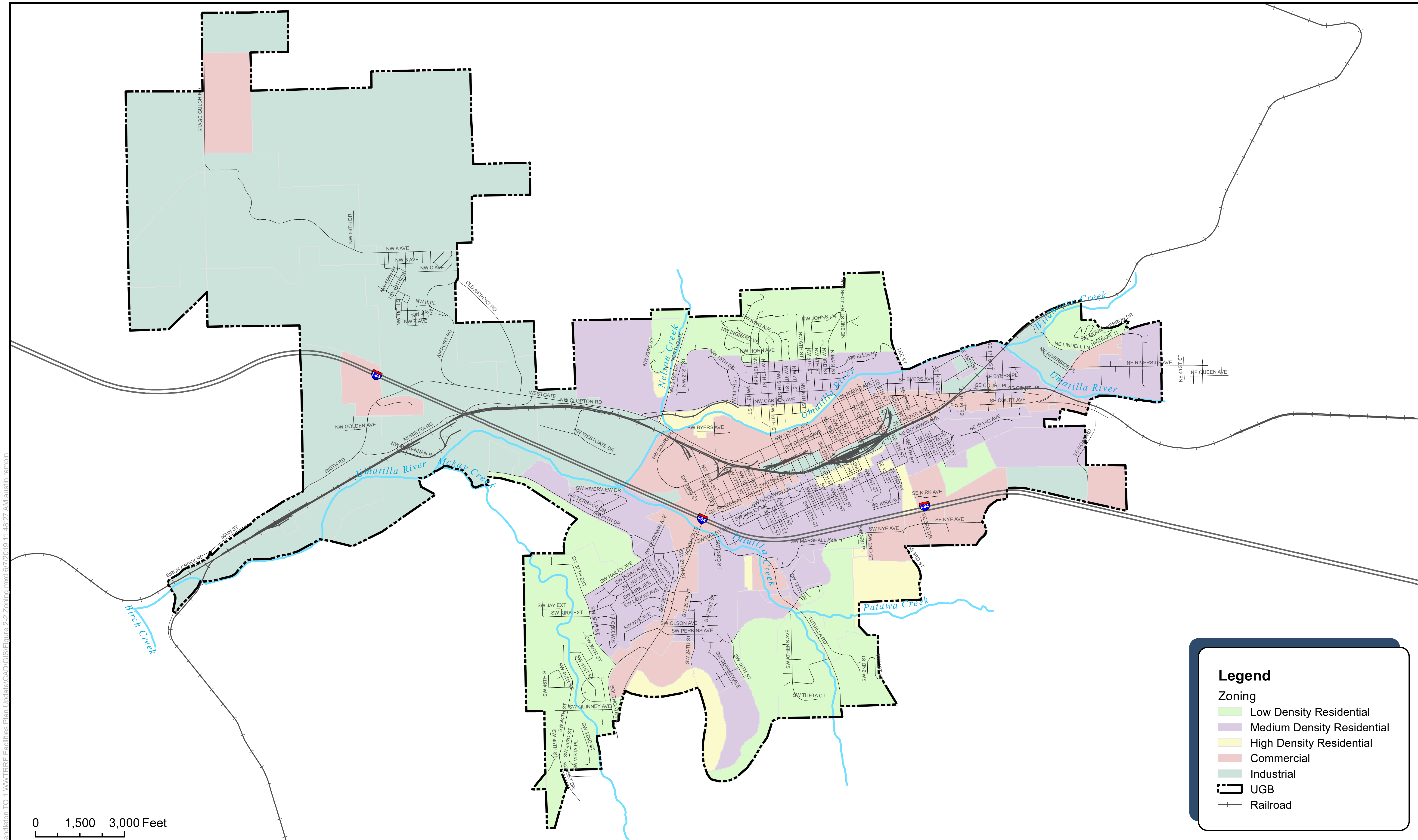
The City's adopted Collection System Master Plan (2015) developed population projections based on land use and zoning designations, current and future population, densities, vacancy rates, and other assumptions consistent with the City's 2011 Comprehensive Plan Update. **Table 2-5**, Population Projections, below, shows the projected population growth over the planning period.

Table 2-5
Population Projections

Year	Population
2020	19,716
2025	21,897
2035	23,970
2040	25,006

Notes:

1. Table data from 2015 Collection System Master Plan, except 2040.
2. Year 2040 population assume linear growth at the same rate as the previous 10 years.



City of Pendleton
WWTRRF Facility Plan Update

Figure 2-2
Zoning Map

June 2019 17-2019

Section **3**

Section 3

Regulatory Requirements

3.1 Regulatory Requirements

This section includes a discussion of the City of Pendleton's (City) National Pollutant Discharge Elimination System (NPDES) Permit for the Pendleton Wastewater Treatment and Resource Recovery Facility (WWTRRF), Umatilla River mixing zone, biosolids management, and future regulations that could impact WWTRRF operations.

3.1.1 Pendleton WWTRRF NPDES Permit

The Oregon Department of Environmental Quality (DEQ) has delegated authority from the United States Environmental Protection Agency (EPA) to enforce the Federal Clean Water Act (CWA) to regulate the discharge of treated effluent from wastewater treatment plants through the NPDES program. Oregon NPDES Permit requirements are included in Oregon Administrative Rule (OAR) Chapter 340, Division 45 (OAR 340-45), whose purpose is to "prescribe limitations on discharge of wastes and the requirements and procedures for obtaining NPDES and WPCF permits from the Department of Environmental Quality." NPDES Permit limits must comply with Oregon water quality standards and biosolids management regulations included in OAR Chapter 340, Division 41 (OAR 340-041) and OAR Chapter 340, Division 50 (OAR 340-050), respectively.

The City of Pendleton NPDES Permit #100982 was last renewed February 3, 2005, allowing the discharge of treated effluent to the McKay Creek just upstream of the confluence with the Umatilla River. The treated effluent must meet seasonal concentration and/or mass load limits for BOD, TSS, E.coli bacteria, Chlorine Residual, Ammonia-Nitrogen, and temperature. A copy of the City's NPDES Permit and the Permit Evaluation Report are included in Appendix D. Table 3-1 summarizes the waste discharge limitations for the Pendleton WWTRRF McKay Creek Outfall contained in Schedule A of the City's NPDES Permit. The NPDES Permit expired on January 31, 2010 and has not been renewed. DEQ staff conveyed to City staff at the 2019 Oregon Association of Clean Water Agencies (ACWA) Conference that the City's permit may be reviewed and reissued within three years in 2022.

3.1.2 Mutual Agreement and Order and Umatilla River Mixing Zone Study

Based on the City's inability to meet the permit requirements for temperature, the city entered upon a Mutual Agreement and Order with the Department of Ecology. As part of the Mutual Agreement and Order (MAO) and a modified NPDES Waste Discharge Permit issued on August 31, 2007, the City was required to develop a temperature management plan and to perform a mixing zone study to evaluate alternative discharge points.

The mixing zone study was submitted to DEQ in 2009 to evaluate moving the outfall from McKay Creek upstream of the confluence (outfall 001) to an alternative outfall within the Umatilla River downstream of McKay and Umatilla confluence (outfall 002). For the study, the 1Q10, 7Q10, and 30Q5 for the Umatilla River were 81.8, 84.7, and 120.5 cubic feet per second (cfs), respectively. Using projected current and projected effluent flow rates from the City of Pendleton WWTRRF and proposed discharge channel geometry, a mixing zone model was constructed. Based on the results of the mixing zone model for year 2016, the Zone of Initial Dilution (ZID) at the outfall 002 would have a length of 9.3 feet with a mixing dilution factor of 6.2, and the edge of the regulated mixing zone (MZ) would be 93 feet from the outfall with a mixing dilution factor of 1.3. For the year 2030, the mixing zone model estimated the ZID and MZ will change to 5.3 and 1.4, respectively. Based on these results, the outfall 002 was installed in 2012. Therefore, these values will be used in further sections including **Section 3.2 - Reasonable Potential Analysis**.

Table 3-1
Outfall 001 NPDES Waste Discharge Limits(a)

Parameter	Monthly Average Concentration (mg/L)	Weekly Average Concentration (mg/L)	Monthly Average Load (b) (lb/day)	Weekly Average Load (b) (lb/day)	Daily Maximum Load (b) (lb/day)
Summer Season (May 1 through October 31)					
BOD_5	20	30	920	1,400	1,800
TSS	20	30	920	1,400	1,800
Ammonia-N	2.0 mg/l (96 lb/day) daily maximum 1.0 mg/l (48 lb/day) monthly average				
Residual Chlorine	0.05 mg/l (2.0 lb/day) daily maximum 0.02 mg/l (0.80 lb/day) monthly average				
Winter Season (November 1 through April 30)					
BOD_5	30	45	1,400	2,100	2,800
TSS	30	45	1,400	2,100	2,800
Ammonia-N	5.2 mg/l (240 lb/day) daily maximum 3.0 mg/l (140 lb/day) monthly average				
Residual Chlorine	0.04 mg/l (1.7 lb/day) daily maximum 0.01 mg/l (0.60 lb/day) monthly average				
Other Parameters (year-round)					
E.Coli Bacteria	Shall not exceed 126 counts/100mL monthly geometric mean or 406 org/100mL for a single sample.				
pH	Shall be within range of 6.0 – 9.0.				
BOD_5 and TSS Monthly Average Removal Efficiency	Shall not be less than 85% monthly average.				

Notes:
(a) From current Pendleton WWTRRF NPDES Permit #100982 for File Number 68260.
(b) Mass load limits are based upon WWTRRF average dry weather design flow of 5.5 MGD.

Abbreviations:
mg/L = Milligrams per liter.
lb/day = Pounds per day.
org/100mL = organisms per 100 milliliters

3.1.3 BOD, TSS, and Ammonia Mass Load Limits

Table 3-2 is a summary of estimated 2040 Pendleton WWTRRF BOD_5, TSS, and Ammonia mass loads discharged to the Umatilla River based on the Design 2040 ADWF, AWWF, or PDF of 3.18 MGD, 3.19 MGD and 4.22 MGD, respectively, and concentration limits as summarized. As shown, the estimated 2040 BOD_5, TSS, and ammonia mass loads are lower than the mass load limits included in the City's existing NPDES Permit.

Table 3-2
Calculated BOD_5 & TSS Mass Loads

Parameter	Monthly Average Concentration (mg/L)	Weekly Average Concentration (mg/L)	Daily Maximum Concentration (mg/L)	Monthly Average Load (lb/day)	Weekly Average Load (lb/day)	Daily Maximum Load (lb/day)
Summer Season (May 1 through October 31)						
BOD_5	20	30	NA	531	796	1056
TSS	20	30	NA	531	796	1056
Ammonia	1	NA	2	27	NA	70
Winter Season (November 1 through April 30)						
BOD_5	30	45	NA	799	1198	1585
TSS	30	45	NA	799	1198	1585
Ammonia	3	NA	5.2	80	NA	183

Note:
NA = Not applicable

Based on these load projections for 2040, there is no requirement for increasing the current BOD, TSS, and Ammonia mass load limits included in the City's NPDES Permit.

3.1.4 Excess Thermal Load Limits

Effluent temperatures in the City's NPDES Permit were based on requirements in the Oregon Temperature Standard and the Umatilla River Basin Temperature total maximum daily load (TMDL); however, the City was not able to meet the new temperature limits. In addition, a lawsuit by the Northwest Environmental Associates (NWEA) sued the EPA over the Temperature TMDL limits. Because the City was unable to meet the permit criteria, the City and DEQ entered into a Mutual Agreement and Order, which allowed for temporary removal of the temperature limit. While the City does not currently have a temperature discharge criterion, a recent judge order requires DEQ to prepare new temperature TMDLs for all basins in Oregon in the next eight years. The schedule for each basin is based on population, which puts the Umatilla Temperature TMDL update last on the list. The required completion date for the updated TMDL is November 28, 2027. There is potential for effluent temperature requirements to be included in the City's next NPDES Permit renewal before the Umatilla Temperature TMDL is updated in 2027. Therefore, an analysis of the historical discharge data was done using the criteria listed in **Table 3-3** which represents conservative criteria (See **Appendix E** for the Temperature Evaluation TM). Based on these criteria, there have been 379 days with potential violations out of 1096 days analyzed from 2015 to 2017. **Figure 3-1** shows the results for 2017 which is typical for the study period of 2015-2017. The majority of the violations occurred during the summer season. Therefore, finding alternative disposal methods including creating Class A or C recycled water to be used for irrigation or other approved non-potable water uses from the WWTRRF effluent should be considered.

Figure 3-1
2017 Potential Temperature Standard Criteria Violation Results

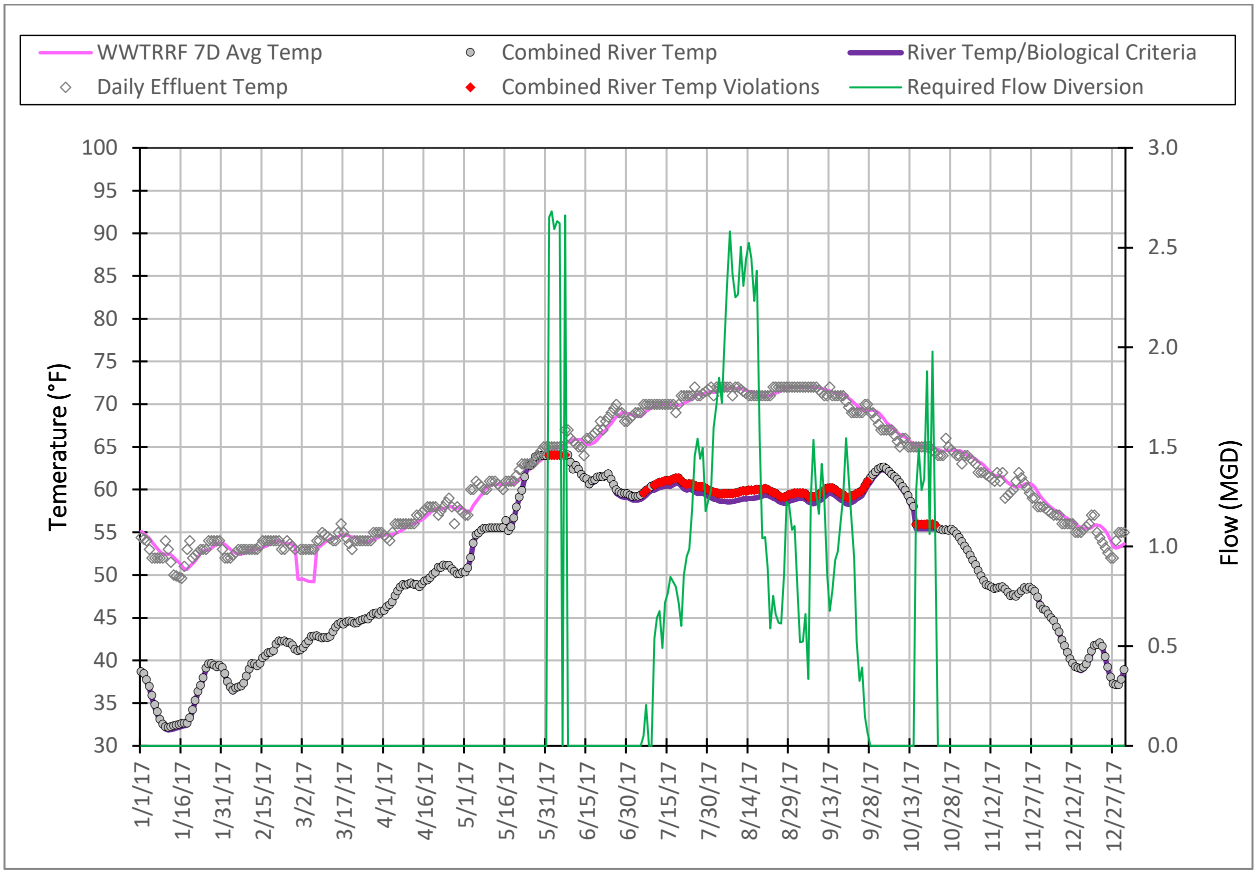


Table 3-3
WWTRRF Effluent Temperature Discharge Criteria

Period		Biological Criteria	Mixing Zone	River Temp	Conditions	
Winter (Temp Std)	(10/15 - 5/15)	55.4°F Ambient	25%	$T_{R\,(7\,dAM)}$ > 55.4°F	T_{ALLOW} =	55.9°F @ EMZ
			100%	50°F<$T_{R\,(60\,day)}$<55.04°F	T_{ALLOW} =	$T_{R\,(60\,day)}$ +0.9°F @ EMZ
			100%	$T_{R\,(60\,day)}$ < 50°F	T_{ALLOW} =	$T_{R\,(60\,day)}$ +1.8°F @ EMZ
Spring (Temp Std)	(5/15 - 5/31)	64°F Ambient	25%	$T_{R\,(7\,dAM)}$ > 64 °F	T_{ALLOW} =	64.5°F @ EMZ
			25%	$T_{R\,(7\,dAM)}$ < 64°F	T_{ALLOW} =	$T_{R\,(7\,dAM)}$+0.5°F @ EMZ
Summer (Temp Std)	(6/1 - 9/30)	64°F Ambient	25%	$T_{R\,(7\,dAM)}$ > 64°F	T_{ALLOW} =	64.5°F @ EMZ
				$T_{R\,(7\,dAM)}$ < 64°F	T_{ALLOW} =	$T_{R\,(7\,dAM)}$+0.5°F @ EMZ
Summer (TMDL)[1]	(6/1 - 9/30)	69.8°F Ambient	25%	$T_{R\,(7\,dAM)}$ > 69.8°F	T_{ALLOW} =	70.05°F @ EMZ
			25%	$T_{R\,(7\,dAM)}$ < 69.8°F	T_{ALLOW} =	$T_{R\,(7\,dAM)}$+0.25°F @ EMZ
Fall (Temp Std)	(10/1 - 10/14)	64°F Ambient	25%	$T_{R\,(7\,dAM)}$ > 64°F	T_{ALLOW} =	64.5°F @ EMZ
			25%	$T_{R\,(7\,dAM)}$ < 64°F	T_{ALLOW} =	$T_{R\,(7\,dAM)}$+0.5°F @ EMZ

Notes:

1. Conditions Criteria stated that if the natural thermal potential of all or a portion of a water body exceeds the biologically-based criteria in Section 4 of the OAR 340-041 Temperature Standard then the natural thermal potential temperatures supersede the biologically-based criteria and are deemed the applicable temperature criteria for that water body. This ruling is no longer valid and therefore the natural thermal potential temperature of 69.8°F is no longer applicable.

3.2 Reasonable Potential Analysis

To determine if wastewater discharge could cause an impairment of the stream water quality criteria, the Oregon Department of Environmental Quality (DEQ) Reasonable Potential Analysis (RPA) workbooks were used along with both analyte concentrations and flow rates from the plant effluent and Umatilla River, where available. Specifically, final effluent sampling data, general stream flow data, and mixing zone study dilution values (ZID and MZ) were used. For this study, the RPA was used to determine the reasonable potential for exceeding the water quality standard for toxic pollutants, ammonia, chlorine, and copper. The following sections discuss the results of the analyses.

3.2.1 Reasonable Potential Analysis for Toxic Pollutants

Based on the treatment plant and stream characteristics, 90 potentially toxic pollutants required Tier 1 monitoring based on the RPA Workbook. Each analyte required four samples for analysis. Between 2007 and 2017, nine individual tests were performed on the effluent of the City of Pendleton Wastewater Treatment Facility. The dates of these tests were: 5/17/2007, 4/27/2009, 5/26/2009, 10/4/2011, 10/10/2011, 10/24/2011, 10/31/2011, 7/16/2012, and 10/31/2017. Each sample was tested for a different combination of analytes. The overall number of tests for each analyte is summarized in **Appendix D**. Out of the 90 analytes required for Tier 1 monitoring, 11 analytes were not tested in a single sample and 11 analytes were tested at least once but not the required four times. Comparing the analytes sampled by the City with those included in a RPA by DEQ analysis for the City in 2015, 6 analytes were tested less than four times or not at all by City of Pendleton but were tested by DEQ. These analytes are shown in **Table 3-4**, below.

Table 3-4
Analytes Suggested for Additional Testing

Pollutant	Tier 1 Testing?	Number of Tests by City of Pendleton	Detected By DEQ?	Pendleton RP?
Iron (total recoverable)	Yes	0	Yes	No
Hardness (Total as CaCO3)	Yes	2	Yes	NA
Nitrates-Nitrite	Yes	2	Yes	NA
Selenium (total recoverable)	Yes	3	Yes	No
Silver (total recoverable)	Yes	3	Yes	No
Thallium (total recoverable)	Yes	3	Yes	No

Notes:
NA = Not applicable because there are no water quality criteria for those pollutants
RP = Reasonable Potential

From the City of Pendleton samples, it was determined that three analytes had a reasonable potential. These chemicals are:

- Bis (2-ethylhexyl) phthalate
- 1,1-Dichloro-2,2-bis(4-chlorophenyl) ethene (4,4'-DDE)
- Cyanide

Although the analysis returned a reasonable potential for exceedance for 4,4'-DDE, it was only measured for twice by the City of Pendleton so more testing may be necessary to accurately calculate if there is a reasonable potential for 4,4'-DDE.

Since the samples are from as long ago as 2007 and may not be representative of current analyte levels, it is recommended that more samples should be collected and analyzed for the DEQ tested analytes.

3.2.2 Reasonable Potential Analysis for Ammonia

An additional RPA analysis was performed to determine if ammonia levels in the effluent presented a water quality concern. The ammonia RPA was calculated using effluent data in the discharge monitoring reports (DMRs) from 1/1/2013 to 5/31/2017, sampled approximately weekly. The concentrations of NH3-N were typically between 0.1-0.3, with some minor variation. However, on 7/14/2014 and 7/27/2014, there were spikes in the effluent up to 21.9mg/L and 21.8mg/L, respectively. Because this large of a spike only occurred during one week in the testing period, it is possible that these data points are outliers. The RPA was calculated both with and without these two data points. For the RPA analysis, the highest 4-day subset of the highest rolling 30-day average was used as the highest effluent concentration as prescribed in the RPA Workbook. With the possible outliers this concentration is 21.9 mg/L, and without it is 2.6 mg/L.

Two different dilution values (MZ and ZID) were used based on the current flow and projected flow in 2030 (**Table 3-5**) from the Mixing Zone Study performed in 2009. The RPA was calculated with both dilution valves and the highest effluent concentration levels to determine current and potential future flow impact on the results. The results of the RPA are shown in **Table 3-5**, below.

Table 3-5
Effects of 2017 vs. 2030 Dilution and Ammonia Spike on Ammonia Reasonable Potential

Projected year for dilution factors	Dilution @ ZID	Dilution @ MZ	Highest Effluent Conc. (mg/L)	Acute RP?	Chronic RP (4-day avg)?	Chronic RP (30-day avg)?
2017	1.3	6.2	21.9	Y	Y	Y
2030	1.4	5.3	21.9	Y	Y	Y
2017	1.3	6.2	2.6	N	N	Y
2030	1.4	5.3	2.6	N	N	Y

As shown in **Table 3-5**, there is always a chronic reasonable potential for ammonia, despite the variations in concentration used and projected flow. If the complete effluent data set is used including the two high values in July 2014, there is also an acute reasonable potential.

3.2.3 Reasonable Potential Analysis for Chlorine

The Pendleton WWTRRF has installed dechlorination facilities using Calcium Thiosulfate (CaS_2O_3) to meet the existing concentration and mass load limits summarized in **Table 3-2**. To assess if the treatment plant still has a potential of exceeding the water quality criteria of the receiving stream, a reasonable potential analysis was performed using the RPA Workbook and effluent chlorine data from the DMRs for 3 years. The concentrations of chlorine were typically below 0.021 mg/l; however, between February and April 2017, there were four events in which the chlorine effluent exceeded 0.021 mg/L with a maximum value of 0.058 mg/L. Because of these large spikes that only occurred four times during the testing period, it is possible that these data points are outliers.

The RPA was calculated using both with and without these four data points. For the RPA, the analysis was performed both with 0.021 mg/L and 0.058 mg/L as the highest effluent value.

The reasonable potential was performed using both the current and potential future MZ and ZID used in **Section 3.1.2**. Data for Chlorine in the stream was not available, but considering chlorine is reactive, the ambient concentration was assumed to be below detection. The results are summarized in **Table 3-6**.

The results show that if the entire data set is included, then there is currently a reasonable potential for acute toxicity as well as a potential for chronic toxicity in the future. If the four points above 0.021 mg/L are removed, then there is no reasonable potential now or in the future. Nonetheless, operation of the disinfection system should be evaluated to mitigate any potential for water quality exceedance.

Table 3-6
Effects of 2017 vs. 2030 Dilution and Chlorine Spike on Reasonable Potential Analysis

Projected year for dilution factors	Dilution at ZID	Dilution at MZ	Highest Effluent Conc. (mg/L)	Acute RP?	Chronic RP?
2017	1.3	6.2	0.058	Y	N
2030	1.4	5.3	0.058	Y	Y
2017	1.3	6.2	0.021	N	N
2030	1.4	5.3	0.021	N	N

3.2.4 Reasonable Potential Analysis for Copper

To determine if the effluent from the site could have a reasonable potential to cause issues with copper toxicity, the biotic ligand model was obtained from the Oregon Department of Environmental Quality website. To run the model, water quality data collected by the City for hydrogen potential (pH), alkalinity, calcium, magnesium, potassium, chloride, sulfate, and dissolved organic carbon from June 2017 to January 2018 was used. Sulfide and humic acid content were not measured so the default values were used. Based on this analysis, the Criterion Maximum Concentration (CMC) ranged from 3.9 to 31.4 microgram per liter (μg/L) and the Criterion Continuous Concentration (CCC) ranged from 2.4 to 19.5 μg/L from June 2017 to January 2018. These values were compared to the calculated Maximum Total Concentration at the Zone of Dilution (ZID) (17.0 μg/L) and the Regulatory Mixing Zone (RMZ) (4.9 μg/L) using the RPA spreadsheet for Ammonia. Based on the result, there was a reasonable potential of exceeding the chronic and acute copper levels throughout the majority of the year. Therefore, further sampling and analysis is recommended to determine if measures are needed to reduce copper discharge from the WWTRRF.

3.3 Biosolids Management

Biosolids are the solids derived from primary, secondary, or advanced treatment of domestic wastewater which have been treated to significantly reduce pathogens and reduce volatile solids to the extent that they do not attract vectors. This term refers to domestic wastewater treatment facility solids that have undergone adequate treatment to permit their land application. In Oregon, the term “biosolids” has the same meaning as the term "sludge" in state statute and the term "sewage sludge" found elsewhere in state administrative rules as well as the code of federal regulations.

Most wastewater treatment plants in Oregon beneficially use their biosolids through agricultural land application on pasture, hay, wheat, and a variety of other crops. A small but increasing number of communities further treat their biosolids such as through composting or high-temperature lime stabilization so that the end product can be sold or given away to the public.

3.3.1 Biosolids Regulations

The DEQ implements regulatory oversight of biosolids beneficial use practices (e.g. land application) in Oregon. Although DEQ does not have formal delegation authority to implement the federal biosolids regulations, the EPA supports DEQ’s regulatory oversight by providing funds, technical assistance and occasional compliance assistance to DEQ. Furthermore, the EPA does not currently conduct permitting activities for the beneficial use of biosolids in Oregon. This includes all beneficial use activities such as land application, composting, lime stabilization, and air drying. The EPA maintains sole authority for biosolids management activities involving municipal sewage sludge incineration.

The DEQ implements their regulatory authority in accordance with OAR 340-050 (Land Application of Domestic Wastewater Treatment Facility Biosolids, Biosolids Derived Products, And Domestic Septage) which references and is consistent with EPA’s biosolids regulations Title 40 CFR Part 503 (Standards for the Use and Disposal of sewage Sludge). DEQ implements regulatory requirements through a wastewater facilities’ NPDES or Water Pollution Control Facility (WPCF) permit depending on whether the facility has a surface water discharge. A Biosolids Management Plan is a component of the permit and contains a complete description of a facilities biosolids beneficial use process including flows, treatment processes, quantity and quality, hauling procedures, spill response plans, land application site information, and site authorizations.

The state biosolids regulations define three measures for biosolids quality:

- Pathogen Reduction
- Vector Attraction Reduction
- Pollutants

3.3.2 Pathogen Reduction Requirements

Pathogens are disease causing organisms such as viruses, parasites and certain types of bacteria. These organisms are significantly reduced during the biosolids treatment process so that they can be beneficially used. Pathogen reduction requirements define two classifications of biosolids – Class A and Class B. These classifications indicate the density (number per unit mass) of pathogens in biosolids. Class A requirements necessitate almost complete destruction of pathogens. Class B requirements call for significantly reducing the density of pathogens and land applying biosolids by implementing specific site management practices such as buffers from rivers and streams. A third classification of biosolids is Class A EQ (Exceptional Quality). This refers to biosolids that have met the Class A pathogen reduction requirements and have met the lower concentrations standards for pollutants or "metals."

To be classified as Class A, biosolids must be treated using one of EPA's six pathogen reduction alternatives which include several treatment methods known as Processes to Further Reduce Pathogens (PFRP), or an equivalent process. These processes include composting, heat drying, heat treatment, thermophilic aerobic digestion, beta ray irradiation, gamma ray irradiation and pasteurization. In addition to using one of the prescribed pathogen reduction alternatives, Class A biosolids must not exceed maximum allowable fecal coliform density or salmonella bacteria density.

Class B biosolids must be treated using one of EPA's three pathogen reduction alternatives which include several treatment methods known as Processes to Further Significantly Reduce Pathogens (PSRP), or an equivalent process. These processes include aerobic digestion, air drying, anaerobic digestion, and lime stabilization.

3.3.2.1 Vector Attraction Requirements

Vector attraction refers to the tendency of biosolids to attract rodents, insects, and other organisms that can spread disease. Biosolids must meet one of the following requirements for reducing vector attraction if they are to be applied to land without restrictions:

- Volatile solids in the biosolids must be reduced by a minimum of 38 percent.
- The specific oxygen uptake rate for biosolids treated by aerobic digestion must be less than or equal to 1.5 milligrams oxygen per hour per gram of total solids at a temperature of 20 degrees Celsius.
- Aerobic processes shall treat the biosolids for a minimum of 14 days with an average temperature of at least 45 degrees Celsius and a minimum temperature of 40 degrees Celsius.
- Lime or other alkali addition must raise the pH of the biosolids to a minimum of 12 for 2 hours and maintain the pH at a minimum of 11.5 for an additional 22 hours without additional lime.

3.3.2.2 Site Management Practices

In addition to meeting pathogen reduction and vector attraction reduction requirements, Class B biosolids land application activities must implement certain site management practices. These practices include maintaining setback distances to drinking water wells and streams, controlling public access to the land application site, grazing or harvest restrictions based on the type of crop and biosolids application method, agronomic application rate calculations, and providing for public notification of the land application activity. There are also additional regulatory considerations that DEQ employs for what are called "Certain Lands". These considerations apply to land under the federal Conservation Reserve Program, land in proximity to airports, and land with easements. Specific information on these "Certain Lands" as well as detailed explanation of DEQ's biosolids regulations can be found in their guidance document titled, "Implementing Oregon's Biosolids Program -- Internal Management Directive, December 2005".

The use of Class A EQ biosolids do not have any of the site management practices and are essentially free of regulatory restrictions once the pathogen reduction and vector attraction reduction standards have been met in the wastewater treatment plant.

3.3.2.3 Pollutants

Wastewater facilities that generate and beneficially use (e.g. agricultural land application) biosolids must monitor for and meet concentration limits for nine pollutants. These pollutants commonly referred to as "metals", include: Arsenic, Cadmium, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, and Zinc. In addition to the nine pollutants, several other parameters must be monitored. The parameters include nitrogen, phosphorus, potassium, pH, total solids and volatile solids.

Four limits have been set for the nine pollutants, as follows:

1. Ceiling Concentrations – All biosolids applied to the land must meet the ceiling concentrations for pollutants listed in 40 CFR §503.13, Table 1. The ceiling concentrations are the maximum concentration limits for the nine regulated pollutants in biosolids. If a limit for any one of the pollutants is exceeded, the biosolids cannot be applied to the land until such a time that the ceiling concentration limits are no longer exceeded.

2. Pollutant Concentrations – Biosolids that are to be sold or given away; or applied to the land and not be required to calculate cumulative pollutant loading (see below) must meet the concentrations listed in 40 CFR §503.13, Table 3. If the pollutant concentrations for the eight regulated metals in biosolids are exceeded, then the facility must track the cumulative loading of the metals until such a time that the pollutant concentration limits fall below Table 3 levels.

3. Cumulative Pollutant Loading Rates – Biosolids that exceed the pollutant concentrations listed in 40 CFR §503.13, Table 3 but are below 40 CFR §503.13, Table 1, must be tracked

and not exceed the cumulative pollutant loading rates per hectare in accordance with 40 CFR §503.13, Table 2.

4. Annual Pollutant Loading Rates – Biosolids that meet Class A requirements with respect to pathogen and vector attraction reduction requirements, are bagged, but do not meet the pollutant concentrations in Table 3 must not exceed the annual pollutant loading rates prescribed in 40 CFR §503.13, Table 4.

3.3.2.4 Biosolids Management Plan

Biosolids Management Plans serve as the planning and operation tool for the production, storage, transportation, and land application of biosolids for beneficial use in Oregon. All wastewater treatment facilities that apply biosolids to the land must have a Biosolids Management Plan approved by DEQ. Once approved by the DEQ, the management plan becomes part of a facility's NPDES permit.

The City's latest Biosolids Management Plan was revised in July 2005 and approved by the DEQ. The plan currently includes Class B pathogen reduction and vector attraction reduction via anaerobic digestion. During 2017, pathogen reduction requirements are met with an average mean cell residence time of 42 days at an average temperature of 98 degrees Fahrenheit. Volatile solids reduction averaged 56 percent with the lowest average monthly reduction of 47 percent. This meets the minimum 38 percent volatile solids reduction requirements of 40 CFR §503.33(b)(1).

In 2016, the City land applied 153.8 dry tons of Class B biosolids to approximately 127 acres the Straughan East field (Lot 1). At Lot 2, the City land applied 111.8 dry tons and 12.7 dry tons of Class B biosolids to approximately 54 acres and 27 acres at Airport Field 5 and 1, respectively. At Lot 3, the City land applied 98.4 dry tons of Class B biosolids to approximately 147.1 acres at Airport Field 4W. The amount of biosolids that were applied per acre was calculated using a yield value of 50-65 bushels and 14 percent protein content requiring between 150 and 240 pounds of available nitrogen per acre. After accounting for residual soil nitrogen, the City applied the appropriate amount of nitrogen within Lot 1 and Lot 3, but accidentally over applied to Lot 2 which resulted in a total 264 and 195 pounds of available nitrogen per acre for Airfield 5 and 1, respectively. The application rate information to help determine appropriate nitrogen requirements for the City's biosolids land application program is based on the Oregon State University's fertilizer guide #FS 335, *"Managing Nitrogen for Yield and Protein in Hard Wheat."*

The City is required to monitor the nine regulated pollutants (Arsenic, Cadmium, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, and Zinc) and several other parameters (nitrogen, phosphorus, potassium, pH, total solids and volatile solids) based on the mass of biosolids applied to the land per year as prescribed in Table 1 of 40 CFR §503.16. The City land applied 341 dry metric tons (376 dry tons) in 2016 and thus was required to monitor for these pollutants once per quarter. Since the sludge was only applied in two different hauls, the concentrations were tracked during each of these two events. The pollutant concentrations were below the limits found 40 CFR §503.13, Table 3 and are considered "high quality" with respect to pollutant concentrations. For example, assuming the City was to continue to land apply at the current application rate and biosolids quality it would take hundreds of years to meet the cumulative pollutant loading rates for the most limiting element of Zinc. Because the City has high quality biosolids they are not required to track pollutant loading rates, however, in practice, staff account for pollutant loading rates as a best management practice. It is recommended that the City continues to track pollutant loading rates because it will help address potential metals or nutrient questions that may arise over the life of their biosolids land application program.

Based on the pollutant loading concentrations and quality data of the other biosolids parameters the City can continue to land apply biosolids at approved land application sites. The City has lost 1,426 acres of their existing 1,700 acres of approved land application sites due to development or other restrictions at the Eastern Oregon Regional Airport and Airport Industrial Park. However, DEQ has recently started to allow additional site authorizations for Class B biosolids without needing a permit modification. Permit holders no longer have to negotiate a change in land application sites as part of their permit renewal. The City should pursue additional site authorizations due to the recent loss of the airport sites.

3.3.3 Future Water Quality Regulations

Potential future regulatory issues and requirements that may impact the Pendleton WWTRRF discharge to the Umatilla River in the future include:

- Toxic Substances Criteria
- Clean Water Act Section 303(d) List
- Increase in NPDES Permit Renewal Fees

3.3.3.1 Toxics Substances Criteria (OAR 340-041-0033)

Allowable acute and chronic concentrations of Toxic Substances in fresh and marine waters for protection of aquatic life and human health are summarized in Table 30 attached by reference to the Oregon Water Quality Standards. The Toxic Substances Criteria and Tables 30, 31, and 40 were updated by DEQ in October 2017.

3.3.3.2 Clean Water Act Section 303(d) List

In 2014, Oregon DEQ submitted Oregon's 2012 Integrated Report and 303(d) list to the EPA. In Dec 2016, the EPA approved most of the submitted 303(d) list, but had a few required modifications. Based on the approved 303(d) list for the Umatilla, copper, iron, lead, and mercury were added to the Category 5 list which means that TMDL is needed for either at or downstream of the outfall 002. In addition, the EPA proposed dissolved oxygen and total phosphorus for downstream of the confluence.

3.3.3.3 NPDES Permit Renewal Fees

Table 3-7 summarizes the fees for 2018 related to the Pendleton WWTRRF NPDES Permit and planned WWTRRF upgrades. It is anticipated that the fees summarized in **Table 3-7** will increase again in 2019.

Table 3-7
Pendleton WWTRRF 2018 NPDES Permit Fees

Item	Description/Cost
Facility Type C1a	2.0 MGD < Design ADWF < 5.0 MGD
New Permit Application	$39,435
Base Annual Fee (5-Year Permits)	$10,197
Annual Fee (10-Year Permits)	$9,206
Major Modification	$19,766
Minor Modification	**$1,083**

3.4 EPA Plant Reliability Criteria

The Pendleton WWTRRF is required to meet the Reliability Class I standards, as defined in EPA's Technical Bulletin "Design Criteria for Mechanical, Electrical, and Fluid System Component Reliability," EPA 430-99-74-001. **Table 3-8** includes a summary of the reliability criteria and requirements to be considered as part of the Alternatives Evaluation and Recommended Plan. These are required to be met for design flows and loads summarized in **Section 5**.

Table 3-8
EPA Class I Reliability Criteria

Treatment Unit Process	Reliability Class I Requirements
Influent Screening	A backup bar screen designed for mechanical or manual cleaning shall be provided. Facilities with only two bar screens shall have at least one bar screen designed to permit manual cleaning.
Pumps (Liquids, Solids & Chemical Feed)	A backup pump shall be provided for each set of pumps performing the same function. The capacity of the pumps shall be such that, with any one pump out of service, the remaining pumps will have the capacity to handle the peak flow.
Primary Sedimentation	The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 50% of the total design flow.
Secondary Clarification	The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 75% of the total design flow.
Aeration Basin	A backup basin will not be required; however, at least two equal-volume basins shall be provided. (For the purpose of this criterion, the two zones of a contact stabilization process are considered as only one basin.)
Aeration Blowers and/or Mechanical Aerators	There shall be a sufficient number of blowers or mechanical aerators to enable the design oxygen transfer to be maintained with the largest-capacity-unit out of service. It is permissible for the backup unit to be an uninstalled unit, provided that the installed units can be easily removed and replaced. However, at least two units shall be installed.
Air Diffuser Systems (if applicable)	The air diffusion system for each aeration basin shall be designed so that the largest section of diffusers can be isolated without measurably impairing the oxygen transfer capability of the system.
Chlorine Contact Chamber	The units shall be sufficient in number and size so that, with the largest-flow-capacity unit out of service, the remaining units shall have a design flow capacity of at least 50% of the total design flow.
Electrical Power Supply	Two separate and independent power sources, either from two separate utility substations or from a single substation and an on-site generator. The backup power supply shall be sufficient to operate all vital components during peak wastewater flow conditions, including critical lighting and ventilation.
Sludge Holding Tanks	Holding tanks are permissible as an alternative to component or system backup capabilities for components downstream of the tank provided the volume of the holding tank shall be based on the expected time necessary to perform maintenance and/or repair and the capacity of sludge treatment processes downstream can handle the combined flow from the storage tanks and the working sludge treatment system
Digestion Tanks	At least two digestion tanks shall be provided.
Digestion Tank Mixing Equipment	Mixing equipment shall be provided to sustain required mixing when one mixer is not in operation.
Electrical Power Supply	Two separate and independent power sources, either from two separate utility substations or from a single substation and an on-site generator. The backup power supply shall be sufficient to operate all vital components during peak wastewater flow conditions, including critical lighting and ventilation.

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Section 4

Section 4

Basis of Planning

4.1 Alternative Development and Evaluation Methodology

This section summarizes the methodology for developing, evaluating, and selecting alternatives to be included in the Recommended Plan. The alternatives evaluation approach uses cost effectiveness and non-economic factors including those factors which the City of Pendleton (City) considers most important.

4.1.1 Scoring Procedure

Alternatives are evaluated using a matrix-based approach incorporating cost and non-cost evaluation criteria. Scores to select the preferred alternative for the City are calculated by scoring each alternative relative to others and assigning a relative importance, or weighting, to each criterion. The alternative with the highest score represents the preferred alternative for the City. The scoring equation is as follows:

$$Total = \sum_{Criteria} (Score * Weighting)$$

4.1.1.1 Score

Alternatives are scored from best to worst based on the number of alternatives being evaluated. Scores for each criterion from range from 4 (best) to 1 (worst). Comparable alternatives may receive the same score.

4.1.1.2 Weighting

The weighting factor is a percentage-based multiplier allowing the City to place greater emphasis on specific criterion of greater importance for the City. For example, life cycle and capital costs are important to the City and are given a higher weighting in the overall evaluation. All Evaluation Criteria and Weightings are developed with input from City staff and total to 100 percent.

4.2 Evaluation Criteria

Evaluation criteria used in the alternatives evaluation will include both cost and non-cost factors. Factors will include:

- Capital Cost;
- 20-year Life Cycle Cost;
- Regulatory Compliance;
- Constructability.

Following is an introductory description of each criterion in the alternatives evaluation along with the weighting factor in parentheses.

4.2.1 Capital Cost (30 percent)

Capital costs are those costs associated with constructing improvements and appurtenances required for each alternative. Capital improvements may include Wastewater Treatment and Resource Recovery Facility (WWTRRF) unit process upgrades; electrical and instrumentation improvements; and architectural, site, and protective systems upgrades.

Cost estimates are prepared to American Association of Cost Engineers (AACE) Class 5 estimate standards for planning-level evaluations with a range of accuracy of -30 percent to +45 percent.

4.2.2 Life Cycle Cost (20 percent)

Life cycle cost includes initial capital costs as well as annual operations and maintenance (O&M) costs for required facilities. Annual O&M costs include WWTRRF personnel, energy, chemicals, maintenance, and other miscellaneous costs. The Net Present Value of annual O&M costs for determining the Life Cycle Cost will be calculated based on the following criteria:

- Labor Rate: $50 per hour
- Energy Rate: $0.06 per kilowatt-hour (kWh)
- Interest Rate: 3.5 percent
- Discount Rate: 3.5 percent
- Evaluation Period: 20 years
- Residual Value: $0

4.2.3 Regulatory Compliance (30 percent)

Regulatory compliance is based on the reliability of each alternative for meeting effluent discharge limits included in the WWTRRF National Pollutant Discharge Elimination System (NPDES) Permit. Each alternative must reliably meet all NPDES requirements, but certain alternatives may have more variability or higher risk relative to long term compliance.

4.2.4 Constructability (20 percent)

Constructability relates to the construction complexity and potential issues associated with constructing the proposed alternative and meeting critical deadlines. For example, construction of a new hyporheic effluent discharge system could require close coordination with a private property owner that could be more difficult to construct for various reasons.

4.3 Basis of Cost Estimating

Construction costs for each alternative will be estimated based on recent construction costs for similar facilities, published standard construction cost data, and the Engineer's experience on similar projects. Standard mark-ups applied to conceptual construction cost estimates are summarized in **Table 4-1.**

Table 4-1
Applied Mark-ups for Conceptual Cost Estimates

Item	Mark-up as Percent of Construction Cost
Mobilization	8%
General Conditions	8%
Contractor Overhead and Profit	12%
Construction Contingency	30%
Engineering/Legal/Administrative	25%

Section **5**

Section 5

Wastewater Characteristics

5.1 Introduction

This section summarizes the wastewater components for the City of Pendleton (City) Wastewater Treatment and Resource Recovery Facility (WWTRRF) , including:

- Flow and load trends compared to previous the Facility Plan;
- Current WWTRRF flows and loads;
- Projected 2040 WWTRRF flows and loads; and
- WWTRRF wastewater characterization.

Flow projections and peak flow estimates to be used as design criteria for recommended facility improvements are for the year 2040, providing an estimated 20-year capacity expansion for WWTRRF improvements following the completion of any capacity upgrades needed and identified in the Facility Plan.

The WWTRRF wastewater characterization included in this section summarizes the water quality characteristics of the raw influent. The characterization will be used to evaluate the current treatment process and to predict future performance using a process model under 2040 flows and loads. The process model will then allow an assessment of the ability of the facilities to meet current and future regulatory requirements summarized in **Section 3**. The wastewater characterization is based on a sampling and testing program developed by Murraysmith staff and implemented by Pendleton WWTRRF staff.

Where applicable, Oregon Department of Environmental Quality (DEQ) guidelines were used in developing flow and load projections at the wastewater treatment plant. However, the guidelines were developed for wastewater treatment plants in Western Oregon and are not entirely applicable to the east side of the state. Wastewater flows in the City of Pendleton are relatively constant throughout the year due to rainfall in the winter season and irrigation in the summer season. Therefore, DEQ guidelines were modified as required to develop reasonable flow and load projections for the City of Pendleton and Eastern Oregon.

5.2 Definitions

DEQ Guidelines: Guidelines for Making Wet-Weather and Peak Flow Projections for Sewage Treatment in Western Oregon (Oregon Department of Environmental Quality 1996). The guidelines are used as a “shortcut” method to use published rainfall statistics to predict maximum monthly and peak daily flow rates. The method is typically used for areas where annual rainfall totals are at least 20-25 inches; however, Pendleton typically averages 12 inches of rainfall per year. Despite not meeting the typical rainfall totals, the amount of irrigation that occurs each year likely makes Pendleton respond similar to regions with higher rainfall totals.

The guidelines develop the standards which govern design capacities of $MMWWF_5$ and $MMDWF_{10}$. The use of these design flow rates assures compliance with the goals of EPA's water-quality regulations, which are designed to protect the environment if the regulations are met 95 percent of the time. The anticipated compliance in the winter months with capacity at $MMWWF_5$ would be 98 percent and compliance in summer months with a capacity of $MMDWF_{10}$ would be 99 percent.

Evaluation Period: The updated flow projections for the WWTRRF are based on WWTRRF Discharge Monitoring Reports (DMRs) from January 2013 through December 2017.

Average Annual Flow (AAF): The average daily WWTRRF flow for the calendar year, including the wet and dry seasons.

Average Dry Weather Flow (ADWF): The daily average WWTRRF flow from May 1 through October 31.

Average Wet Weather Flow (AWWF): The daily average WWTRRF flow from November 1 through April 30.

Maximum Month Dry Weather Flow (MMDWF): The WWTRRF flow associated with a 10-year return rainfall event during the dry weather period. The design 10-year return (10-percent occurrence probability) rainfall event for the month of May is 2.4 inches, as published for the "Pendleton Municipal Airport" gauging station in "Climatography of the United States No. 81, Supplement No. 1," produced and distributed by the National Oceanic and Atmospheric Administration (NOAA) and National Climatic Data Center (NCDC).

Maximum Month Wet Weather Flow (MMWWF): The WWTRRF flow associated with a 5-year return rainfall event for the wettest month during the wet weather season. Typically, this definition corresponds to a January flow event for Western Oregon; however, Pendleton monthly precipitation probabilities indicate November or December to have a greater 5-year return event. For this reason, the maximum monthly rainfall accumulation in the Evaluation Period is used to determine the MMWWF.

Peak Daily Average Flow (PDF): The WWTRRF flow associated with a 5-year return, 24-hour rainfall event during a period with high groundwater and saturated soils. The design annual 5-year return, 24-hour rainfall event in the City of Pendleton is 1.2 inches, as published in Oregon NOAA Atlas 2 rainfall isopluvial maps. (See **Appendix F**)

Peak Week Flow (PWF): The A peak weekly flow that occurs 1/52 of the time or 1.9 percent probability.

Peak Instantaneous Flow (PIF): The highest peak WWTRRF flow attained during a 5-year peak day flow event.

5.3 Current Flows and Loads

The 2007 Facility Plan suggested the influent flow data may be incorrect, which was verified during preliminary design of the 2010 plant upgrades. The following data was taken from the *WWTP Phase 1 Upgrades Preliminary Design Report*, prepared by Kennedy/Jenks Consultants on 12 November 2008. **Table 5-1** shows the 2008 Design Flows the 2008 BOD and TSS load factors.

Table 5-1
2008 Design Flows and BOD and TSS Load Factors

Parameter	Units	Dry Weather *(May 1 through Oct. 31)*		Wet Weather *(No. 1 through April 30)*		Annual Average	Daily Peak Average	Peak Instantaneous
		Monthly Avg	Monthly Max	Monthly Avg	Monthly Max			
Flow	Million Gallons Per Day	2.09 (AWWF)	2.25 (MMWWF)	2.30 (ADWF)	2.60 (MMADWF)	2.12	3.25	3.95
BOD_5	Load Factor (ppcd)	0.254	0.282	0.266	0.320	NA	NA	NA
TSS	Load Factor (ppcd)	0.281	0.340	0.261	0.325	NA	NA	NA

Current WWTRRF flows and loads are tracking consistently with 2008 design flows and load factors. This is particularly due to the stagnant population growth the City has experienced over the last 10 years. Also, flows are slightly lower because the City has addressed known I/I problems. Annual rainfall for the Evaluation Period is consistent with historical annual averages and does not appear to indicate a correlation with lower recorded flows and abnormally dry years.

5.4 Evaluation of Existing WWTRRF Flow Data

WWTRRF DMRs were reviewed to establish current flows for the Pendleton WWTRRF. The following observations were made during the DMR review:

- Monthly WWTRRF flows are relatively consistent throughout the summer and winter permit seasons. This is different from Western Oregon, where winter season flows are typically higher due to winter rainfall and minimal impacts from summer irrigation on groundwater elevations. Therefore, modification of DEQ Guidelines were required to develop reasonable flow projections for the City of Pendleton in Eastern Oregon.

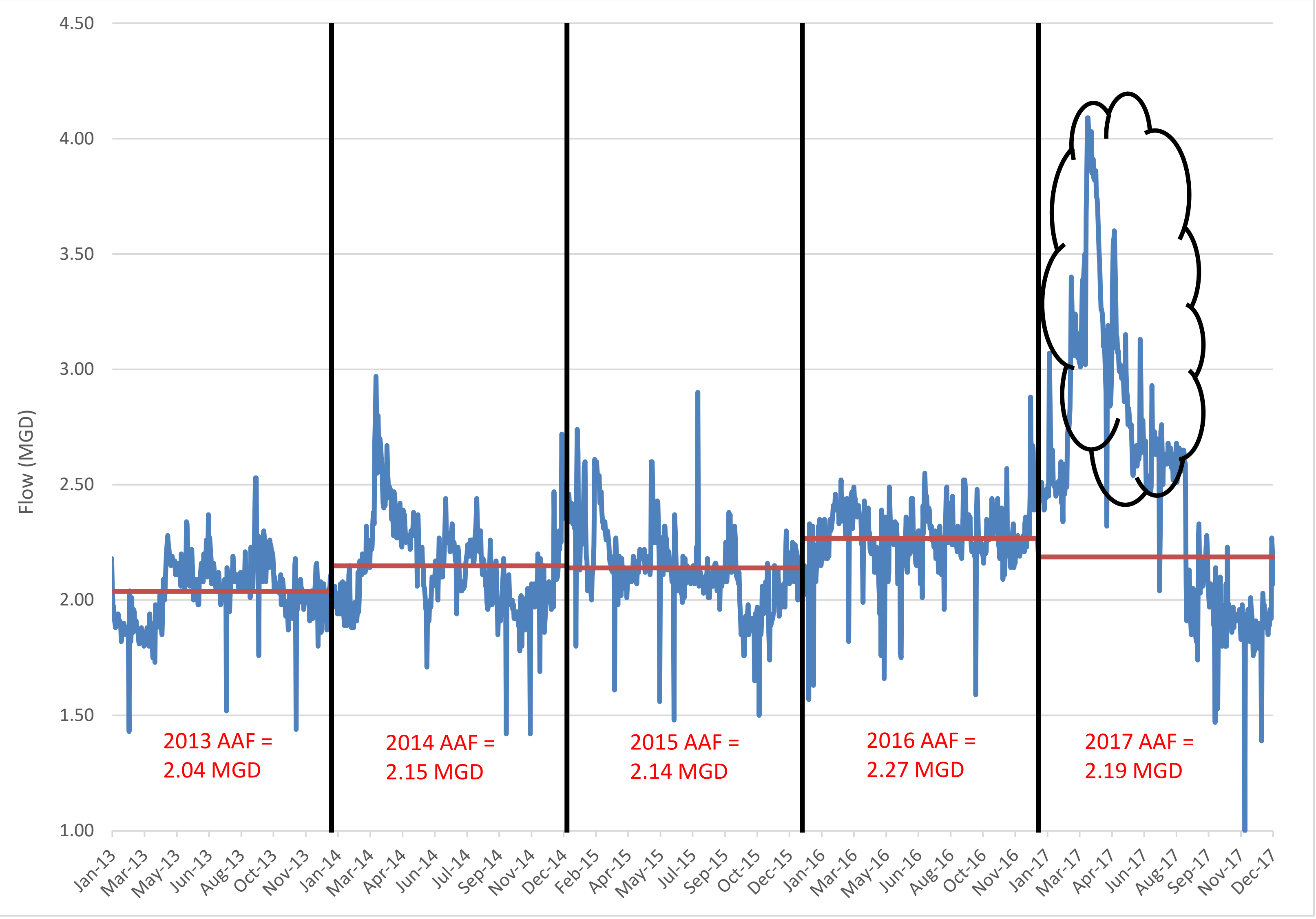
- WWTRRF flows in the first half of 2017 are higher than any other six-month span in the evaluation period. Discussions with WWTRRF staff indicate the higher than average flows during this period are the result of an infiltration/inflow issue associated with the wastewater system for the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) that has been resolved.

5.5 Current Wastewater Flows

5.5.1 Daily Flow Analysis

Daily flow from January 2013 to December 2017 was plotted to review trends and is shown on Figure 5-1 on the following page. Along with daily flow, the graph shows average yearly flows. As shown, early 2017 flows are considerably higher than previous years, while 2013 to 2014 flows are trending logically with 2008 Design Flows. Therefore, the first half of 2017 was not included in the Evaluation Period.

Figure 5-1
Daily Flow (January 2013 to December 2017)



5.5.2 Current WWTRRF Average Annual, Wet, and Dry Season Flows

Current annual, summer (dry) season, and winter (wet) season Pendleton WWTRRF flows and annual rainfall are summarized in **Table 5-2**. Flow data were analyzed from 2013 through May 2017 to represent full range of dry and wet weather seasons observed at the WWTRRF.

Based on the information in **Table 5-2**, the current AAF, ADWF and AWWF for the Pendleton WWTRRF are **2.15 million gallons per day (MGD)**, **2.14 MGD** and **2.15 MGD**, respectively. This is in comparison to the estimated sewer system average dry weather flow of 2.8 MGD per the 2015 City of Pendleton Collection System Master Plan.

Table 5-2
City of Pendleton 2013-2017 Rain and Flow History

Season	Year	Rainfall (inches)	Average Flow (MGD)
Annual	2013	9.28	2.04
	2014	13.42	2.15
	2015	10.09	2.14
	2016	13.44	2.27
	2017	16.35	2.19
	Average[1] (2013-2017)	**2.15**	
Dry Weather (May 1 - Oct 31)	2013	4.96	2.11
	2014	3.50	2.11
	2015	3.50	2.10
	2016	5.97	2.26
	2017	5.49	2.25
	Average[1] (2013-2017)	**2.14**	
Wet Weather (Nov 1 - Apr 30)	2013-14	7.29	2.15
	2014-15	7.23	2.19
	2015-16	7.73	2.19
	2016-17	11.28	2.18
	Average[1] (2013-2017)	**2.15**	

Note:
Average of the daily flow for each period during the four-year period.

5.5.3 Current WWTRRF Maximum Monthly Flows

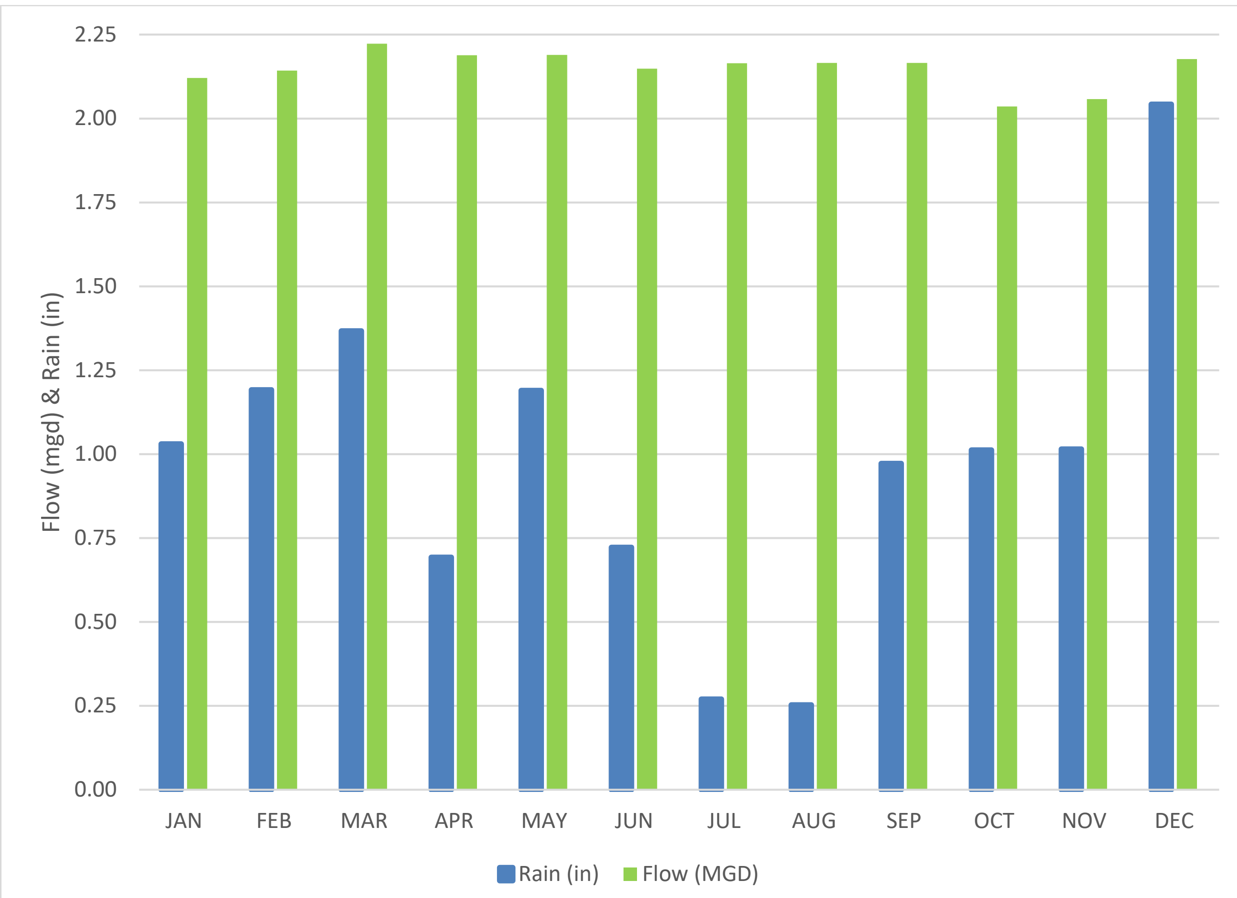
DEQ guidelines developed for Western Oregon suggest a method to calculate maximum month flows for wet and dry seasons based on the probability of exceeding a particular design storm event. Current maximum monthly flows for the winter and summer seasons were then estimated as summarized in the Definitions for Maximum Month Dry Weather Flow and Maximum Month Wet Weather Flow. The summer and winter seasons in the City's National Pollutant Discharge Elimination System (NPDES) Permit correspond to the dry and wet seasons, respectively.

5.5.3.1 Maximum Month Dry Weather Flow

DEQ guidelines suggest that MMDWF is to be calculated by correlating rainfall and observed plant data. However, Pendleton WWTRRF flows during the summer (dry) season are relatively stable compared with the winter (wet) season.

Figure 5-2 summarizes observed monthly average WWTRRF flows and rainfall from 2013 through 2017, along with historical average rainfall. As shown, average monthly flows to the Pendleton WWTRRF are relatively consistent throughout the year, even though rainfall is typically lower in the dry season. This could be the result of a well-maintained wastewater collection system, low groundwater impacts on collection system flows, or irrigation during the summer months.

Figure 5-2
Pendleton Average WWTRRF Flow vs. Average Monthly Precipitation 2013-2017

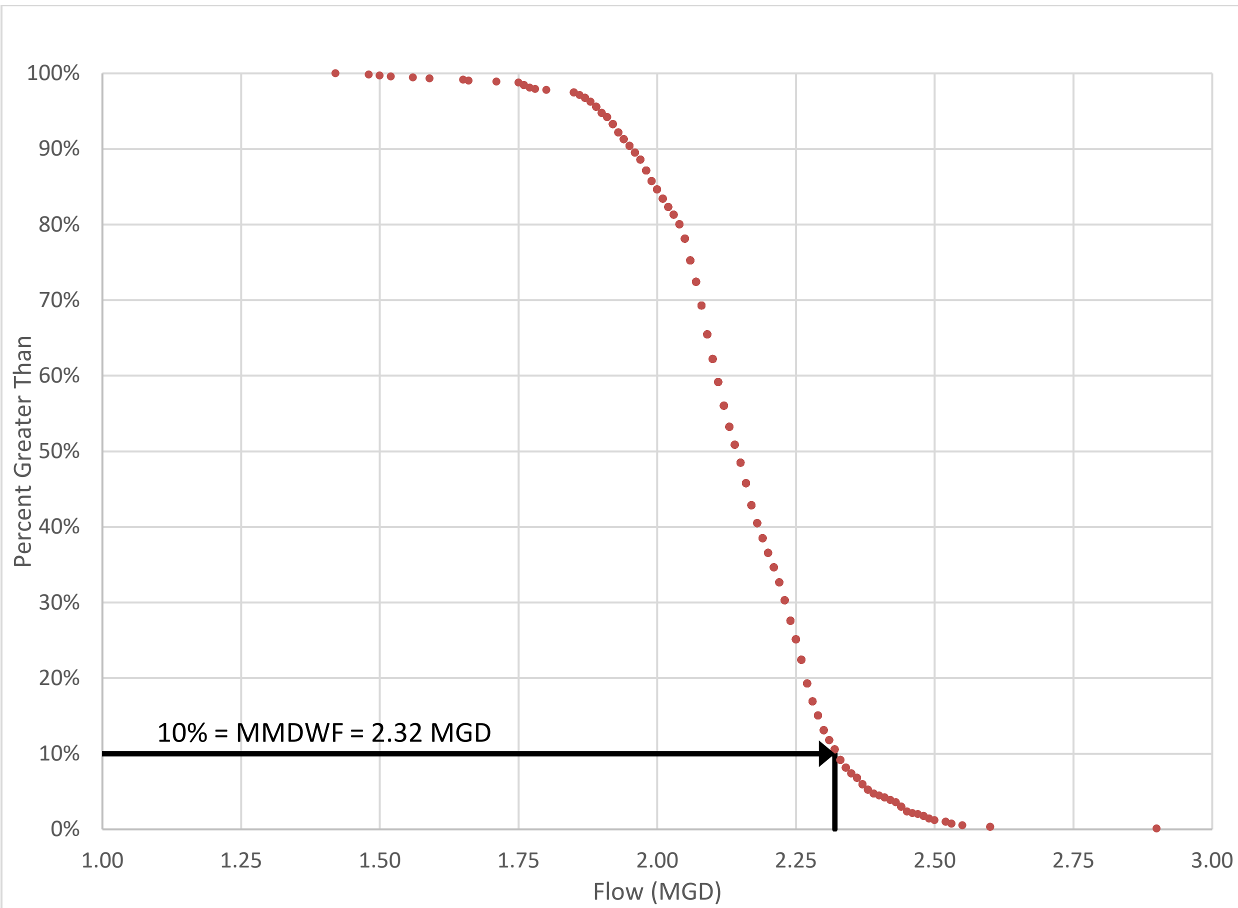


DEQ Guidelines that were developed for making WWTRRF flow projections in Western Oregon will not accurately predict summer (dry) season flows for the Pendleton WWTRRF, and an alternate methodology for estimating the current MMDWF is proposed.

WWTRRF summer (dry) season flows during the Evaluation Period were tabulated and sorted from highest to lowest flow and the events were ranked according to the percentage of monthly dry weather flow events greater than the individual event. The percentile of each event was then plotted versus plant flow. Using DEQ definitions regarding plant reliability for the summer (dry) season, the flow event with a ten percent exceedance probability based on the rankings was selected as the current MMDWF. **Figure 5-3** is a graph of the actual plant flow events sorted and plotted against percentile of flow events greater.

Based on this alternate methodology, the current MMDWF for the Pendleton WWTRRF is **2.32 MGD**.

Figure 5-3
Pendleton WWTRRF Dry Weather Flow vs. Ranked Flow Percentile

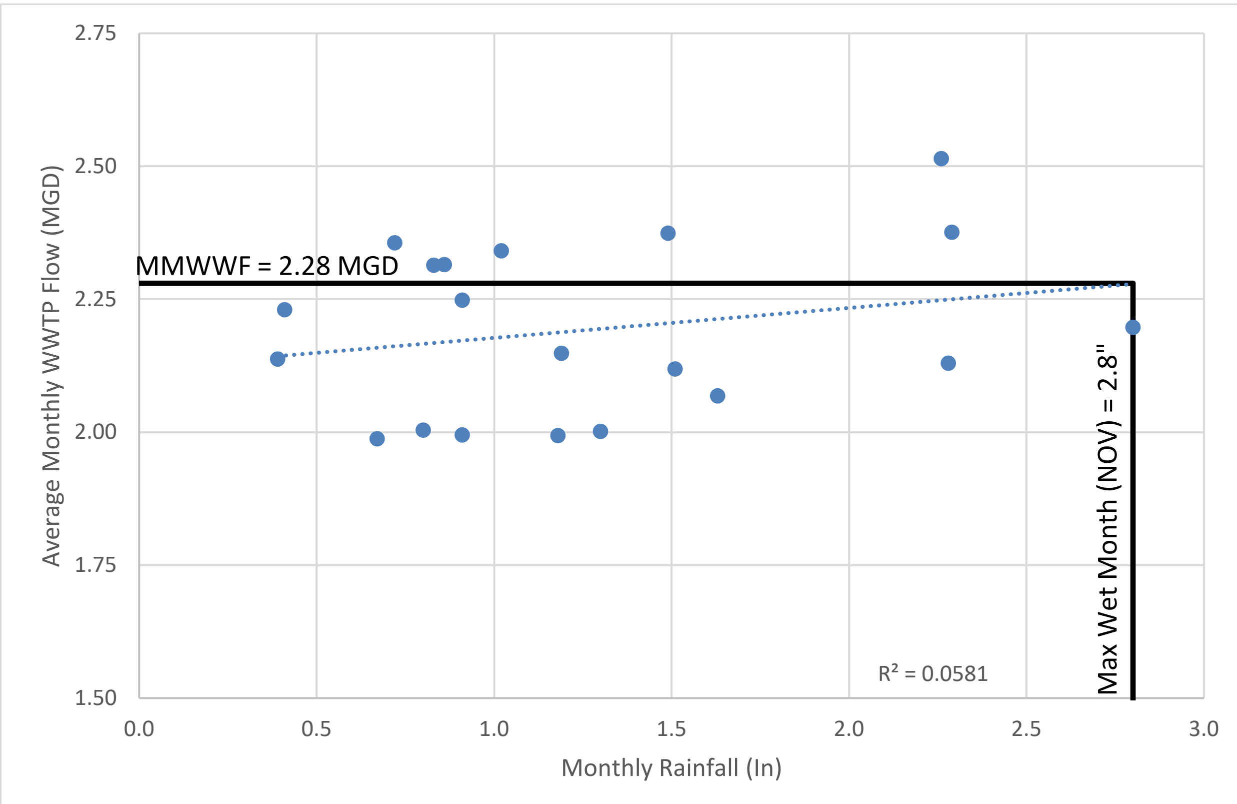


5.5.3.2 Maximum Month Wet Weather Flow

Current MMWWF was estimated following DEQ Guidelines by plotting monthly WWTRRF flows from 2013 through 2017 versus monthly rainfall. A statistical trendline was then developed based on the scatter plot and the design flow was calculated based on the trendline equation and the monthly average rainfall for the winter (wet) season from May 1 through October 31.

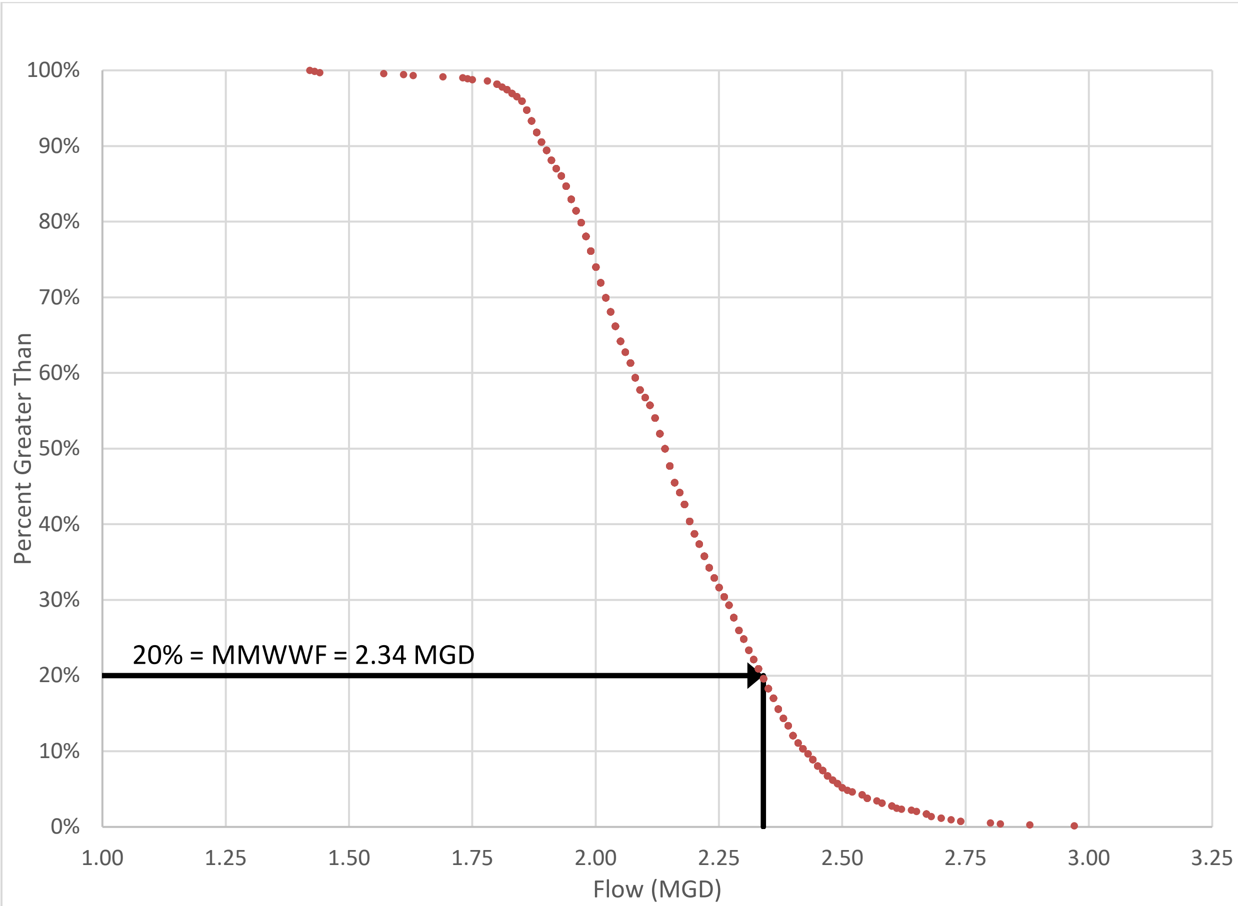
Figure 5-4 is a graph of the WWTRRF winter (wet) season monthly average daily flow versus rainfall. The maximum monthly winter (wet) season rainfall quantity for the City of Pendleton used to estimate the MMWWF is 2.8 inches for the month of November, which was the maximum monthly accumulation in the Evaluation Period. Based on this evaluation, the current MMWWF for the Pendleton WWTRRF is 2.28 MGD.

Figure 5-4
Pendleton WWTRRF Wet Weather Flow vs. Monthly Precipitation



As a means of verifying the reliability of the alternative methodology used for estimating the MMDWF, the same procedure recommended for determining the MMDWF by ranking maximum monthly flows was used to estimate and confirm the estimated MMWWF. **Figure 5-5** is a graph of winter (wet) season flow events sorted and plotted versus percentile of flow events greater.

Figure 5-5
Pendleton WWTRRF MMWWF vs. Ranked Flow Percentile



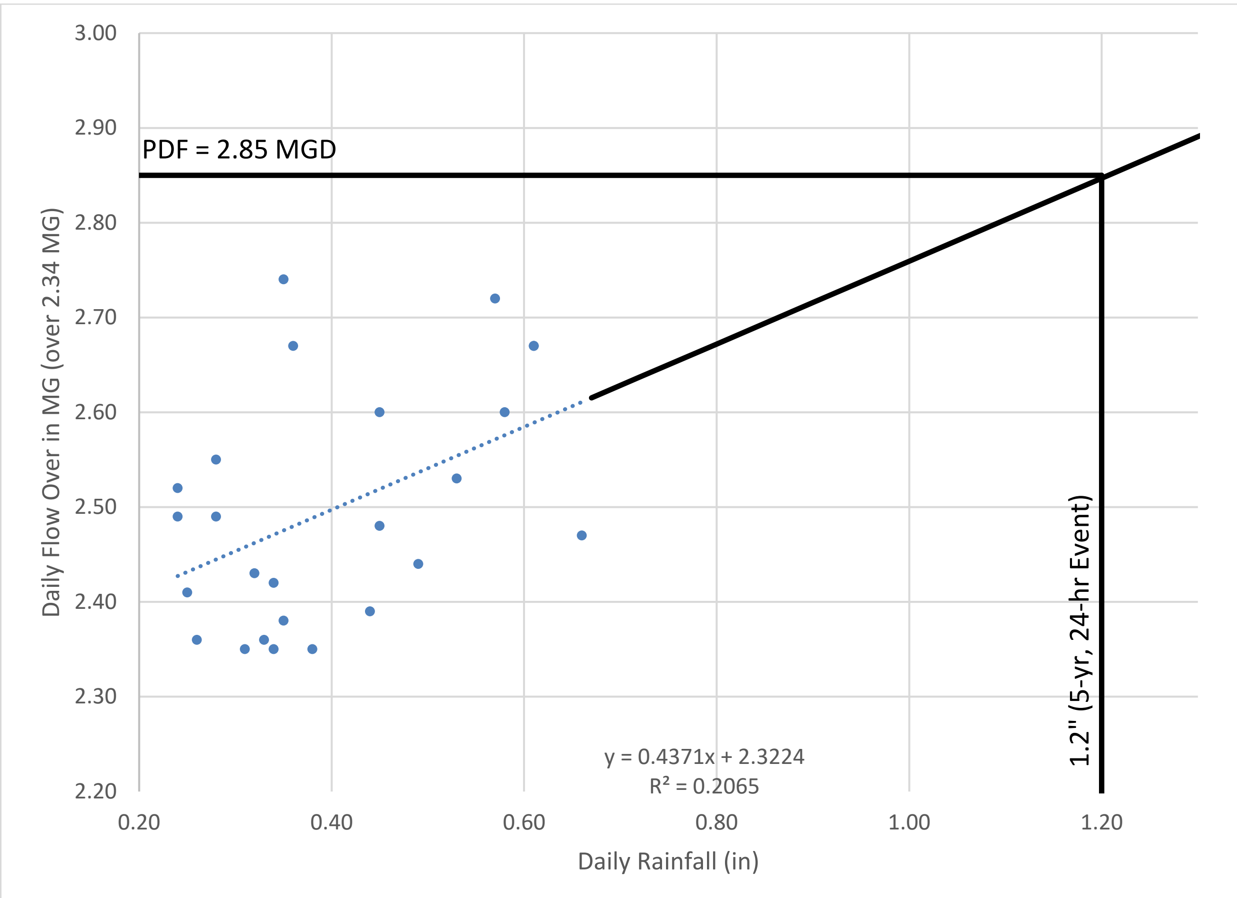
Based on this methodology the MMWWF based on the 20 percent winter (wet) season reliability criteria is estimated to be 2.34 MGD. This is close to the MMWWF of 2.28 MGD estimated using DEQ Guidelines. Because the alternate methodology for estimating MMWWF produced a result almost 3 percent greater than using the DEQ method, the more conservative alternative method for projecting MMDWF is used. Therefore, the estimated current MMWWF for the Pendleton WWTRRF is **2.34 MGD**.

5.5.4 Current WWTRRF Peak Daily Average Flow

The current Pendleton WWTRRF PDAF was estimated by evaluating WWTRRF peak flows and rainfall events during the Evaluation Period. The peak rainfall event used to estimate the current WWTRRF PDAF was 1.2 inches, which is the annual 5-year return, 24-hour rainfall event for the City of Pendleton from Oregon NOAA Atlas 2 rainfall isopluvial maps.

To review historical data, the current WWTRRF PDAF was estimated by plotting WWTRRF flows of greater than 2.34 MGD (MMWWF) and periods with rainfall greater than 0.23 inches. **Figure 5-6** is a graph of Pendleton WWTRRF peak flow events meeting these criteria from 2013 through 2017. Based upon the evaluation, the estimated current Pendleton WWTRRF PDAF is **2.85 MGD**.

Figure 5-6
Pendleton WWTRRF Peak Flow Events vs. Daily Precipitation



5.5.5 Current WWTRRF Peak Instantaneous Flow

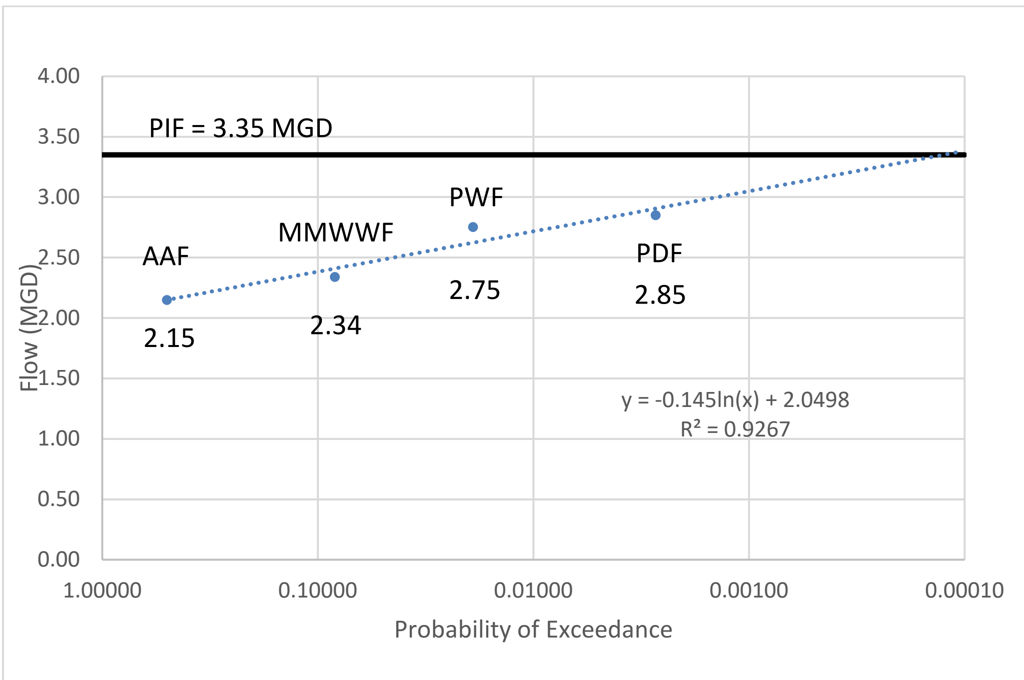
Current PIF was estimated using the statistical probability procedure specified in the DEQ Guidelines. The procedure is an analytical evaluation assuming certain exceedance probabilities for design flow events:

- The exceedance probability for the AAF is 50 percent. The AAF used to determine the current PIF was 2.15 MGD.
- The exceedance probability for the MMWWF is 8.3 percent. The MMWWF used to determine the current PIF was 2.34 MGD.
- The exceedance probability for the PWF is 1.9 percent. The PWF used to determine the current PIF was 2.75 MGD.

- The exceedance probability for the PDF is 0.27 percent. The PDF used to determine the current PIF was 2.85 MGD.
- The exceedance probability for the PIF is 0.011 percent.

Figure 5-7 is a probability chart used to estimate the current PIF. The AAF, MMWWF, PWF, and PDF were plotted, and the current PIF was estimated by extrapolation. Based on the evaluation, the current PIF for the Pendleton WWTRRF is **3.35 MGD**. The current PIF is less than the 2008 Design PIF of 3.95 MGD because the City has successfully addressed I/I problems.

Figure 5-7
Pendleton WWTRRF Flow vs. Event Probability



5.5.6 Projected WWTRRF Flows

Per capita flow contributions and peaking factors for current design WWTRRF flow events and the estimated 2017 population of 16,890 are summarized in **Table 5-3**. Per capita flow factors were also developed. The PDF/AAF and PIF/AAF peaking factors are 1.33 and 1.56, respectively.

Table 5-3
Per Capita Flow Contributions for Design Flow Events

Flow Event	Current Flow (MGD)	Peaking Factor	Per Capita Flow (gpcpd)
AAF	2.15	1.00	127
ADWF	2.14	1.00	127
AWWF	2.15	1.00	127
MMDWF	2.32	1.08	137
MMWWF	2.34	1.09	139
PWF	2.75	1.28	163
PDF	2.85	1.33	169
PIF	3.35	1.56	198

Note:
gpcpd = gallons per capita per day

The PDF/AAF and PIF/AAF peaking factors are lower than typically expected for an older wastewater collection system. Potential explanations for the lower than typical peaking factors may include:

- The existing collection system was well constructed and has been well maintained over time, resulting in low infiltration and inflow (I/I);
- I/I that does enter the system is relatively consistent due to rain events in the winter season and irrigation practices in the summer season. This results in a more uniform flow across the year and dampens the peaking events; and
- Storm events in Pendleton are typically short duration, high intensity storms, resulting in events that produce high volumes of surface runoff and lower infiltration.

Current per capita flow factors are used to project estimated future flows. Future population projections have been multiplied with the per capita flow factors to develop estimates of future flow events in 5-year increments as presented below in **Table 5-4**.

Table 5-4
Future Projected Flows (MGD)

Flow Event	2017	2020	2025	2030	2035	2040
ADWF	2.14	2.51	2.78	2.91	3.05	3.18
AAF	2.15	2.51	2.79	2.92	3.05	3.18
AWWF	2.15	2.51	2.79	2.92	3.06	3.19
MMDWF	2.32	2.71	3.01	3.15	3.29	3.44
MMWWF	2.34	2.73	3.04	3.18	3.32	3.47
PWF	2.75	3.21	3.57	3.74	3.91	4.08
PDF	2.85	3.33	3.70	3.87	4.05	4.22
PIF	3.35	3.91	4.35	4.55	4.76	4.96

5.6 Wastewater BOD and TSS Loads

Like the current flow estimation methodology, WWTRRF DMRs were analyzed for the Evaluation Period for monthly average and maximum month influent BOD_5 and TSS concentrations and mass loads. The calculated average and maximum monthly loads were divided by the 2017 population of 16,890 people to establish population loading factors for the Pendleton WWTRRF. **Table 5-5** summarizes the seasonal average and maximum monthly concentrations, loads, and population loading factors.

As shown in **Table 5-5**, average BOD_5 concentrations are approximately 245 milligrams per liter (mg/L) for the summer and 232 mg/L for the winter season, whereas current average monthly TSS concentrations are approximately 243 mg/L in the summer and 220 mg/L in the winter.

Table 5-5
Current BOD_5 and TSS Loads

Parameter	2017 Population	Monthly Average			Maximum Monthly Average		
		Concentration (mg/L)	Load (ppd)	Load Factor (ppcd)	Concentration (mg/l)	Load (ppd)	Load Factor (ppcd)
Summer Season (May 1 through October 31)							
BOD_5	16,890	245	4,398	0.260	275	4,861	0.288
TSS	16,890	243	4,357	0.258	278	5,275	0.313
Winter Season (November 1 through April 30)							
BOD_5	16,890	232	4,158	0.246	259	4,570	0.271
TSS	16,890	220	3,926	0.233	255	4,471	0.265

Notes:
ppd = pounds per day
ppcd = pounds per capita per day

Population loading factors developed in **Table 5-5** were used in conjunction with estimated population projections for 2040 to estimate future BOD and TSS loads. These projected loads were converted to average and maximum monthly concentrations by using the projected 2040 ADWF and AWWF. **Table 5-6** presents the 2040 BOD and TSS loading projections for the summer (dry) and winter (wet) weather seasons.

Table 5-6
2040 BOD and TSS Loading Projections

Parameter	2040 Population	Flow (MGD)	Monthly Average		Monthly Maximum	
			Load Factor (ppcd)	Load (ppd)	Load Factor (ppcd)	Load (ppd)
Summer Season (May 1 through October 31)						
BOD_5	25,006	3.18	0.260	6,511	0.288	7,197
TSS	25,006	3.18	0.258	6,451	0.312	7,810
Winter Season (November 1 through April 30)						
BOD_5	25,006	3.19	0.246	6,155	0.271	6,766
TSS	25,006	3.19	0.232	5,812	0.265	6,620

Table 5-7 and **Table 5-8** present the future BOD and TSS summer season and winter season loading projections respectively throughout the design life of the facility.

Table 5-7
Future BOD & TSS Summer Season Loading Projections

Year	Population	BOD Load (ppd)		TSS Load (ppd)	
		Monthly Avg	Monthly Max	Monthly Avg	Monthly Max
Summer Season (May 1 through October 31)					
2017	16,890	4,398	4,861	4,357	5,275
2020	19,716	5,134	5,675	5,086	6,158
2025	21,897	5,702	6,302	5,649	6,839
2030	22,933	5,971	6,601	5,916	7,163
2035	23,970	6,241	6,899	6,184	7,487
2040	25,006	6,511	7,197	6,451	7,810

Table 5-8
Future BOD & TSS Winter Season Loading Projections

Year	Population	BOD Load (ppd)		TSS Load (ppd)	
		Monthly Avg	Monthly Max	Monthly Avg	Monthly Max
Winter Season (November 1 through April 30)					
2017	16,890	4,158	4,570	3,926	4,471
2020	19,716	4,853	5,335	4,582	5,219
2025	21,897	5,390	5,925	5,089	5,797
2030	22,933	5,645	6,205	5,330	6,071
2035	23,970	5,900	6,486	5,571	6,345
2040	25,006	6,155	6,766	5,812	6,620

5.7 WWTRRF Wastewater Characterization

WWTRRF staff completed a sampling and testing program to characterize plant influent. These data were used for process design and modeling of alternatives to keep up with regulatory requirements. **Table 5-9** contains a summary of the sampling and testing program used to develop in-plant influent water quality characteristics.

Table 5-9
Wastewater Water Quality Characteristics Sampling

Location	Parameters Sampled
Raw Influent	Total COD, CBOD, TSS, VSS, NH_3-N, NO_3-N, TKN, Total-P, Ortho-P, Alkalinity, pH

A summary of minimum, maximum and average concentrations for samples collected and tested from July 2017 through April 2018 are included in **Table 5-10** below.

Table 5-10
Wastewater Water Quality Characteristics

Parameter	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)	Average Concentration (mg/L)
Raw Influent (15 Samples)			
Total COD	407	652	537
Filtered COD	118	190	165.27
Flocculated and Filtered COD	60.3	144	115.67
CBOD	145	236	198.85
Filtered CBOD	58.2	81	64.86
TSS	175	309	236.87
VSS	79.9	242.97	88.3
NH_3-N	20.8	43.9	32.37
NO_3-N	0.57	1.9	1.25
TKN	27.2	49	39.8
Total-P	6.18	15.2	8.92
Ortho-P	3.19	9.77	5.37
Alkalinity	144	232	202.86
pH	7.35	7.61	7.47
Dissolved Oxygen	1.79	4.87	3.63

Section 6

Section 6

Existing WWTRRF Evaluation

6.1 Introduction

This section summarizes the existing condition of the City of Pendleton's (City) Wastewater Treatment and Resource Recovery Facility (WWTRRF), including recommendations for necessary upgrades to keep the plant in good working order. Murraysmith performed an on-site evaluation of the major unit processes to identify specific areas for improvements, which are summarized in the sections to follow. The WWTRRF handles domestic, commercial, and industrial wastewater flows from the incorporated areas of the City, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), the community of Reith, and the area surrounding the Pendleton airport.

This memorandum includes:

- Existing WWTRRF components
- WWTRRF Condition Assessment Recommendations
- Unit Process Capacity Evaluation
- Summary of Recommended Improvements

The Preliminary List of Recommended Improvements is included in **Appendix G** for reference and includes upgrades identified in the condition assessment to maintain facility performance and simplify operations. The improvements were grouped into cost ranges and identified as Operations and Maintenance (O&M), Capital Improvements (CIP), and To Be Determined (TBD) projects. Below **Table 6-1** shows the cost ranges for the improvements.

Table 6-1
Improvement Cost Range

Group	Range ($)	Project Type
A	<5,000	O&M
B	5,000 to 25,000	O&M
C	25,000 to 50,000	TBD
D	50,000 to 100,000	TBD
E	>100,000	CIP

Improvements identified in the A and B cost ranges are smaller O&M projects that could potentially be completed by City staff. The total for O&M projects is approximately $4.4M, or approximately $220,000 per year for the 20-year planning period.

Improvements classified in the C and D cost ranges fall between O&M and CIP type projects. The total for the TBD projects is approximately $2.6 million, and the Recommended Plan addresses as many of these as possible.

Improvements listed in the E cost range are larger CIP type projects that are expected to be in the Recommended Plan. The CIP projects identified include the following:

- Major structural renovations of the Secondary Clarifier East
- Major renovations of the Secondary Digester Complex, including possible expansion
- Addition of digester gas storage and Cogeneration improvements
- Possible addition of an alternate disinfection method
- Major structural renovations of the Chlorine Contact Chamber
- New automatic site entrance gate
- Addition of a new building to house chemicals stored all over the site
- Expand Main Shop for parts storage and relocated Welding Shop
- Update plantwide Supervisory Control and Data Acquisition (SCADA) system

6.2 Existing Wastewater Collection System

The City adopted a Collection System Master Plan in May 2015, which was prepared by Murraysmith. This plan comprehensively describes the existing collection system including the condition, capacity and recommended improvements.

6.3 Existing Wastewater Treatment Plant

The WWTRRF is located in the western portion of the city near the convergence of McKay Creek and the Umatilla River. City records show that the plant was originally constructed around 1948, and was upgraded in the 1960s, early 1970s, 1999 (drying beds), 2002 (administration building), 2007 (solar array) and 2011. The 1970 upgrade was constructed to increase the WWTRRF's capacity to 16.3 million gallons per day (MGD). However, shortly after the upgrade, several industrial discharges left the City, and influent flows never reached the new plant capacity.

In 2011, a more comprehensive upgrade improved existing equipment and added additional features to increasing the plant's efficiency. The existing grit building was converted into a headworks electrical building. A new headworks building, and grit chamber were constructed. The primary solids handling system was also upgraded. The East primary clarifier was improved with a new influent well, rake blade, scum collection arms, and walkway. Cogeneration equipment and a solar array were installed to reduce energy usage for plant operation. A new aeration basin structure was constructed along with an MBR building. A secondary process building was constructed. This houses blower equipment to provide air to the aeration basin, and electrical equipment critical to plant operation. Both secondary clarifiers' scum systems were upgraded. The existing chlorine contact chamber was upgraded with partitions in the North train to increase residence time within the chamber, and an adjacent dichlorination building was built, which houses dichlorination chemicals, pumps, and a part of the utility water loop. A dewatering facility was built to process solids.

The plant currently treats an average annual flow (AAF) of 2.15 MGD. The projected peak instantaneous flow (PIF) for design year 2040 is 4.96 MGD. Current and projected design flows are summarized in the Flow and Load Projections Technical Memorandum. Based on current flow projections for the planning phase, the WWTRRF's has more capacity than necessary. The following sections detail each unit process and make recommendations for keeping the facility in good working order, optimizing performance and improving operations and maintenance.

A discussion of the major WWTRRF components are summarized below and described in detail in the sections that follow.

- **General Electrical:** Service Entrance, Generator, and Switchgear
- **General Site:** Yard Piping, Septage Receiving, and Site Security
- **Preliminary Treatment:** Headworks, Influent Screening, and Grit Removal
- **Primary Treatment:** Primary Clarifiers and In-Plant Pump Station
- **Secondary Treatment:** Aeration Basins and Secondary Clarifiers
- **Disinfection and Outfall:** Disinfection System, Chlorine Contact Chamber and Outfall
- **Solids Treatment:** Primary Digester, Secondary Digester, Sludge Pumping, Dewatering, and Sludge Drying Beds
- **Miscellaneous Site Utility Systems:** Hot Water System, Utility Water System, and Cogeneration System
- **Miscellaneous Site Buildings:** Administration/Lab, Welding and Parts Shop, Main Shop, Machine Shed, Lawn Equipment Shed, and Chemical Storage Building

The Existing WWTRRF Site Plan is shown by **Figure 6-1**, and the Existing Process Schematic is shown by **Figure 6-2**.

See **Table 6-2**, below, for a summary of WWTRRF design criteria.

Table 6-2
Design Criteria

System	Data/Type
Preliminary Treatment	
Fine Screens	
Type	Rotary Drum
Quantity	2
Opening	2mm
Capacity (Each)	6.5 MGD
Water Demand (Each)	17 GPM
Influent Flow Measurement	
Type	Parshall Flume w/Ultrasonic Flow Meter
Quantity	1
Throat Width	12-inch
Maximum Capacity	10.4 MGD
Primary Treatment	
Primary Clarifiers	
Quantity	2
Diameter	90 Feet
Sidewater Depth	8.6 Feet
Volume (Each)	0.41 MG
Total Surface Area	12,717 SF
Total Weir Length	565 Feet
Capacity (Each)	9.5 MGD
In-Plant Pump Station	
Pump Type	Submersible
Quantity	3
Motor HP	50
Design Point	3.6 MGD @ 49’ TDH
Minimum Capacity	1.0 MGD @ 30’ TDH
Firm Capacity	5.8 MGD @ 57’ TDH
Secondary Treatment	
Basin Flow Control	
Type	Parshall Flume w/Ultrasonic Flow Meter
Quantity	3
Throat Width	9-inches
Maximum Capacity (Each)	5.7 MGD
Aeration Basin	
Number of Trains	3
Basin Volume	1.4 MG
Average Sidewater Depth	22 Feet
Process Blowers	
Type	K Turbo Air Blower
Quantity	3
HP (Each)	125
Capacity (Each)	1200 SCFM

System	Data/Type
Type	Aerzen Air Blower
Quantity	1
HP	50
Capacity	1270 SCFM
Secondary Clarifiers	
Quantity	2
Diameter	115 Feet
Depth	11 Feet
Volume (Each)	0.80 MG
Total Surface Area	20760 SF
Total Weir Length	722 Feet
RAS Pump Station	
Pump Type	Submersible
Quantity	3
HP (Each)	50
Design Point	3.6 MGD @ 50' TDH
Minimum System Capacity	1.0 MGD @ 31' TDH
Firm System Capacity	5.5 MGD @ 49'TDH
Underground Pump Station (WAS)	
Waste Pump Type	Centrifugal
Quantity	1
HP	3
Capacity	250 GPM
Solids Transfer Pump Type	Positive Displacement
Control	Constant Speed
Quantity	1
HP	10
Capacity	85 GPM
Disinfection	
Chlorine Contact Chamber	
Trains	2
South Train	
Length to Width Ratio	4.8
Water Depth	8 Feet
Volume	34,800 CF
Volume	0.26 MG
North Train	
Length to Width Ratio Per Train	46.1
Water Depth	8 Feet
Volume	33,000 CF
Volume	0.25 MG
Chlorine Gas	
Quantity of Storage Tanks	10
Capacity (Each)	150 LB
Chlorinators	
Number	2

System	Data/Type
Type	Vacuum w/ Carrier Water
Capacity	100 LB/DAY
Calcium Thiosulfate	
Bulk Storage Tank Volume	5,700 GAL
Pump Type	Diaphragm
Pump Quantity	2
Pump Capacity	5.5 GPH @ 150 PSI
Solids Treatment	
Primary Digester	
Quantity	1
Diameter	56 Feet
Depth	28.5 Feet
Volume	0.52 MG
Detention Time @ Avg. Daily Sludge Production	32 Days
Plant Sludge Pump	
Quantity	1
Type	Rotary Lobe
Motor HP	7.5
Design Point	50 GPM @ 40 FT TDH
Primary Digester Sludge Recirculation Pump	
Quantity	1
Type	Screw Centrifugal
Motor HP	5
Design Point	260 GPM @ 22 FT TDH
Primary Mixing Pump	
Type	Screw Centrifugal
Quantity	1
Motor HP	25
Design Point	3200 GPM @ 13 FT TDH
Primary Sludge Pump East	
Quantity	1
Type	Positive Displacement (Piston)
HP	3
Capacity	85 GPM @ 80 FT TDH
Primary Sludge Pump West	
Quantity	1
Type	Positive Displacement (Disk)
HP	5
Capacity	127 GPM
FOG System	
Rock Trap Design Flow	300 GPM
Fog Receiving Pump	
Type	Chopper
Quantity	1
HP	5
Capacity	300 GPM @ 17 FT TDH

System	Data/Type
Fog Mixing Pump	
Type	Screw Centrifugal
Quantity	1
HP	5
Capacity	340 GPM @ 18 FT TDH
Secondary Digester	
Quantity	2
Diameter	45 Feet
Depth	21.5 Feet
Volume (Total)	0.45 MG
Detention Time @ Avg. Daily Sludge Production (Total)	27 Days
Secondary Digester Sludge Recirculation Pump	
Type	Screw Centrifugal
Quantity	1
Motor HP	7.5
Design Point	310 GPM @ 35 FT TDH
Dewatering Press	
Type	Screw Press
Quantity	1
Capacity	1167 Dry LBS/HR
Flow Rate	50 GPM
Min Inlet Concentration	1.3%
Min Outlet Concentration	15%
Motor HP	5
Dewatering Press Feed Pumps	
Type	Rotary Lobe
Quantity	2
Capacity	50 GPM
Drive Type	Belt
Motor HP (Each)	5
Dewatering Polymer System	
Quantity	1
Storage Tank Quantity	2
Volume	510
Motor HP	0.5
Polymer Metering Pump Range	0.3-3.0 GAL/HR
Polymer Makedown Pump Range	60 GAL/HR
Miscellaneous Site Utility Systems	
Cogeneration System	
Type	Capstone CR 65
Quantity	2
Power Generated	53 kW
Fuel Use (Each)	25 CFM
Electrical Efficiency	29%
Recoverable Heat (Each)	250 MBH

System	Data/Type
Gas Conditioning System	
Design Gas Flow Range	17-50 SCFM
Design Gas Hydrogen Sulfide Content	2000 PPMV
Design Gas Siloxane Content (All Species)	1400 PPBV
Min Gas Pressure at Discharge	90 PSIG
Max Gas Pressure at Discharge	95 PSIG
Hot Water Pumps	
Quantity	2
Type	Centrifugal
Motor HP	3
Design Point	125 GPM @ 68 FT TDH
Primary Boiler	
Quantity	1
Type	Indirect Fire
Fuel Type	Natural Gas
Capacity (Output)	850 MBH
Hot Water Flow Rate	55 GPM
Hot Water Loop Design Temperature	140 F
Utility Water Pumps	
Quantity	3
Type	End Suction Centrifugal
Firm Capacity	185 GPM @ 330 FT TDH
Pump Range (Each)	25-200 GPM
Motor HP (Each)	25
Bladder Tank	
Number	1
Volume	200 GAL

6.3.1 Existing WWTRRF Condition Evaluation

A team of Murraysmith engineers visited the WWTRRF to conduct an assessment of existing conditions on September 19 and 20, 2017. The group broke into teams to extensively investigate the liquids stream, solids handling, electrical equipment, and select structural components throughout the plant. The teams walked the plant to ascertain manufacturing information, operational data, and condition of mechanical equipment. During the first site visit, the primary clarifier east, secondary clarifier west, and the south train of the chlorine contact chamber were drained.

Peterson Structural Engineers (PSE) were also on-site for the two-day evaluation. They inspected several structures and gathered information on the facility's as-built conditions. Structures assessed include the primary and secondary clarifiers, chlorine contact chamber, primary digester, and north secondary digester. PSE prepared a Condition Assessment Technical Memorandum that is included in **Appendix H** and includes existing conditions of the inspected structures along with recommended improvements and items that require further investigation.

Murraysmith and PSE returned for a second site visit on 18 October 2017 to finalize the condition assessment. At the time of the second site visit, the primary clarifier west, secondary clarifier east, and the north train of the chlorine contact chamber were drained. The secondary digester north had also been cleaned, so the interior could be inspected. After both trips, the team inspected the interior of all original liquid-holding structures except the secondary digester south and primary digester. Due to current operations, these structures could not be drained for inspection.

Condition assessment field notes and photos were collected electronically and are included in **Appendix I** for reference. Information gathered from the assessment was used to develop a list of recommended improvements needed to keep the facility in good working order, optimize performance and improve operations and maintenance.

The following sections include a summary of WWTRRF unit processes, their condition and recommendations for improvements.

6.3.2 General Electrical

The facility is served by a 480-volt, 3-phase, 4-wire electrical power distribution system. The incoming service and main switchgear were upgraded in 2011 and is located outside the secondary process building on the east wall at ground level. The facility power distribution system consists of the utility service entrance, standby generator, automatic transfer switch, metering, main distribution switchgear, motor control centers (MCC), 480-volt power panels, lighting transformers and 120/208-volt lighting panels. Apart from the electrical equipment in the digester building most of the power distribution equipment downstream of the main switchgear was upgraded in 2011. Further descriptions, assessments and recommendations for the facility electrical equipment follow below and in subsequent sections.

6.3.2.1.1 Condition Assessment and Recommendations – General Electrical

The addition of power meters to the MCCs installed with the 2011 upgrades should be considered so that plant staff can track power usage to determine potential problem areas.

6.3.2.2 Utility Service Entrance

The utility service entrance is owned and was provided by the local serving electrical utility company, PacifiCorp. Electrical power service to the facility is provided from a 12,470-volt, 3 phase overhead distribution line running on the north side of the facility. The service drop conductors run down a power pole adjacent to the gravel drive next to the fence line adjacent to the secondary process building area. The service drop conductors continue underground from the power pole to a 750 kilo-volt-ampere (KVA) pad mounted transformer on facility property. The utility owned 750 KVA transformer steps the 12.47 Kilo-volt (KV) transmission primary voltage down to 480-volt secondary utilization voltage for the facility. The utility service entrance conductors continue underground from the pad mounted transformer to the main circuit breaker in the switchgear. The utility revenue metering equipment is located on the 480-volt service entrance conductors in a switchgear metering bus section just ahead of the main circuit breaker.

The utility service entrance equipment is owned and maintained by PacifiCorp. The switchgear metering bus section is owned by the City.

6.3.2.2.1 Condition Assessment and Recommendations – Utility Service Entrance

The utility service entrance equipment was installed in 2011 and is in good condition. It is still within the first trimester of its 25-30 expected lifespan. No upgrade is recommended at this time due to the condition or serviceability of the equipment.

The 2500 ampere rated main switchgear has the capacity for future growth to 2000 KVA.

It is recommended that the utility service entrance equipment be maintained by the utility in accordance with their preventive maintenance standards.

The City owned switchgear metering bus section is due for 5-year testing and maintenance in accordance with ANSI/NETA MTS-2015 *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems*. It is recommended that the 5-year maintenance be performed by a NETA certified testing contractor.

6.3.2.3 Generator and Automatic Transfer Switch

Standby emergency power is supplied by a 1,000 kilowatt (KW) diesel engine-generator. It is in a sound attenuated, weather-resistant, walk-in enclosure located north of the utility transformer and secondary process building. The standby generator was installed in 2011 with the facility upgrades. The standby generator has a 1600 ampere power output circuit breaker and diesel fuel storage belly tank on the equipment skid. Its output is 480-volt, 3 phase, 4-wire connected to the automatic transfer switch located in the main switchgear via underground conductors connected to the standby power terminals on the automatic transfer switch.

The automatic transfer switch, (ATS), is integral to the main switchgear assembly. The ATS is 2500 ampere rated and hard bussed from its normal power connections to the switchgear main Circuit breaker. The ATS load connections are hard bussed to the switchgear feeder section horizontal bus.

The City has a contract with Caterpillar for testing and maintenance. The standby generator was load tested and maintenance was performed last in 2016.

6.3.2.3.1 Condition Assessment and Recommendations – Generator and Automatic Transfer Switch

The generator and ATS were installed in 2011 and are in good condition. They are still in their first trimester of their 25-30 year expected lifespan. No upgrades are recommended at this time due to condition or serviceability.

The 2500 ampere rated ATS has capacity for another 660 KW of standby power in parallel with the existing 1000 KW generator.

6.3.2.4 Main Switch Gear

The main switchgear is the primary power distribution center for the facility. The incoming service entrance power is distributed to various processes and buildings on the campus via feeder circuits originating from the main switchgear. The main switchgear consists of two major groups, the service entrance sections and the feeder sections. The service entrance group consists of the main circuit breaker section, metering section, solar array circuit breaker and ATS section. The service entrance group is described in detail above. The feeder group consists of sections for circuit breakers feeding MCCs and 480-volt power panels throughout the facility. There are currently nine feeder circuit breakers installed, five to MCCs, one to the administration building power panel and three spares for future use. The feeder section also has spare space for several smaller circuit breakers.

6.3.2.4.1 Condition Assessment and Recommendations – Main Switchgear

The main switchgear equipment was installed in 2011 and is in good condition. It is still within the first trimester of its 25-30 expected lifespan. No upgrade is recommended at this time due to the condition or serviceability of the equipment.

Capacity for future growth cannot be determined at this time without further data. Power monitors in the main section are not connected to the SCADA system. To determine actual plant power usage real time power trends must be evaluated. Accumulated power usage by the utility is not enough to determine actual bus loading at any given point in time. Due to the sizes of the existing utility service entrance and standby generator, the capacity of the main switchgear is underutilized, but cannot be quantified without power study data.

It is recommended that the main switchgear power monitors be upgraded if necessary and connected by data cable to the WWTRRF SCADA system and trended.

The main switchgear is due for 5-year testing and maintenance in accordance with ANSI/NETA MTS-*2015 Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems.* It is recommended that the 5-year maintenance be performed by a NETA certified testing contractor.

6.3.3 General Site

The following section describes the condition of appurtenances within the site that are not directly associated with the unit processes required for treatment. The condition of the plant's security system, yard piping, and the septage receiving station are discussed, and recommendations for improvements are made where needed.

6.3.3.1 Site Security

Plant security is currently minimal. There is a fence surrounding most of the plant, but it is not uniform in style or size, and there are gaps. The current gate is in poor condition and should be replaced. This gate must be manually unlocked in the morning and locked in the evenings. There are currently no security cameras on site.

6.3.3.1.1 Condition Assessment and Recommendations – Site Security

Based on the above assessment Murraysmith recommends the following improvements:

- Install fencing around entire site
- Install automatic entrance gate
- Install security cameras and connect to SCADA

6.3.3.2 Yard Piping

The influent gravity sewer enters the site near the entrance gate on the east side of the plant and leads to the headworks. This 36-inch gravity pipe routes wastewater from the City's collection system to the treatment plant and is under a shallow layer of gravel. Excessive traffic loading could cause damage.

A portion of the collection system flows to the 28th Street Lift Station, which is located on the west side of the plant site. Sewage is pumped through an 8-inch forcemain that connects to the 36-inch influent gravity pipe directly upstream of a manhole located east of the entrance gate.

Other yard piping spans the plant as it routes wastewater, utility water, and hot water to their respective unit processes. Yard piping is adequate, but there are some capacity issues which will be discussed in later sections related to the unit processes. One inadequacy associated with the yard piping is the inability to reroute flow from the chlorine contact chamber back to the headworks. Piping and conveyance is discussed in more detail in later sections.

6.3.3.2.1 Condition Assessment and Recommendations – Yard Piping

Based on the above assessment Murraysmith recommends the following improvements:

- Connect chlorine contact chamber to headworks by installing a pipe from the IPPS to the storm pump station

- Encase influent gravity sewer in concrete inside fence to headworks

6.3.3.3 Septage Receiving

The septage receiving station will be located adjacent to and to the northeast of the headworks building. The station is a small stainless-steel structure fitted with manual bar screens. Raw septage is unloaded from septage hauling trucks and passes through the receiving station for preliminary screening before being combined with influent flow entering the headworks.

6.3.4 Preliminary Treatment

WWTRRF preliminary treatment was upgraded in 2011 and includes fine screens, grit removal, and flow monitoring for the influent wastewater. Prior to the upgrade, raw influent entered the building from a 36-inch interceptor sewer passing through a 19 MGD comminutor through a 4-foot concrete channel. Post 2011 upgrades, the 36-inch interceptor sewer remains in service. There are two rotary drum screens currently installed and an additional flow channel for bypass is present. The bypass channel contains a 4-foot wide manual bar screen.

Once the influent has been screened, a horizontal-flow grit chamber removes grit through a circular grit collector. A grit pump transfers grit from the chamber to a grit classifier. The grit is then dumped into a container and then transported to a landfill for disposal. Headworks effluent passes through a Parshall flume with a flow meter before being routed to the primary clarifiers.

Existing conditions currently provide sufficient capacity through the headworks system to accommodate the projected flow of 4.96 MGD by 2040. While both the influent and bypass channels have a capacity of 23.2 MGD, the flow through the Parshall flume is limited by its size to 10.4 MGD. Once flows through the Parshall flume begin to approach 10 MGD, improvements should be considered.

6.3.4.1 Fine Screens

The influent screening process within the headworks building consists of two parallel rotary drum screens. These mechanical fine screens each contain a 2-millimeter perforated-plate stainless steel drum screen. Screenings are lifted by a spiral lifting screw up an auger. Within the auger, screenings are washed and dewatered prior to being dumped into an adjacent dumpster for disposal at a landfill.

The rotary drum screens have a maximum capacity of 6.5 MGD each. Currently, the screens are more than capable of handling the AAF of 2.15 MGD and future 2040 PIF of 4.96 MGD. Also, the screens have a constant water demand of 17 gallons per minute (gpm).

6.3.4.1.1 Condition Assessment and Recommendations – Fine Screens

The headworks building is still new and in good condition, although there are some upgrades that could be made to improve operations and maintenance. While the heating, ventilation, and air conditioning (HVAC) system in the building functions adequately, the air sensors to detect combustible gases is improperly placed. Currently, a sensor is located near the ceiling and close to the floor. The sensors should be moved or replaced so that it will accurately detect any combustible gas that may be present.

The maintenance area for the drum screens is not adequate, and operators have difficulties accessing the screens for cleaning and repairs. The roof of the headworks building is removeable, however there is no lifting device installed. An overhead gantry and maintenance platform on the northerly side of building may allow the operators to maneuver and maintain the equipment easier. Also, running the hot water loop to the headworks building will facilitate cleaning of the equipment and could be used for additional heating if desired.

Floor gratings within the headworks building have been damaged due to excessive loading from dumpsters and have been replaced with non-uniform materials. Operators are currently using makeshift wheeled dumpsters used to catch and dispose of screenings. The weight and wheels of the dumpsters in conjunction with the non-uniform floor gratings cause the operators significant difficulty when performing daily maintenance tasks.

Based on the above assessment, Murraysmith recommends the following improvements:

- Move or replace air sensing alarm
- Run hot water loop for heating and cleaning
- Standardize floor grating and garbage system

6.3.4.2 Grit Removal

The grit removal system is comprised of a 20-foot square concrete grit chamber with a grit collection rake, grit pump, and grit auger classifier. The floor of the grit chamber is sloped towards the center to facilitate the collection and discharge of grit from the chamber to the grit classifier equipment. The grit collection rake rotates in a 20-foot diameter path directing the material to the center of the storage chamber.

This system has a firm capacity of 7 MGD, and based on current and projected flows, it has no capacity issues.

Captured grit is pumped from the aerated grit chamber to a Raptor grit classifier by a self-priming T Series Gorman-Rupp pump within an above-ground hot box. Removed grit is washed and transported by auger through the chamber, separating larger grit particles from the smaller ones. Large, mostly inorganic grit is disposed of into a dumpster and sent to landfill. Smaller, organic grit particles are returned to the system. Approximately 2 cubic yards of grit is removed per week. This value is within the typical design range for grit removal and does not indicate any issues with the grit removal system.

6.3.4.2.1 Condition Assessment and Recommendations – Grit Removal

The currently installed grit removal system is running correctly, however, operators informed Murraysmith about issues encountered with the air release valves leaking, undersized hot box, and lowering the blower adjustment.

Based on the above assessment, Murraysmith recommends the following improvements:

- Increase size of hot box and repair valve leaks
- Replace blower for flow matching control

6.3.4.3 Influent Flow Meter and Composite Sampler

After grit removal, flow passes through a Parshall flume with an ultrasonic flow meter and is routed to the primary clarifiers. The 12-inch Parshall flume is functioning well. However, the units in which the flow rate is displayed on-screen in the field are ambiguous, requiring conversion.

The composite sampling system, located in a small shed adjacent to the Parshall flume, is in fair condition. Although it is approaching the end of its life cycle, the sampler is functioning adequately. It is recommended to revisit and reassess this equipment in the next 5 years.

6.3.4.3.1 Condition Assessment and Recommendations – Influent Flow Meter and Composite Sampler

Based on the above assessment, Murraysmith recommends the following improvements:

- Add a temperature sensor for influent flow and connect to SCADA.

6.3.4.4 Downstream Conveyance Facilities to Primary Clarifiers

After passing through the Parshall flume, flow travels through a pair of knife gates towards the primary clarifiers. The pipeline to the east primary clarifier is 30-inch diameter, while the west primary clarifier is fed by a 36-inch pipe. Grit washing water and reclaimed organic particles are fed back into the primary influent prior to the grit chamber. Both primary influent pipes are sized adequately to handle future projected flows.

6.3.5 Primary Treatment

The WWTRRF primary treatment system consists of two circular primary clarifiers each with a 90-foot diameter and depth of 8.6 feet. For current flows, one clarifier is online at a time, because they are completely redundant. Although the dual primary clarifier system was designed for a much greater capacity, operating only one clarifier at a time helps to mitigate low surface loading flow rates.

Surface loading rates for the two primary clarifiers is lower than the usual standard, because the structures co-thicken both primary sludge and waste activated sludge (WAS) from the secondary clarifiers. The typical range of surface loading rate for a primary clarifier is 600-800 gallons-per-square-foot-day (gal/ft^2*day) with a peak range of 1200-1700 gal/ft^2*day. Currently, The WWTRRF sees a loading of 410 gal/ft^2*day under normal conditions and a peak loading of 510 gal/ft^2*day. While lower loading rates can result in excessive odor and unwanted bacteria growth, this does not seem to be an issue.

6.3.5.1 Primary Clarifier West

The west primary clarifier originally functioned as a secondary clarifier. Two additional northern clarifiers were eventually constructed for secondary treatment, making four total clarifiers on-site. The original clarifier was reverted to a primary treatment structure so that both primary and secondary treatment processes include two clarifiers. The two primary clarifiers are configured such that parallel and series operation is possible.

The west clarifier consists of a central drive unit, scum scrapers and boxes, a rake arm, triangular weirs, and launders. In 2006, an overhaul of the west clarifier replaced the center well, drive unit, arm rakes, scum rake, weirs and launder coatings. The sludge sump in the floor of the clarifier was seen accumulating groundwater. The clarifier is still functioning well since these improvements were made, but PSE identified structural deficiencies that need to be addressed.

6.3.5.1.1 Condition Assessment and Recommendations – Primary Clarifier West

The west primary clarifier's inner and outer walls and the launder coating are in poor condition. The clarifier walls exhibited vertical cracks and exposed aggregate. The west clarifier's launder coating was in fair condition along the weir wall and floor but could be seen peeling and flaking in other areas on the inner surface of the outer wall. Issues with these clarifier elements should be addressed to avoid further deterioration. The drive unit and scraper mechanism appear to be in good condition.

Based on the above assessment, Murraysmith recommends the following improvements:

- Install groundwater relief system to address groundwater infiltration
- Sandblast and coat catwalk and exposed metal.
- Repair concrete launders and recoat.
- Perform spot repairs of the outside wall cracks.
- Skim coat the interior wall of the clarifier.
- Perform spot repairs of the clarifier floor slab.
- Sandblast and coat the scraper mechanism.
- Rebuild or replace drive in the next 5 years.

6.3.5.2 Primary Clarifier East

In the past, the east primary clarifier functioned as the only primary clarifier with the west primary clarifier serving as a secondary clarifier. Two additional northern clarifiers were eventually constructed for secondary treatment, making four total clarifiers on-site. The structure consists of a central drive unit, scum scrapers and boxes, a rake arm, weirs and launders.

In 2011, improvements were made to this clarifier. The center well structure, rake arms, and catwalk were replaced. The concrete structure has been spot-repaired. The sludge sump in the floor of the clarifier was seen accumulating groundwater. The clarifier is functioning well since these improvements were made, but PSE identified structural deficiencies that need to be addressed.

6.3.5.2.1 Condition Assessment and Recommendations – Primary Clarifier East

The east primary clarifier's inner and outer walls as well as the floor slab remain in fair condition, however some minor improvements should be considered. The launder coating is in very poor condition and should be replaced within the next 3 years to avoid failure.

Based on the above assessment, Murraysmith recommends the following improvements:

- Install groundwater relief system to address groundwater infiltration.
- Sandblast and coat catwalk and exposed metal.
- Repair concrete launders and recoat.
- Spot repair the outside wall cracks.
- Skim coat the interior wall.
- Rebuild or replace drive in the next 10 years.

6.3.5.3 I/O Junction Box and Combined Effluent Junction Box

From the primary clarifiers, flow passes through a combined effluent junction box and then through an I/O junction box towards the in-plant pump station. Within the combined effluent junction box, flow from the east and/or west primary clarifier is consolidated to travel through one 36-inch concrete pipe. The effluent box is in good condition and needs no improvement at this time.

After leaving the combined effluent box, flow travels through the I/O junction box on its way to the in-plant pump station. The junction box carries flow "IN" to the west primary clarifier on one side and "OUT" to the in-plant pump station on the other. The lifting handle and grate is broken and should be replaced.

6.3.5.4 In-Plant Pump Station

The in-plant pump station (IPPS) is located directly north of the west primary clarifier, routes flow from the primary clarifiers to the aeration basin and was installed with the 2011 upgrade. It is comprised of a concrete wet well structure holding three 8-inch Meyers submersible pumps and a concrete vault containing three plug valves for isolation when necessary. The pump station has a triplex pump configuration in a wet well that is 16 feet deep. The concrete structures are both in good condition.

The pump station conveys flow through a 14-inch force main to the aeration basin, and along the way, the RAS pump station discharge piping connects to this same force main. This is causing an issue with the station hydraulics as the RAS pumps are overriding the check valves in the IPPS discharge piping.

6.3.5.4.1 Condition Assessment and Recommendations – In-Plant Pump Station

The main issue with the in-plant pump station is that the pumps do not run high enough on the pump curve to operate efficiently. Often, the pumps shut off because there is not enough head through the system. Although the pumps are only 6 years old, the sizing is not optimal. Adjusting the level float within the wet well could potentially help diagnose and mitigate the pumps' auto shut-off issue by varying head conditions. Installing pressure gauges could also help diagnose the issue.

There is no flow meter installed at the pump station and the sump in the valve box is slightly shallow. Also, there is no lifting device for the pumps.

Based on the above assessment, Murraysmith recommends the following improvements:

- Install a flow meter.
- Investigate pump issues that cause shut-off.
- Provide a permanent pump lifting device.

6.3.5.5 Downstream Conveyance to Aeration Basins

The in-plant pump station lifts the primary clarifier effluent and carries it through a 14-inch force main to where the flow meets the recycled activated sludge (RAS) flow. These 2 force mains combine into an 18-inch pipe and continue to the aeration basin for the first step of secondary treatment.

Upon reaching the aeration basin, the primary effluent/RAS flows through Parshall flume flow splitters and is distributed into the trains of the aeration basin.

6.3.6 Secondary Treatment

Secondary treatment at the WWTRRF consists of a three-train aeration basin and two secondary clarifiers. Once primary effluent and RAS flow reach the aeration basin, it is distributed between three aeration basin trains. Under normal operating conditions, the plant utilizes two trains at a time. The two secondary clarifiers receive flow from the aeration trains and are redundant. One clarifier is typically online at a time under normal operating conditions.

6.3.6.1 Secondary Process Building

The secondary process building was constructed as part of the 2011 upgrades and is adjacent to and east of the aeration basin structure. This building is two stories with a control room upstairs and a blower room in the lower level. The blowers force air into the aeration basin to support aerobic metabolic processes within the biological treatment process.

The blower room contains three K Turbo blowers and one Aerzen blower. The three K Turbo blowers are oversized for the aeration system and are only used in hotter months. Due to insufficient air conditioning in this level of the building, the inverters melted down on the three K Turbo blowers in the past. The blower currently used most is an Aerzen hybrid model that is not sized correctly for the aeration system. In the winter months, the unit cannot be turned down any further than it is presently operating and currently produces too much air. In the summer months it cannot provide enough air for the aeration system.

Also, polyaluminium chloride (Pax 14) totes are stored in the blower room due to lack of chemical storage in the WWTRRF. Per Occupational Safety and Health Administration (OSHA) regulations, an emergency shower and eyewash station should be available where chemicals are stored.

6.3.6.1.1 Condition Assessment and Recommendations – Secondary Process Building

The secondary process building structure remains in good condition since the 2011 upgrade, however, there are a few potential code issues associated with electrical equipment. The dry transformer in the control room should have the appropriate clearance in front of the unit and the MCCs need to have 42 inches of yellow paint in front of them.

Based on the above assessment, Murraysmith recommends the following improvements:

- Install a new, smaller blower.
- Install HVAC in the blower room.
- Paint the floor yellow in front of the MCC and dry transformer.
- Remove blockage in front of the dry transformer.
- Perform 5-year maintenance on MCC.
- Add blowers to SCADA.

6.3.6.2 Secondary Process Storage Building

The secondary process storage building was constructed as part of the 2011 upgrades. This building is in good condition and is used for storing safety equipment, parts, and administrative files. The building is not conditioned, and should safety equipment continued to be stored here, an HVAC system should be added to protect the equipment from extreme temperatures. Staff would like to use this space for file storage only and move the safety equipment to a more centrally located place.

6.3.6.3 Flow Split Flumes

There are three 9-inch flow split Parshall flumes at the head of the aeration basin. The 9-inch flumes are too small to accommodate the current combined influent and RAS flows into one train. Due to current flow, the plant must run two trains at a time. Options should be considered to enable WWTRRF staff to run one train during the summer months to save energy costs. All three flumes are outfitted with ultrasonic flow meters. The split flumes are generally functioning well and remain in good condition since their installation in 2011.

6.3.6.4 Aeration Basin

The aeration basin structure is adjacent to the secondary process building and was also constructed in 2011. The activated biological treatment process takes place within this structure. The air pipe from the secondary process building blowers travels through the side of the basin wall. The connection leaks where the pipe penetrates the wall.

The basin is comprised of three redundant trains, each containing two invert mixers. They mix mixed liquor suspended solids (MLSS) within the aeration chambers and are critical to the functionality of this unit process. Each train has a Wilo Pumps gear box chamber installed to power the mixers. These motors are heavy and hard to maintain, because the gear box and motor complex are offset outside of the catwalk area over the basins. With no platform supporting these units, operators are required to fill the basins and use a boat to repair and perform regular maintenance on the mixers.

Used membranes from the City's water treatment plant sit in the final chambers of the system. These membranes act as fixed film media, not bioreactors. The membrane inserts facilitate red worm growth, which can impede the biological secondary treatment process. Other membrane bioreactor (MBR) units should be considered for future installation to provide proper functionality and potentially production of Class A recycled water for reuse.

Birds nest in the bridge crane and create a mess. The utility water loop around the aeration basin is undersized, freezes in winter months, does not provide adequate connections for cleaning, and does not have valves to isolate trains. Isolating utility water loop trains would save costs on energy consumption and help mitigate pipes freezing in the winter months. Also, the air control valves freeze in the winter making them inoperable.

6.3.6.4.1 Condition Assessment and Recommendations – Aeration Basins

Based on the above assessment, Murraysmith recommends the following improvements:

- Investigate options to run one train in the summer months.
- Seal the basin wall around the air pipe penetration to stop leaks.
- Install a catwalk or platform around the gear boxes for maintenance.
- Add bird deterrent to bridge crane.
- Increase UT water connections to 2 inches.
- Configure UT water loop to isolate trains and add valves.
- Add heat tracing or insulation to air line and to utility water loop to prevent freezing.

6.3.6.5 MBR Building

An MBR building was installed in 2011 just south of the aeration basin structure to facilitate operation of the reactors installed in the aeration basin. Despite intensive efforts, the plant operating staff were unable to make the MBR system work effectively. The system is currently offline, but all components remain in-tact and in good condition.

The MBR system is comprised of three permeate pumps, three metering pumps, six actuated valves, a pneumatic valve compressor, three flow meters, and a 5,000-gallon chemical storage tank. The tank stores chlorinated membrane wash water for membrane cleaning. This wash water is fed by the utility water system. All mechanical parts of the MBR system are functioning well.

The building has several code issues related to its electrical components and chemical storage. First, the Variable Frequency Drive (VFD) control panel has multiple problems. There are no overcurrents or disconnects for the drives within the panel, and the power to these drives cannot be disconnected even if the power to the panel is turned off. They prompt Underwriters Laboratories (UL) listing concerns, and the breakers are not lockable, or switch rated. Each VFD should have its own lockout switch in the control panel, and power wiring and control wiring must be segregated. The panel also has holes that compromise its National Electrical Manufacturers' Association (NEMA) code rating. The MBR building's power panel is the sole source of power to the compressor tank that operates the pneumatic valves within the building. The tank's solenoid valve is powered via the control panel's uninterruptable power supply. This creates a voltage spike in the panel when it turns on.

Because sodium hypochlorite is stored in this building, an emergency shower and eyewash station should be available for WWTRRF staff.

6.3.6.5.1 Condition Assessment and Recommendations – MBR Building

Based on the above assessment, Murraysmith recommends the following improvements should the City decide to use the MBR equipment:

- Rebuild VFD panel to bring it in-line with current code requirements.
- Provide 42 inches of clear space in front of the 480 Volt drives.
- Paint the floor yellow to the required dimensions.
- Patch holes in the VFD control panel to meet NEMA rating.
- Provide an alternative power supply for the solenoid valve.
- Install an emergency shower and eyewash station.

6.3.6.6 Downstream Conveyance to Secondary Clarifiers

The secondary clarifiers are filled with MLSS effluent from the aeration basin. The MLSS travels through a 24-inch ductile iron pipe to the concrete control junction box structure where flows are directed to either the east or west secondary clarifier, whichever is online. The splitter box uses gate valves to direct flow. These valves were replaced within the last 10 years and still function well. From the control structure, the MLSS flows through a 36-inch pipe to one of the two clarifiers.

6.3.6.7 Secondary Clarifier West

The west secondary clarifier is a 115-foot diameter circular structure with an 11-foot sidewater depth. The clarifier is 47 years old and was constructed in 1970. The system consists of a central drive unit, scum scrapers, a scum box, arm rakes, weirs, and launder. The west secondary clarifier sees low surface loading rates because settled sludge from the secondary clarifier is carried to the primary clarifier for co-thickening. The secondary clarifiers were designed for a greater capacity than the plant receives, therefore, only one clarifier is used at a time.

The floor of this clarifier is showing signs of degradation. Sections of the floor are lifting in a few places and could benefit from spot repair. The clarifier wall and launder surfaces are also in need of repair and new paint, as they are starting to deteriorate. The launders are configured so that they never fully drain when the clarifier is taken offline. This causes problems with algae growth and prohibits WWTRRF staff from completing repairs. The center well and steel scraper mechanism show significant amounts of corrosion, and they should be sandblasted and recoated. New scum boxes were installed in 2011 with other plant upgrades, so those are functioning well. The west secondary clarifier's primary drive gear box was also rebuilt two years after the plant upgrade. As seen in the primary clarifiers, this secondary clarifier is exhibiting significant groundwater infiltration issues.

6.3.6.7.1 Condition Assessment and Recommendations – Secondary Clarifier West

Based on the above assessment, Murraysmith recommends the following improvements:

- Install groundwater relief system.
- Repair concrete launders and recoat.
- Sandblast and coat catwalk.
- Sandblast and coat steel members, including the scraper mechanism and well.
- Spot repair the outside wall cracks, the interior wall surface, and the floor slab.
- Install a 2-inch yard hydrant for cleaning.
- Add effluent gate to launders to facilitate repairs.

6.3.6.8 Secondary Clarifier East

The east secondary clarifier is identical to the west secondary clarifier in that it is circular with a 115-foot diameter and 11-foot sidewater depth. The west clarifier is the same age as the east and in similar condition. The surface loading rates are similarly low due to the export of sludge for co-thickening in the primary clarifiers.

The east secondary clarifier has the same groundwater intrusion problems that plague the other clarifiers. PSE's analysis identified the east secondary clarifier as being in the poorest condition of all structures inspected. The topping slab is in disrepair and will need to be removed and replaced. Concrete on the inner clarifier wall surface is deteriorating, and there are a few larger vertical cracks on the outside wall of the clarifier. The launder structure has cracks and coating deficiencies that need repair. However, the launders are configured so that they never fully drain when the clarifier is taken offline. This causes problems with algae growth and prohibits WWTRRF staff from completing repairs. Welding on the center well is starting to pull apart and should be repaired.

6.3.6.8.1 Condition Assessment and Recommendations – Secondary Clarifier East

Based on the above assessment, Murraysmith recommends the following improvements:

- Install groundwater relief system.
- Repair concrete launders and recoat.
- Spot repair the outside wall cracks.
- Skim coat the interior clarifier wall.
- Spot repair the floor slab.
- Sandblast and coat steel members, including the scraper mechanism and well.
- Remove and replace topping slab.
- Install a 2-inch yard hydrant for cleaning.
- Add effluent gate to launders to facilitate repairs

6.3.6.9 Control Junction Box and Effluent Junction Box

The secondary effluent overflows the clarifier weirs and leaves the treatment structure through a 36-inch concrete pipe, flowing into a combined effluent junction box. This structure combines flow from the secondary clarifiers and is the primary chlorine injection site for disinfection. From this effluent junction box, chlorinated effluent leaves the structure toward the chlorine contact chamber through a 36-inch concrete pipe. The west secondary clarifier effluent can bypass the effluent junction box through a bypass line that discharges directly into the north cell of the chlorine contact chamber.

6.3.6.10 RAS Pump Station

The RAS pump station is located between the two secondary clarifiers. This pump station pumps return activated sludge from the bottom of the secondary clarifiers and combines it with flow pumped from the in-plant pump station on its way to the head of the aeration basin. The pump station is comprised of a concrete structure and three submersible Meyers pumps. These pumps are identical to those installed in the in-plant pump station. The concrete structure is divided into chambers. The structure has a pump and a valve chamber in the lower level, and the upper level is a storage area.

There are some significant deficiencies in the RAS pump station. The RAS pumps will not turn down enough to provide the required flow rate to the aeration basin. Rain and washdown water collect in the valve chamber. Operators must manually pump the chamber dry. The vault is not laid out efficiently. The floor grating panels above the submersible pumps are difficult to remove, as they are currently full width across the entire RAS pump chamber. The mud valve in the upper chamber is leaking. There is no flow meter, which makes it difficult to measure RAS versus waste WAS flow. Pump maintenance is difficult, because there is no lifting device installed. Finally, there is a concrete chamber in the ground on the west side of the pump station that houses an offline iron pipe. This pipe is non-functional, and the chamber needs to be abandoned.

Condition Assessment and Recommendations – RAS Pump Station

Based on the above assessment, Murraysmith recommends the following improvements:

- Optimize pumps so they can be turned down to provide lower flow rate to aeration basin.
- Install flow meter.
- Replace grate over pumps with a sectioned grate system.
- Install a lifting device over the pumps.
- Abandon the existing iron pipe and concrete chamber on the west side of the pump station.

6.3.6.11 Underground Pump Station (WAS)

The underground pump station (WAS) is located immediately south of the RAS pump station. It is an underground structure with an above-ground storage shed where excess hoses and miscellaneous supplies including granular chlorine are stored. Birds nest in the ceiling of the above-ground portion of the building, making their way into the hose storage area. The underground pump station was designed to route WAS from the sludge storage basins to the drying beds adjacent to the plant's dewatering building, but the sludge storage basins are not currently used. Currently, WAS is pumped from the bottom of the secondary clarifiers and sent to the primary clarifiers for co-thickening.

The pump station consists of three pumps, one centrifugal Paco Pumps waste pump, one regressive cavity Moyno solids pump, and one submersible sump pump. The submersible sump pump is configured with a 2-inch trash pump, which is part of the WAS pump station but does not pump WAS. The waste pump is old but functions well. The solids transfer pump has been rebuilt and is functioning adequately. The pump station's pressure gauge is broken and should be replaced. Some of the automatic valves were recently replaced and remain in good condition. Other non-automated valves are finicky and difficult to turn.

6.3.6.11.1 Condition Assessment and Recommendations – Underground Pump Station (WAS)

Based on the above assessment, Murraysmith recommends the following improvements:

- Repair or replace pressure gauge.
- Replace manual valves.

6.3.7 Disinfection and Outfall

Secondary effluent leaves the secondary clarifier, passes through the concrete effluent junction box where it is chlorinated, and flows into a splitter box where it is directed into one of two chlorine contact chamber trains for disinfection. Once the water has reached the end of the contact chamber and achieved disinfection, it leaves the chlorine contact chamber through an effluent channel where it is dosed with calcium thiosulfate to dechlorinate. The dechlorinated effluent flows through a 36-inch outfall from the chlorine contact chamber, under McKay Creek, to a submerged diffuser in the Umatilla River. This discharge point lies beyond the convergence of the Umatilla River and McKay Creek.

6.3.7.1 Disinfection System

The WWTRRF disinfection system utilizes chlorine gas as its primary disinfecting agent. The system is comprised of chlorine gas cylinders, rotameters, scales, chlorine monitors, and metering pumps. Under existing circumstances, 4 or 5, 150-pound chemical cylinders are usually stored for use in disinfection.

The current chlorine gas system is maintenance and labor intensive and is costly to operate. Handling of chlorine gas is a safety hazard to the operators. While the existing system has multiple safety constraints, new scales and SCADA technology would improve current operations. Alternative disinfection methods should be considered to eliminate the chlorine gas system.

6.3.7.1.1 Condition Assessment and Recommendations – Disinfection System

Based on the above assessment, Murraysmith recommends the following improvements:

- Replace cylinder scales.
- Update the SCADA system programming to improve disinfection operations.
- Investigate alternative disinfection methods.

6.3.7.2 Disinfection Building

The WWTRRF's disinfection system is in the disinfection building, located immediately east of the chlorine contact chamber. The building is used for storing, dosing, and distributing chlorine gas solution to the secondary clarifier effluent before it enters the chlorine contact chamber. Three lines run from this building to different chlorine injection points. The first is in the effluent junction box, the second in the chlorine contact chamber, and the third is a bypass injection point that has been taken offline. Because of the structural configuration of this building, unloading and storing chemicals is difficult. Improvements to the loading dock area would better facilitate this process.

6.3.7.2.1 Condition Assessment and Recommendations – Disinfection Building

Based on the above assessment, Murraysmith recommends the following improvements:

- Install a roll-up door.
- Add a loading dock for chemical delivery.

6.3.7.3 Chlorine Contact Chamber

Chlorinated secondary effluent passes through a splitter box upstream of the chlorine contact chamber where flow is split between the two trains of the chamber. Only one train needs to be online at a time to accommodate current flows. The flow splitter is currently functioning well.

The chlorine contact chamber is the final stage of disinfection before effluent leaves the treatment plant. The structure is 145 feet long, 60 feet wide, and 8.2 feet deep. It is divided into 2, 30-foot channels. The northern channel has been partitioned with divider panels to increase contact time during disinfection. The design residence time in the north train of the contact chamber with the divider panels is 75 minutes, and the design residence time in the unpartitioned south train is 156 minutes. Both disinfection periods are more than sufficient per regulatory requirements.

There is currently limited catwalk access over the contact chamber. An additional catwalk across the middle and down the center of the contact chamber would simplify maintenance for operators. Two specific components of the chlorine contact chamber are not functioning correctly, including the ground water relief system and the chlorine analyzer. The contact chamber also is lacking a backwash system for maintenance. A water supply should be constructed to provide water for cleaning the chamber.

Structurally, the chlorine contact chamber is in disrepair. During the winter of 2016, the contact chamber floated, damaging the concrete structure. Presently, the structure has cracks and degradation. The walls and floor are in fair condition, but a new coating on the walls would provide additional protection. The wall expansion joints are in poor condition and need repairs throughout the chamber. Finally, the divider panels in the north train of the contact chamber do not currently allow for expansion and contraction. These panels should be replaced to prevent further damage at anchorage locations.

6.3.7.3.1 Condition Assessment and Recommendations – Chlorine Contact Chamber

Based on the above assessment, Murraysmith recommends the following improvements:

- Replace chlorine analyzer.
- Replace divider panels in north train and install divider panels in the south train of the contact chamber.
- Construct additional catwalk.
- Repair the groundwater relief system.
- Patch spalled and cracked concrete around the chamber anchors, repair vertical cracks along the exterior of the chamber walls, repair wall expansion joints, and recoat interior walls.
- Add 2-inch yard hydrants on the north and south side of the contact chamber.

6.3.7.4 Dechlorination System

The dechlorination building is the westernmost structure on the treatment plant site adjacent to the north side of the chlorine contact chamber. The structure is made of concrete masonry unit (CMU) brick and houses the dechlorination chemicals and pumps as well as the utility water system. The building used to have a raised platform entrance that has since been removed, leaving a door opening in the building wall that has been only temporarily sealed. The CMU brick is a specialty order and will need to be acquired to seal this opening.

Within the dechlorination building, a 6,200-gallon high density polyethylene (HDPE) tank holds the dechlorination chemical, calcium thiosulfate. It is a relatively safe chemical. A chemical tank fill station is located on the outside wall of the building and connects via piping to the tank inside so that chemical trucks can easily unload product into the storage tank.

The dechlorination system includes two identical pumps. These pumps are small Iwaki dual metering pumps, designed to dose the chlorinated water with calcium thiosulfate at a rate up to approximately 360 milliliter per minute. The pumps are both 6 years old and functioning very well. Dosed chemical is pumped into the dechlorination system where it is diluted and carried by a utility water hose to the chlorine contact chamber effluent channel. Disinfected, chlorinated effluent is showered and dechlorinated with diluted calcium thiosulfate as it flows through the channel before entering the outfall.

The building has a few code issues related to its electrical components. Yellow paint must extend at least 42 inches from the front of the MCC. There are instruments that operators read inside of the control panel, requiring the live panel to be opened and closed often.

6.3.7.4.1 Condition Assessment and Recommendations – Dechlorination System

Based on the above assessment, Murraysmith recommends the following improvements:

- Repair building wall to fill in door opening with CMU brick.
- Perform 5-year maintenance on MCC.
- Paint the floor yellow to the required dimensions.
- Relocate instruments to outside of control panel.

6.3.7.5 Outfall, Effluent Sampling and Flow Monitoring

Final effluent passes through three outfall manholes before reaching McKay Creek and ultimately the Umatilla River discharge. There is a sampling shed located adjacent to the first outfall manhole within the treatment plant fence. Samples are taken from this manhole and measured for chlorine residual. The second outfall manhole contains a submersible, ultrasonic flow meter. This flow meter's sensor was recently replaced and is in good condition, but it's accuracy is questionable. The third and final outfall manhole is the largest and contains temperature sensors that are read two to three times a year.

A 36-inch outfall pipe carries effluent from the chlorine contact chamber through the manholes. After the 36-inch pipe leaves the fourth manhole, it is reduced to a 24-inch pipe before reaching a splitter box. The splitter box divides flow into two concrete-encased 14-inch pipes that run underneath McKay Creek via a siphon system. Once flow has passed under the creek, it is combined back into one 24-inch pipe and carried to a diffuser in the Umatilla River where it is discharged.

6.3.7.5.1 Condition Assessment and Recommendations – Outfall Piping, Sampling, and Discharge

Based on the above assessment, Murraysmith recommends the following improvements:

- Install a Parshall flume to accurately measure effluent flow and connect to SCADA.

6.3.8 Solids Treatment

The WWTRRF's solids handling consists of one primary anaerobic digester, two secondary anaerobic digesters, co-thickening in the primary clarifier, drying beds, dewatering, and a solids storage basin (SSB). Typically, waste activated sludge (WAS) is brought into the headworks where it is sent to the primary clarifier for co-thickening. The thickened solids are then pumped from the primary clarifier to the primary anaerobic digester and then to the secondary digester. After the requisite time for sludge digestion has passed, the digested sludge is sent to the drying beds or the dewatering building. The sludge can be pumped to the SSB from the secondary anaerobic digesters. It is used during times of peak solids production, but it is strictly a tertiary solid handling process as the SSB must be manually cleaned. It is not used often. After the digested sludge has been adequately dewatered, it is collected and sent away for land application.

6.3.8.1 Solids Thickening

The plant has two possible methods of solids thickening. The first is co-thickening in the primary clarifier. The second is decanting from the secondary anaerobic digester. However, the supernatant collection system in the secondary anaerobic digesters is out of commission. Currently, the only thickening available is co-thickening in the primary clarifier. This process involves pumping WAS to the headworks where it flows to the primary clarifier. Within the primary clarifier, the WAS settles along with the primary sludge. This process has the benefit of absorbing some odor causing volatile fatty acids and producing sludge with higher solids content. Co-thickening is typically done in smaller plants where space may be limited, but, due to the WWTRRF's treatment capacity, this method has been adopted.

Industry standard co-thickening design criteria stipulate that solids loading rate should be approximately 8 pounds per square foot of clarifier area, and excessive solids retention time should be avoided. If solids are retained for too long, septic conditions will occur. The excess biosolids ferment producing gasses such as hydrogen sulfide and other mercaptans. These rising gasses contribute to odor issues and settling disruption. WAS also has different settling characteristics than primary sludge which should be taken into consideration.

The co-thickened sludge is approximately 2.6-3 percent solids which is within the expected yield for a clarifier of 1 to 12 ratio floor slope. During site visits, neither odors nor bubbles were observed emanating from the primary clarifiers suggesting that the co-thickening process is not holding solids for an excessive amount of time.

6.3.8.2 Anaerobic Digesters

Anaerobic digestion occurs using a single primary digester and two, parallel secondary digesters. The primary digester is a 56-foot diameter, 29-foot tall brick-faced, concrete structure approximately 50 years old. It takes co-thickened sludge from the primary clarifier which is digested under mesophilic conditions for approximately 30 days. This process provides significant destruction of the volatile solids. The digested sludge is pumped to the top of the primary digester where it is conveyed to the secondary anaerobic digesters by gravity. The gas produced from this process is routed from the top of the structure down to the gas handling room adjacent and to the east of the primary digestion complex. Primary mixing is accomplished using a single pump housed in the primary mixing building. This pump draws sludge from the bottom of the primary digester and discharges it at the top. Further discussion of mixing can be found in **Section 6.3.8.5 Digested Sludge Pumping**.

The past three years, the operators have encountered a foaming issue in early spring related to a WAS secondary process change. This results in foam being discharged in an uncontrolled manner in and around the WWTRRF. It is a severe health, safety, and maintenance issue. The operators have found that using an anti-foaming agent has alleviated the issue for now. However, the chemical defoamer is stored in the primary mixing building due to lack of chemical storage space in the WWTRRF. Per OSHA regulations, an emergency shower and eyewash station should be available where chemicals are stored.

As part of the 2011 improvements, a lime skid was installed on the upper floor of the primary digester complex. This unit was designed to regulate the hydrogen potential (pH) of the primary digested sludge. It was used one time then decommissioned. The pumps and motors are still operable, and the can be salvaged for use in other parts of the plant, but the skid partially blocks access the loading dock on the south side of the complex.

Ferric chloride addition began as an operator experiment to improve dewatering. The process worked, so dosing continued. At the time of the experiment, the only location where addition was feasible was the roof of primary digester where co-thickened sludge enters. The current process is not ideal. The operators must bring the chemical to the roof, and then manually apply the solution.

Secondary anaerobic digestion is carried out in two parallel, 45-foot diameter, 22-foot tall, brick-faced concrete structures. The south digester is original, and the north digester was built in the 1950s upgrade. Both structures are fitted with floating roofs. Sludge volume is measured using pressure transducers attached to the roofs. The pressure transducers are inoperable and should be replaced with a functioning system. At the time of Murraysmith's site visit, secondary anaerobic digestion was performed solely in the older south secondary digester. These digesters have minimal mixing capability and the supernatant lines are inoperable. Due to the destruction of volatile organic compounds in the primary digestion process, the main purpose of the secondary digesters is solids storage.

Mesophilic conditions are maintained in both primary and secondary digestion using sludge circulation pumps in conjunction with two heat exchangers. The circulation pumps route the sludge from the digestion tanks through the primary heat exchanger, for primary digestion, or through the secondary heat exchanger, for secondary digestion. This process maintains the temperature of the digester sludge between 95 and 105 degrees Fahrenheit. Further discussion of sludge circulation pumps can be found in Section 6.3.8.5 Digested Sludge Pumping. The primary heat exchanger is a spiral-type Alfa Laval model 1H-SW-1W which was installed 6 years prior. It is currently operating as intended. The secondary heat exchanger is also a spiral-type Alfa Laval model 1H which was installed 25 years prior. Despite its age, the secondary heat exchanger is in good working order. It will only need to be replaced if space becomes an issue with future upgrades. The primary heat exchanger, secondary heat exchanger and secondary recirculation pump do not have redundant units. Due to the criticality of these unit processes, redundancy should be considered. The Fats, oils, and grease (FOG) mixing pump can be used as the primary recirculation pump if needed, but the FOG system will be offline while it is used.

The heat exchangers are fed hot water from a primary boiler, a secondary boiler, and the cogeneration system. The primary boiler is in the primary digester complex. It is a Parker natural gas boiler, which was installed 6 years prior. This boiler is an auxiliary system to the cogeneration system, and there are no operational issues. This boiler is controlled solely through a Honeywell HMI panel, which is not connected to SCADA. The secondary boiler is a HB Smith natural gas Series 28 model, which was installed 65 years prior. This boiler is operating beyond its design life, and it has constant operational issues. The main issue associated with this equipment is the lack of temperature control. The heat transfer between this system and the secondary heat exchanger is only regulated via a hand valve.

Primary digested sludge is conveyed from primary digestion to secondary digestion by gravity through a 6-inch cast iron pipeline. Flows through this portion of the plant are relatively low, so the capacity of the current pipeline appears to be adequate. Although not used in regular operation, digested sludge can be conveyed from the secondary digesters back to the primary digester through a 6-inch cast iron pipe, located in the secondary digester complex. There are several valves that are inoperable or leaking within the secondary digester complex. These should be repaired or replaced. Further discussion of sludge conveyance can be found in Section 6.3.8.5 Digested Sludge Pumping.

6.3.8.2.1 Condition Assessment and Recommendations – Anaerobic Digesters

The primary anaerobic digester generally appears to be in good condition. Much of the mechanical equipment is less than 10 years old, and the treatment capabilities are meeting design criteria. The piping within the complex is in good condition, however some of the plug valves in the floor are no longer operable. The performance of the primary digester complex is expected to remain satisfactory for the next 10 years. The main issues are minor cracking of the façade near the top of the structure, and an issue with an actuated valve associated with the mixing process. Both issues are minor, having little to no effect on the operation and safety of this process. The lime skid is in disarray and should be removed. This area could be used to improve chemical storage and handling, along with covering a portion of the loading dock area outside.

The secondary digesters are in worse condition than the primary. There is cracking evident in the façade of the south secondary digester and within the digester complex. The walls, floor and lid, are in fair condition. Performance and reliability are acceptable. Internal structural inspection was only carried out in the north secondary digester. However, the structure of the south secondary digester is assumed to be in equal condition.

Within the secondary digester complex there are several issues. The supernatant lines are no longer operable and there are numerous frozen valves. The piping within the secondary digester complex is not of standard size, and some of the piping may be oversized. There is also evidence of leaking seals between the south secondary digester and the secondary digester complex. As discussed above, the mixing pump is new and in good working condition, but there is no redundant unit. The boiler is working past its design life, and there are several issues with it. All digester gas created from secondary digestion goes to the waste flare. It should be stored and conditioned for use in the cogeneration system.

Based on the above assessment, Murraysmith recommends the following:

Primary Anaerobic Digestion

- Add auxiliary boiler and chemical injection pumps to SCADA.
- Improve chemical storage and handling.
- Remove lime skid and salvage parts.
- Add in-line ferric chloride injection.
- Replace the leaking actuated valve associated with primary mixing.
- Repoint brick façade.
- Seal cracks in concrete stair piers and continue monitoring.
- Add riser to the air release valve located on the roof of the primary digester to mitigate foam overflows.

Secondary Anaerobic Digestion

- Reconfigure layout, replace valves and piping; add external mixing system; improve yard piping between primary and secondary digester complexes; add drains to digesters; remove and replace supernatant lines and valves.

- Install ferric chloride injection system, plus two injection ports for other chemicals.

- Replace boiler and connect to SCADA.

- Replace booster pump.

- Replace heat exchanger.

- Add radar level indicator to the top of the digester complex, connect to SCADA.
- Consider affixing roof of secondary digesters to improve digester gas utilization.
- Repoint brick façade.

6.3.8.3 FOG Receiving and Handling

Fats, oils, and grease (FOG) are received infrequently from independent sources for disposal and treatment. This material is pumped from the truck through the FOG receiving station and into the FOG storage tank. From the storage tank, the FOG is heated and mixed, then metered and pumped into the primary anaerobic digester.

The FOG receiving station is a pipe assembly directly south of the primary mixing building. This assembly allows tanker trucks to directly couple to the receiving pump. The receiving pump is a Wemco-Hidrostal model CFV2 chop-flow pump. It is 6 years old, and it is in like-new condition. This pump has a very low suction head capacity, and because it is not a flooded suction, it often loses prime. The controls are on the east side of the building, away from the entryway, so operating the pump requires two people. The FOG receiving station is in very good condition.

The FOG storage tank is a concrete structure located partially underneath the primary digester complex and partially below the adjacent loading dock. Its volume is approximately 12,000 gallons. The only means of mixing involve pumping the FOG through the FOG heat exchanger and back to the tank. This level of mixing is not adequate and causes solids to build up around the support columns within the tank. The FOG mixing pump is a Wemco-Hidrostal model D4K screw centrifugal pump. This pump is 6 years old with a flow capacity of 340 gpm. Along with most of the FOG receiving appurtenances, this pump is in good condition, and its performance is expected to remain satisfactory for the next 10 years.

The heat exchanger associated with the FOG mixing loop is a Bell and Gosset straight tube heat exchanger. This equipment is also 6 years old. In general, it is in good condition, but it has some maintenance issues associated with it. The holes that the FOG travels through are often plugged, and there are no temperature controls beyond turning the hot water feed on or off. Cleaning this equipment difficult because it is heavy, and the space is limited.

After heating and mixing, the FOG is pumped and metered into the primary anaerobic digester, which is done using a Seepex model BN progressive cavity metering pump. Pump safety components should be installed.

6.3.8.3.1 Condition Assessment and Recommendations – FOG Receiving and Handling

FOG receiving and handling was installed 6 years ago. Because it is infrequently used, all components are in good or very good condition. It is expected that they will perform as designed for the next 10 years or more. The main issues present include the receiving chopper pump losing prime, solids buildup in the FOG storage tank, heat exchanger clogging, and an inoperable transducer. Despite these issues, FOG receiving in infrequent, so all recommendations are low priority.

Based on the above assessment Murraysmith recommends the following improvements:

- Remove concrete footing underneath the FOG receiving pump.
- Relocate FOG receiving pump controls to doorway of mixing building.
- Improve FOG mixing.
- Furnish and install a radar level sensor for FOG tank.
- Furnish and install a basket strainer before the heat exchanger.
- Make the FOG heat exchanger more accessible.
- Finish FOG metering pump safety component installation.

6.3.8.4 Primary Sludge Pumping

There are two primary sludge pump stations that convey co-thickened sludge from the primary clarifiers to the primary digester complex. The two stations are located between the east and west primary clarifiers. The two pumps vary in manufacturer and housing, although their intended functions are the same.

6.3.8.4.1 Primary (Raw) Sludge Pump East

The east primary sludge pump is in a small building just west of the east primary clarifier and pumps co-thickened sludge from the east primary clarifier to the primary digester. The east primary sludge pump is a Carter Pump Company 11-inch piston pump, which is seated on a concrete pedestal. The pump is heavy, it is located down a small flight of stairs, and piping runs through the center of the building at waist height. This makes maintenance activities difficult. The flow meter and valves are inoperable and should be replaced. The pump station building is not waterproof, but this does not seem to affect the functionality of the structure.

6.3.8.4.2 Condition Assessment & Recommendations – Primary Sludge Pump East

The east primary sludge pump is in poor condition. The performance and reliability has significantly decreased, and maintenance, rehabilitation, or replacement is necessary to restore functionality to acceptable conditions. The piping and valves are also in poor condition.

Based on the above assessment, Murraysmith recommends the following:

- Reconfigure piping and valves to provide better access for maintenance activities.
- Raise the floor of the pump station to improve access to the pump.
- Replace pump system including valves and flow meter.

6.3.8.4.3 Primary (Raw) Sludge Pump West

The west primary sludge pump is located just east of the west primary clarifier in a small building, and it pumps sludge from the west primary clarifier to the primary digester. The west primary pump is a Wastecorp 4 inch SludgePro disc pump. The discs need to be replaced frequently. Valves are located outside of the building and are configured so that sludge can be pumped from either the scum pit or the center well.

The building's drain is connected to the 36-inch west primary clarifier effluent pipe meaning the drain is indirectly connected to the IPPS. When the level in the IPPS reaches approximately 10 feet, the water surcharges the drain flooding the sludge pump building. This occurrence is most prevalent during power outages.

6.3.8.4.4 Condition Assessment & Recommendations – Primary Sludge Pump West

Based on the above assessment, Murraysmith recommends the following:

- Replace pump system including valves and flow meter.
- Connect building drain to PCW scum pit to eliminate flooding.

6.3.8.5 Digested Sludge Pumping

The plant has four pumps used to convey of digested sludge within and between anaerobic digesters. These include the primary digester sludge pump, the sludge recirculation pump, the mixing building pump, and the secondary sludge mixing pump.

The primary digester sludge pump is a 6-year-old Borger model CL 390. It is a 7.5 horsepower (hp) rotary lobe pump capable of pumping a range of 180 – 620 gpm. It is located on the lower level of the primary digester complex. This pump is used to route sludge from the secondary digesters through the primary digester complex, and to dewatering unit operations. This pump is in fair condition operating as needed, and It will be capable of operation for the 5-10 years. However, it is a critical component with no redundancy.

The sludge recirculation pump is a screw centrifugal Wemco-Hidrostal model D4K. It is 6 years old, has a 5 hp motor, and pumps 250 gpm of sludge through the primary digester complex. The pump is located on the lower level of the primary digester complex. This pump conveys sludge through the primary heat exchanger and back into the primary digestion tank keeping the in-tank solids temperature within mesophilic range. The pump is in good condition. Performance and reliability is expected to remain for 10 years or more. This mixing pump is adequately sized, and it moves sludge at a rate capable of maintaining an average temperature of 98 degrees Fahrenheit.

The mixing building pump is a centrifugal style Wemco-Hidrostal model H12K. It is 6 years old, has a 25 hp motor, and pumps 3,200 gpm of sludge. The pump is in the primary mixing building to the south of the primary digester. As discussed in **Section 6.3.8.2 Anaerobic Digesters** the mixing pump draws sludge from the bottom of the primary anaerobic digester and lifts it approximately 25 feet where it is discharged at the top of the tank. Industry standard design criteria stipulate that 0.2 to 0.3 hp is required per 1000 cubic foot of storage. This equates to 14 to 22 hp for the primary digester. The mixing pump is rated for 25 hp; therefore, the available mixing power is adequate.

The secondary digester mixing pump is a centrifugal style Wemco-Hidrostal model D4K. It is 6 years old, has a 7.5 hp motor, and pumps 310 gpm. The pump is in the secondary digester complex. This pump mixes sludge within both secondary digesters, and it moves sludge between the north and south secondary digester. The pump is currently in good condition, yet it has no redundant unit. With only one pump, the digesters cannot be mixed independently. Industry standard design criteria stipulate that between 7 and 10 hp is required per secondary digester. The mixing pump is rated for 7.5 hp, so the power supplied is adequate for a single digester. Additionally, the pump is manually operated.

6.3.8.5.1 Condition Assessment & Recommendations – Digested Sludge Pumping

The primary mixing pump, secondary mixing pump, and sludge recirculation pump are all in good condition, and they will likely remain reliable for the next 10 years or more. The primary digester sludge pump, located on the lower floor of the primary digester complex, is in fair condition. The performance and reliability are expected to remain for the next coming years, but rehabilitation or replacement may be required in 5-10 years. This pump and the secondary mixing pump are both critical components for their respective unit operations, and they should have redundant units.

Based on the above assessment, Murraysmith recommends the following:

- Addition of a redundant primary digester sludge pump.
- Addition of a redundant primary mixing pump.
- Addition of a redundant secondary digester mixing pump.
- Automate the secondary digester mixing pump operation.

6.3.8.6 Solids Electrical Building

The solids electrical building is a brick-faced concrete structure added as part of the 2011 upgrades. It houses the MCCs, power panel, and control panels for the solids handling unit processes. The structure is in very good condition. It has no issues with heating or cooling. The solids electrical building has additional space available for more control panels, if necessary. The only issue with this building involves electrical code. To meet code, the floor must be painted yellow 42 inches from the electrical components. The MCC that is housed in this building is due for five-year maintenance.

6.3.8.7 Digester Gas and Flare

Digester gas is produced from both primary and secondary anaerobic digesters. It is collected from the upper portion of the respective digester buildings and piped to the gas handling room. The gas is then split between the cogeneration system and the waste flare. The primary digester is optimized for volatile solids reduction producing the largest portion of digester gas. Coupled with its fixed roof, it is capable of producing gas at higher pressure than the gas produced from secondary digestion. Because the primary and secondary digesters are set up in parallel, the gas produced from primary digestion overcomes the gas produced from the secondary digester closing the check valve within the gas handling room. Without the check valve, gas from the primary digester would back up the secondary gas line causing digester gas to leak out of the secondary digester's floating roof. Because of this, all secondary digester gas is routed to the waste flare.

The gas handling room houses various piping, valves, flame arresters, pressure regulators, and a small sedimentation basin, which facilitate safe operation of the waste flare and cogeneration system. The building was installed as part of the 2011 upgrades. All the equipment in very good condition. The issues involve the gas flow meter and moisture pipes freezing as they reach the cogeneration system. Further discussion of the cogeneration system can be found in Section 6.3.10.1 Cogeneration.

The waste flare is located north of the gas handling room, and it burns off excess digester gas. It is partially fed by natural gas to ensure constant operation. The flare is showing visible signs of age, and there is no flow meter to indicate and track digester gas usage. The gas piping is set in two runs; one of the runs has been recently replaced, but the other run is rusting in areas. These pipes come out of a shed adjacent to the flare. The shed is old and in fair condition, as is the equipment inside.

6.3.8.7.1 Condition Assessment and Recommendations – Digester Gas and Flare

The gas handling room and the pipes and appurtenances that route gas from primary digestion are all in good condition. However, the gas flow meter located in this room cannot measure the available British Thermal Units (BTUs) in the digester gas.

The gas handling process has two main issues that need to be addressed. All gas produced from the secondary digester is routed to the flare, which could be alleviated by re-piping or storage. Digester gas, routed to cogeneration, freezes pipes down the line. The flare is in poor condition and should be replaced.

Based on the above assessment Murraysmith recommends the following improvements:

- Replace or repair aging pipes and fittings.
- Move existing gas flow meter to the waste flare and replace with a biogas flow meter.
- Replace waste flare.
- Move waste flare feed.

6.3.8.8 Dewatering

Solids dewatering is accomplished through mechanical dewatering and drying beds. The mechanical dewatering facility is used year-round while the drying beds are used only during drier months.

The dewatering building is located south of the primary digestion building, and it houses equipment for mechanical dewatering. This includes an FKC model SHX screw press, a polymer injection system, and a solids testing laboratory. The press is fed by two Borger model CL390 rotary lobe pumps. Each pump can pump sludge at 50 gpm. The polymer solution is fed using the same type of pump. The building has three heaters, but they are barely capable of keeping the space warm in the winter. There is no permanent access to the upper level of the screw press for maintenance. The solids testing lab consists of a small workbench, which holds all necessary equipment. The small lab space has no PC for data logging and acquisition. Also, the topography of the area around the dewatering building does not allow for stormwater to drain into the area collection system.

Also, polymer totes are stored in the dewatering building due to lack of chemical storage space in the WWTRRF. Per OSHA regulations, an emergency shower and eyewash station should be available where chemicals are stored.

The plant has five sludge drying beds. Four beds are located along the southern property line, and a larger bed is located near the WWTRRF entrance along the eastern property line. The four southern beds are original to the plant and numbered 1 through 4 from west to east. The fifth was added as part of the first upgrade and is known as Drying Bed No. 7. Original Drying Bed Nos. 5 and 6 were demolished to make room for the dewatering building during the 2011 upgrade.

Drying Bed Nos. 1 through 4 are fed from the secondary digesters, or the SSB, through a 6-inch cast iron pipe using two manual valves located in the center of the basins. To access the valves, operators need to walk along a narrow, deteriorating concrete walk to the center of the basins. Flow between basins is split in the same area using wooden slide gates. They leak severely and require additional support to adequately channel flow into the proper basin. In general, the asphalt lining is in fair condition, but the concrete walls are severely cracked which allows sludge to leak out.

Drying Bed No. 7 is the largest of the five beds, as its volume is greater than the other four beds combined. It is fed from secondary digestion and the SSB though a 6-inch pipe. The asphalt walls are sloped making it difficult for operators to remove dried solids, and there are areas where the wall has been damaged from the loader bucket. Splitting this larger bed into cells and adding walls would facilitate easier removal and increase the available volume for dried biosolids storage.

Storage of solids is an issue in the winter months because the drying beds cannot be used effectively due to rainy weather. Winter storage solutions should be evaluated.

6.3.8.8.1 Condition Assessment and Recommendations – Dewatering

The dewatering building itself is new and in good condition, but the heating capacity needs to be improved. The press works as designed and is in very good condition. It is expected to remain reliable beyond 10 years; however, there is inadequate access to the upper portions of the press. The press feed pumps are also in very good condition, yet they are oversized. The polymer system is in fair condition, although the model was discontinued by the manufacturer and is no longer supported. A new system or acquiring parts for the existing system should be considered prior to failure. It is spread out taking more space than required and is piped completely underground. This makes it difficult for operators to reconfigure the system to suit their needs. There is no tote mixer for the bulk polymer, which would improve consistency of the dewatering process. Also, the duct that ventilates air from the press condensates and water drips through the duct joints onto the floor. This causes a mess in the building and the ductwork is beginning to corrode. Replacing the ductwork with a different material that is sealed and draining it back to the press is recommended to address this issue.

Overall, the dewatering beds are in fair to poor condition. The walls of the southernmost beds are in severe disrepair. The valving and flow splitting are outdated and create unnecessary health and safety risks. Rehabilitation or replacement should be strongly considered.

Based on the above assessment, Murraysmith recommends the following improvements:

Dewatering building

- Run hot water loop or provide natural gas to building for heating.
- Improve lab capability and safety.
- Construct catwalk to access the upper portions of the screw press.
- Replace press ductwork and slope to drain condensation back to press.
- Consider a new polymer system to replace existing obsolete system.
- Install an emergency shower and eyewash station.
- Reconfigure dumping area outside of building to improve drainage and add permanent wall for solids removal.
- Add a truck washdown station adjacent to building.

Sludge Drying beds

- Drying Bed Nos. 1-4: Repair or replace walls and valves; rework basin isolation; and replace inlet.

- Drying Bed No. 7: Add vertical walls on the east and south sides; consider splitting into three cells.

6.3.9 SCADA System

The WWTRRF SCADA system is resident on one PC workstation at the Secondary Process Building, several PC workstations in the Administration Building, and several PanelView HMIs on local control panels in process areas throughout the facility. The SCADA software used at the WWTRRF is Rockwell Automation RsView32, running on MS Windows XP operating systems. The SCADA system is setup on multiple PCs running independently. RsView32 HMI allows operators at the WWRRTF to monitor and control process operations. The software functions adequately with the current system, but developer support is diminishing as users switch to more modern SCADA software.

The Rockwell Automation (RA) software installed on the WWTRRF SCADA servers is still viable but only has limited support from the manufacturer. No more RA software upgrades are scheduled for RSView32. RSView32 is run on 32-bit PC operating systems which are no longer supported by MS Windows XP software service packs or security patches. RA RSView32 is quickly trending toward legacy status in favor of the newer edition RA FactoryTalk SCADA software suite.

City staff have expressed the desire to continue using Rockwell Automation products. The City's existing PLC, HMI, and SCADA equipment, including software, is provided by either Rockwell Automation or a Rockwell Automation partner. Rockwell Automation (RA) is the leading automation supplier in the United States and their equipment and software is currently used by many Municipal and Industrial customers. RA's support and service structure are extensive and cover the Pendleton area well. Nearly all Systems Integrators and Automation Contractors are familiar with RA products and many are very proficient. It would be expensive for the City to switch automation product vendors due to required staff training, stocking different spare parts, and finding new suppliers/service vendors for a different product line. It is recommended that the City continue using RA products.

6.3.9.1.1 Condition Assessment and Recommendations – SCADA System

Based on the above assessment, Murraysmith recommends updating the plantwide SCADA system with RA FactoryTalk. This suite of software can be assembled and used to best suit the City's needs. This software will replace and fulfill the current HMI, process trending, and alarming functions provided by RSView32. There are many more features and opportunities for the City to archive data, create internal and DEQ reports, remote access to process data, portable and mobile access to data, advanced alarm notifications, and many more features not previously available. These options are variable and individually configurable for each Client's needs.

6.3.10 Miscellaneous Site Utility Systems

WWTRRF utility systems include the cogeneration system, hot water loop, and utility water loop. These systems afford the operators flexibility in their day to day operations, and they allow for clean, hygienic conditions at the plant.

6.3.10.1 Cogeneration

The cogeneration system involves taking digester gas, conditioning it, and sending it to two microturbines. These generate power for the plant and hot water for the hot water loop. See **Section 6.3.8.7 Digester Gas and Flare** for further discussion of digester gas handling. Conditioning begins at the iron sponges. These two cylindrical tanks remove sulfur compounds and other impurities from the digester gas. The partially conditioned gas is then sent to a chiller, which reduces the gas temperature while increasing density. Next, the gas moves through a siloxane removal system. This process removes volatile methyl siloxanes to prevent scale build-up on critical equipment in the cogen process. The gas then moves through a series of compressors and blowers producing a final product that the microturbines can use.

The microturbines are Capstone model 65C with a maximum power output of 65 kW each. They are 6 years old. Despite being relatively new, these units have many issues that are mostly caused by the quality and quantity of the digester gas. As gas moves through the cogeneration system, it draws heat from the environment which periodically freezes components in the conditioning system. The gas has a high moisture content, and although much of the moisture is removed during the conditioning process, enough makes it to the microturbines to cause problems. Even when the conditioning system is working well, the gas pressure is too low to run the microturbines at full capacity. Despite this fact, the microturbines require full maintenance, tear down, and rebuild, as if running at full capacity.

The cogeneration system also contains a waste heat radiator designed to take excess heat from the microturbines. This equipment has a capacity of 8-pounds per square inch (psi), and it is not currently in use. The system requires a larger capacity to waste heat, however, the microturbines have built-in waste heat radiation.

6.3.10.1.1 Condition Assessment and Recommendations – Cogeneration

The conditioning system is in good shape currently. All components operate reliably, and they are expected to remain operable and in acceptable condition for 10 years or more. The microturbines are in good condition. As discussed above, they operate under substandard conditions causing many break downs halting the cogeneration process. If current conditions remain, rehabilitation or replacement will be necessary in the next 5-10 years.

Based on the above assessment, Murraysmith recommends the following improvements:

- Reconfigure gas transmission from primary and secondary digesters to produce a more consistent gas stream to the microturbines.

- Move control panel inside the solids electrical building.
- Improve moisture removal in conditioning system.

6.3.10.2 Hot Water Loop

The hot water loop is a closed system which is primarily used to maintain mesophilic conditions in the primary and secondary digesters, heat buildings, and provide hot wash-down utility water. The loop begins in the primary digester complex. Here, water is heated using the auxiliary boiler or the cogeneration system. The hot water is sent to the lower floor of the primary digester complex where it is fed a closed loop corrosion inhibitor. It is then pumped using two Bell & Gossett model 2x9.5 centrifugal pumps installed during the 2011 upgrades. The loop then continues through the primary heat exchanger and out of the complex. The hot water is then sent to the east primary sludge pump station where it is boosted using a Taco model 005-F2-3 cartridge circulator. The hot water then enters the secondary digester complex where it gains more heat from the secondary boiler. The water is then pumped using a Taco model 9-96 booster pump to the secondary heat exchanger. From there, the hot water continues to the admin building. It is boosted using a Bell & Gossett series HV pump and sent through the furnaces to heat the building. The loop continues back to the primary digester complex where it flows through a Bell & Gossett model P20 plate heat exchanger, to heat washdown water. The water flows back to the auxiliary boiler to close the loop.

The hot water loop feeds the primary digester complex, the secondary digester complex, the administration building, and the east primary pump station limiting its operational usefulness. Expanding the loop to other buildings is difficult because it is sized strictly for its current operation.

6.3.10.2.1 Condition Assessment and Recommendations – Hot Water Loop

The hot water loop itself is in good condition. The water pumps at adequate pressure, and there are no major leaks in the system; however, it is limited. Other locations could benefit from the hot water loop. The booster pumps are in good condition and should operate adequately for the next 10 years. The main hot water pumps are in fair condition needing rehabilitation or replacement in the next 5-10 years.

Based on the above assessment, Murraysmith recommends the following improvements:

- Add temp and flow monitoring to SCADA.
- Upsize trunk and extend hot water loop to other locations in the plant.

6.3.10.3 Utility Water Loop

Utility water is pumped from the chlorine contact chamber effluent using three parallel Grundfos model CR32 vertical centrifugal pumps. Each pump is 6 years old, has a 25 hp motor, and has a flow capacity of approximately 160 gpm. These pumps route water through two Mueller cartridge filters into a bladder tank. The bladder tank is pressurized allowing the utility water to flow through several unit processes including headworks, primary sludge pumping, the aeration basin, secondary clarifiers, dewatering, and the dechlorination system.

The utility water system lacks a flow meter, which would allow operators to monitor usage and identify leaks in the system. The pipes going to the aeration basin and dewatering building may be undersized and/or lack loops that would sustain higher pressure through the system. Pressure is lacking in the headworks area and there are periodic pressure surges. The fine screens have a constant water demand of 17 gpm. If the utility water system cannot be modified to better meet this demand, a connection to nearby potable water should be considered.

6.3.10.3.1 Condition Assessment and Recommendations – Utility Water Loop

The utility water system was upgraded in 2011, so the pumps and bladder tank are in good condition. They are expected to maintain adequate functionality for 10 years or more. The filters are in fair condition needing replacement or rehabilitation in the next 5-10 years.

Based on the above assessment, Murraysmith recommends the following improvements:

- Reconfigure utility water yard piping to add loops and increase main sizes and install a pressure tank near the headworks.
- Install a flow meter.
- Install additional isolation valves.
- In lieu of above improvements, potable water from nearby Well 11 could be used at the headworks which will provide around 100 psi.

6.3.11 Miscellaneous Site Buildings

There are several miscellaneous buildings on-site that indirectly support the day-to-day operation of the WWTRRF. These buildings include administration, laboratory, welding parts shop, main shop, machine shed, lawn equipment shed, and chemical storage. The following section discusses the condition of these buildings.

6.3.11.1 Administration Building

The administration building is the detached structure in the middle of the plant, and It was constructed as part of the 2002 upgrades. It contains the administrator's office, a central control room, a locker room, and the plant's laboratory. The HVAC system consists of dual air conditioning units located outside the building on the south wall and two furnaces in the southwest corner of the building, which run off the hot water loop. Both furnaces are operating beyond their design life. The room where they are housed is small making any maintenance activities difficult.

The building itself is lacking adequate lockers, showers, and a conference room. Also, there are some areas with Americans with Disabilities Act (ADA) compliance issues.

6.3.11.2 Laboratory

The administration building holds two laboratory rooms. The primary lab is a 17-foot x 32-foot space in the back of the building added after the rest of the building was constructed. It has counters lining the walls on three sides with an island in the middle. This space is where most of the lab work is performed. It contains most of the equipment required for day-to-day operation. The second part of the lab is located adjacent to the primary lab in a smaller room approximately 8-foot square. This space contains some of the larger appurtenances required for testing.

The lab is functional, but there are safety and operability issues. There is no OSHA approved eyewash station, as the eye rinse station that they have now requires two distinct actions to operate. There is no chemical shower. The nearest shower is in the locker room down the hall. The counters are not spill-proof, so any chemical spills that occur can freely run down to the floor. The storage cabinets are too low, and the counters are too shallow; both of which disrupt daily operation.

6.3.11.2.1 Condition Assessment and Recommendations – Laboratory

The laboratory is in fair condition. Though the space is usable, there are enough deficiencies to necessitate upgrades within the next 5 to 10 years.

Based on the above assessment, Murraysmith recommends the following improvements:

- Combine the two lab spaces.
- Reconfigure cabinetry and island.
- Replace countertops with spill-proof counters.
- Install a larger, combined refrigerator.
- Install OSHA approved eyewash station.
- Add lockers and showers per OSHA requirements.

6.3.11.3 Welding and Parts Shop

The welding and parts shop is located south of the primary digester complex. The building was constructed in three separate portions and consists of the welding shop, parts storage, and other miscellaneous storage. The building has a roll-up door on one wall.

The building is being used as effectively as possible, but there is not enough room for all the parts kept on-hand. Because it was constructed in three iterations, the building's floor is uneven in some areas. An air compressor is stored along with the parts. It is loud and should be moved outside. The parts storage needs improvements and should be moved to a separate, larger space where parts stored in other areas of the WWTRRF can be consolidated with these materials. This building causes a blind spot for septage haulers and equipment deliveries and there have been several near misses that could have resulted in injuries. Because of this safety issue, City should consider demolishing this building.

6.3.11.3.1 Condition Assessment and Recommendations – Welding and Parts Shop

Based on Murraysmith's assessment and operator input, the recommended improvements to this building are as follows.

- Re-pipe and run the hot water loop to this building to provide heat or install a new heater.
- Consider relocating the parts storage area.
- Consider demolishing building to improve site lines and safety.

6.3.11.4 Main Shop

The main shop stands just to the west of the welding and parts shop. The metal structure has five open bays, and one enclosed bay with a concrete floor and roll-up door. The enclosed bay is considered the main shop, is heated, and has a restroom. Here WWTRRF staff store tools and use the area for equipment repair.

The west side of the Main Shop could be expanded to house the displaced welding and parts shop should the City decide to demolish the existing building.

6.3.11.5 Machine Shed

The machine shed consists of five bays attached to the main shop. The bay adjacent to the main shop has a concrete floor, while the rest of the bays have a gravel floor. The bays currently house a variety of plant vehicles, miscellaneous equipment, and supplies. Wood and parts are stored in shelves along the back wall behind the equipment.

Ferric chloride is stored in the machine shed due to lack of chemical storage space in the WWTRRF. Per OSHA regulations, an emergency shower and eyewash station should be available where chemicals are stored.

The addition of roll-up doors to close off the building should be considered, allowing insulation and heat to be implemented.

Alternatively, there is potential for the main shop to absorb the adjacent, concreted bay and expand into a larger, conditioned, enclosed area.

6.3.11.6 Lawn Equipment Shed

The lawn equipment shed, located south of the east secondary clarifier, used to be the plant's dechlorination building until it was converted to storage for general lawn equipment. The shed has both a regular door and a roll up door and is currently full.

Electrical service for this building is provided through a 220 volt extension cord from the chemical storage building to a breaker panel that is located behind a shelving unit. Also, the in-wall heater does not have required clearance around it, making it unsafe. Both are electrical code issues that should be addressed.

6.3.11.6.1 Condition Assessment and Recommendations – Lawn Equipment Shed

Based on the above assessment, Murraysmith recommends the following:

- Provide electrical service and heating that meets required code.

6.3.11.7 Chemical Storage Building

Chemicals, some safety equipment, and spare parts are stored in the chemical storage building. The building, located south of the east secondary clarifier, is comprised of a wooden structure with a brick facia and used to contain the WWTRRF's generator. It lacks gutters, and the roof is leaking causing damage to the wooden structure beneath.

The building currently houses various chemicals including oil, degreaser, paint, herbicides, pesticides, waste oil, brake fluid, antifreeze, etc. Typically, several drums of each chemical are stored on-site, but the building has no chemical containment system. According to OSHA safety regulations, chemical containment is required in case of spills or leaks. A tote stand with containment is available to meet this requirement but would not fit in the existing building. Also, the chemical storage building should have an emergency shower and eyewash station.

Chemicals should be moved to a new location that will accommodate totes with containment systems and have room for an emergency shower and eyewash station. Also, chemicals that are stored in other areas could be moved to this new location. This would eliminate the need for containment, emergency showers, and eyewash stations at each location chemicals are stored.

6.3.11.7.1 Condition Assessment and Recommendations – Chemical Storage Building

The chemical storage building is in fair condition. The roof should be repaired to eliminate leaks. Should chemicals continue to be stored here, a few additional improvements are recommended. They are as follows:

- Install chemical containment system, emergency shower, and eyewash station.
- Repair roof leaks.
- Consider adding a new building to house all chemicals currently stored all over the WWTRRF site.

6.3.12 Summary of Existing WWTRRF Improvements

The Preliminary List of Recommended Improvements is included as **Appendix G** for reference and includes upgrades identified in the condition assessment to maintain facility performance and simplify operations. The improvements were grouped into cost ranges and identified as Operations and Maintenance (O&M), Capital Improvements (CIP) and To Be Determined (TBD) projects.

Improvements identified in the A and B cost ranges are smaller O&M projects that could potentially be completed by City staff. The total for O&M projects is approximately $1.8M, or approximately $90,000 per year for the 20-year planning period.

Improvements classified in the C and D cost ranges fall between O&M and CIP type projects. The total for the TBD projects is approximately $2.6 million, and the Recommended Plan addresses as many of these as possible.

Improvements listed in the E cost range are larger CIP type projects that are expected to be in the Recommended Plan. The CIP projects identified include the following:

- Major structural renovations of the Secondary Clarifier East
- Major renovations of the Secondary Digester Complex, including possible expansion
- Addition of digester gas storage and Cogeneration improvements
- Possible addition of an alternate disinfection method
- Major structural renovations of the Chlorine Contact Chamber
- New automatic site entrance gate
- Addition of a new building to house chemicals stored all over the site
- Expand Main Shop for parts storage and relocated Welding Shop
- Update plantwide SCADA system

FIGURE 6-1

Existing WWTRRF Site Plan

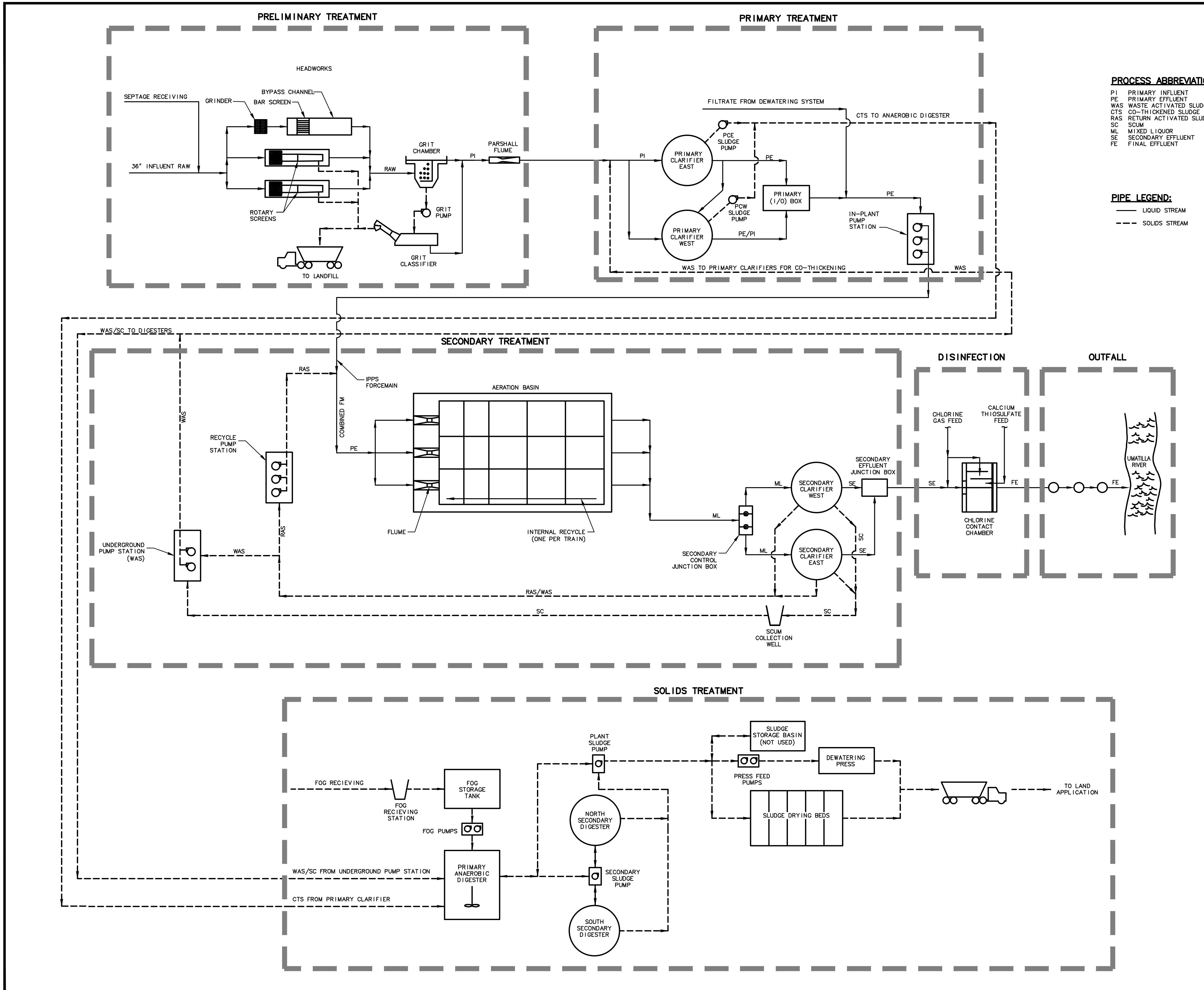


FIGURE 6-2

CITY OF PENDLETON · INCORPORATED 1880 · OREGON

WWTRRF Facility Plan Update

Existing Process Schematic

JUNE 2020

murraysmith

17-2019.402

murraysmith

Section 7

Section 7

Unit Process Option Evaluations

7.1 Liquids Stream Unit Process Options

This section addresses deficiencies identified during the Wastewater Treatment and Resource Recovery Facility (WWTRRF) condition assessment and regulatory requirement review for the liquid stream unit processes. The Existing WWTRRF Evaluation section summarizes and categorizes recommended improvements into three groups, Operations and Maintenance (O&M), Capital Improvements (CIP), or To Be Determined (TBD), based on cost ranges. This section discusses in greater detail the recommended improvement projects that fall outside of the O&M category. The following areas were identified as needing larger upgrades based on the condition assessment:

- **Primary Clarifiers** – Structural renovations are needed to keep the clarifiers in good working order;
- **Secondary Clarifiers** – Major structural renovations are required to keep the clarifiers in good working order;
- **Chlorine Contact Chamber** – Major structural renovations are required to keep the facility in good working order; and
- **Utility Water System** – Improvements to the utility water system are required to provide flow and pressure to the Headworks and other areas.

This section also presents a preliminary analysis of the options available to address deficiencies or increase capacity of liquid stream unit processes, where required. Each option includes a description of the unit process, installation requirements, capital costs, and 20-year lifecycle costs. The following Unit Processes with alternatives are evaluated:

- **Headworks and Dewatering Building Heat** – Improvements are required to provide heat to the Headworks and Dewatering buildings to prevent utility water freezing;
- **Return Activated Sludge (RAS) and In-Plant Pump Station (IPPS) Pump Stations** – Improvements to the RAS and in-plant pump stations are needed to optimize the force main hydraulics;
- **Blower Upgrade –** Optimization of the blower arrangement is necessary to reduce energy consumption and adapt to seasonal oxygen demand fluctuations;

- **Disinfection Methods** – Alternate methods for disinfecting final effluent are identified and evaluated for replacement of the existing chlorine gas system;

- **WWTRRF Final Effluent Flow Measurement** – A new effluent flow meter is necessary to more accurately measure effluent flow; and

- **Long-term Temperature Compliance –** Improvements may be needed to meet potential future permit conditions for discharging into the Umatilla River.

7.1.1 Liquid Stream Condition Assessment Related Upgrades

Aging mechanical equipment, structural, and coatings noted in the condition assessment requires replacement with like equipment or repairs; therefore, only one option is included. The majority of the upgrades to existing aging facilities are included in the Recommended Plan section to follow.

7.1.1.1 Primary Clarifiers

According to the condition assessment, most significant structural deficiencies in the Primary Clarifiers are concrete cracking, degradation of launder coating, and corrosion of exposed steel. While both clarifiers need improvements to continue functioning without failure, the repairs necessary for the west clarifier are more substantial.

It is recommended that Primary Clarifier East (PCE) undergoes launder coating demolition and recoating, spot repair of the outside wall, and the application of a skim coat on the interior clarifier wall. Cracking observed is most likely due to shrinkage. There is abandoned and exposed steel present that is recommended to be removed and spot repaired, respectively. Skim coating the interior wall would work to prevent further deterioration of the concrete.

Primary Clarifier West (PCW) shows similar deficiencies as PCE with a few additional recommended improvements. Like in the east clarifier, it is recommended to spot repair the outside wall cracks, remove abandoned steel and spot repair exposed steel within the concrete wall, and to apply a skim coat to the inner surface of the clarifier wall to prevent continued deterioration and exposure of aggregate. Partial launder recoating is recommended, as PCW's launder is not in need of full recoating. The floor slab of PCW is also showing areas of delamination and wear that could be spot patched, or a skim coat applied. Finally, it is recommended to blast and recoat the corroded steel scraper mechanism of PCW.

The estimated capital cost to perform all recommended repairs for PCE and PCW is $284,000.

7.1.1.2 Secondary Clarifiers

According to the Condition Assessment, Secondary Clarifier East (SCE) was in the poorest condition of the structures investigated. Full rehabilitation is recommended. Cracking on the walls and clarifier floor, pitting of concrete on the interior of the clarifier walls and floor, splitting of anchorage on the bearing block of the skimmer arm, corrosion of steel elements, and failure of welds on the scraper arm are present. It is recommended that the scraper mechanism, weirs, center well and drive be replaced entirely.

In the Secondary Clarifier West (SCW), concrete cracking on the walls and throughout the floor slab, isolated areas of peeling and spalling in the launder coating on the inner side of the outer wall, and heavy corrosion on the steel elements are present. In addition to structural repairs, it is recommended that the SCW drive unit be replaced, as it is approaching the end of its life cycle.

The estimated capital cost to perform all recommended repairs for SCE and SCW is $1,504,000.

7.1.1.3 Chlorine Chamber Structural Repairs

Recommended improvements for the Chlorine Contact Chamber include repairing large vertical cracks and expansion joints, spalled and broken areas around equipment anchors, general spalling and degraded concrete, as well as constructing concrete baffle walls in the north and south trains of the chlorine contact chamber. An additional catwalk is also recommended to be constructed for maintenance and operator access. Chlorine contact chamber structural repair and improvement costs are estimated to be approximately $369,000.

7.1.1.4 Utility Water System

The utility water system is unable to provide the necessary pressure at the headworks for the screen purge cycle in addition to providing a constant water demand of 17 Gallon per Minute (gpm). A combination of inadequate pipe and pump sizes result in insufficient pressures. It is recommended to install a pressure tank near the headworks, booster pump, flow meter, additional isolation valves in the system, and increase the utility water pipe size on the east side of the WWTRRF. The estimated cost of this is $65,000.

Through the course of the facility planning effort it was found that in leu of upgrades to the utility water system, the City of Pendleton (City) could connect to the newly redeveloped well 11 for needed water demand and residual pressure.

7.1.2 Liquid Stream Unit Process Options Evaluation

The following analysis presents researched alternatives and recommendations to address unit process efficiency and capacity issues throughout the WWTRRF. The unit processes discussed below were identified during the condition assessment. These recommended areas for improvement all require an analysis of available options, as there is no isolated, direct path to address the deficiencies. See **Figure 7-1** for the Overall Site Plan.

7.1.2.1 Headworks and Dewatering Building Heating

The Headworks and Dewatering buildings need improved heating to prevent water lines from freezing during the winter months. Both buildings currently have electric unit heaters installed, but they are not sufficiently sized to effectively heat the buildings. The buildings' high ceilings and poor insulation make it difficult for the existing heaters to maintain interior temperatures above freezing. In addition, the Headworks building is Class 1, Division 2 space and the required air changes further reduce the capacity of the existing heaters to prevent pipe freezing.

Exposed pipes in the Headworks and Dewatering buildings can be heat traced and insulated; a combination of natural gas and upgraded electric heating source could be installed; or the Plant Hot Water Loop can be routed to the Headworks and Dewatering buildings to provide a heat source.

7.1.2.1.1 Insulate and Heat Trace Water Lines in Buildings

In order to protect above-ground pipes in the Headworks and Dewatering buildings, heat trace and insulation is required for the exposed utility water pipes. New wiring and conduit would be required in each building to provide power to the heat trace cable. Installation would be simplified by routing power to specific areas requiring freeze protection through conduit to avoid subgrade work. See Figure 7-2 for the Headworks Heat Trace Plan and Figure 7-3 for the Dewatering Heat Trace Plan.

The capital cost of this alternative is $54,000. The 20-year net present worth (NPW) of O&M cost is $52,000.

7.1.2.1.2 Convert to Natural Gas Heaters and Upsize Electric Unit Heaters

A natural gas connection exists on the WWTRRF property adjacent to the Dewatering building. This alternative recommends that the Dewatering building's heating system be converted to natural gas, since the building is not a classified space. A connection from the natural gas line to the heating equipment inside the building will be required. The capital cost of natural gas heating for the Dewatering building is $60,000 with a $104,000 20-year net present worth of O&M.

Converting the Headworks building to a natural gas heating system was considered, but natural gas heating equipment rated for classified space is not available. Therefore, it is recommended to upgrade the existing electric heating system. Based on the calculated British Thermal Units (BTU's) per hour required to heat the 1,700 square foot building, three 10-kilowatt (kW) unit heaters are required to prevent pipe freezing. This is assuming 480-volt models are selected. The capital cost of upgrading the existing unit heaters and installing three additional units is $28,000. This includes running new electrical conduit to the additional heater locations to power the units. The 20-year net present worth of O&M for upgrading the electric heat system in the Headworks building is $107,000.

7.1.2.1.3 Use Hot Water Loop

Currently the Plant Hot Water Loop runs throughout the site, but not immediately adjacent to the Headworks and Dewatering Buildings. There is an option to expand this existing system and install equipment to provide heat in the two buildings and prevent pipe freezing. This would require installing approximately 250 feet of new trenched and insulated pipe to extend the hot water loop to the Headworks and Dewatering buildings.

A skid-mounted makeup air unit with a hot water coil for heat exchange, blowers, ducts, and fans would also be necessary. While the makeup air unit is not rated for use inside a Class 1, Division 2 space, it would be installed on the building exterior and provide heated outside air to the classified Headworks building. The same configuration would be utilized for the Dewatering building. The externally located units would not require that the Hot Water Loop be extended into the building interiors, which simplifies installation. See **Figure 7-4** for the Hot Water Loop Extension Plan.

The cost of this alternative is $159,000 for materials, equipment, and installation. The 20-year net present worth of O&M cost is $67,000. These costs were developed under the assumption that there is enough recirculation and heat capacity in the existing hot water loop to support additional heat draw from the system.

7.1.2.1.4 Headworks and Dewatering Building Heating Options Summary

Table 7-1 shows a comparison of CIP cost and 20-year net present worth of O&M costs of all three alternatives.

Table 7–1
Headworks and Dewatering Building Heating Options Summary

Building Heating Alternatives	CIP Costs	20-Year NPW O&M
Alt 1: Insulate and Heat Trace Water Lines	$54,000	$52,000
Alt 2: Natural Gas/Electric Heating	$88,000	$211,000
Alt 3: Hot Water Loop Heating	$159,000	$67,000

Notes:
1. Estimate is for planning purposes only; Association for the Advancement of Cost Engineering International (AACEI) Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor operations and procedures (O&P), contingency, engineering, legal, and administration

7.1.2.1.5 Recommendation

Utilizing the hot water loop in conjunction with a makeup air unit and hot water coils is the recommended alternative to prevent pipe freezing in the Headworks and Dewatering buildings. Although this alternative has the highest capital cost, it will provide building heat for operators while they are performing maintenance on equipment. It is also recommended based on the lower 20-year net present worth O&M costs.

7.1.2.2 Recycle Pump Station and In-Plant Pump Station Upgrades

RAS from the two secondary clarifiers flows into the RPS where it is pumped into a force main and combined with flow from the IPPS prior to entering the head of the aeration basin. The RPS is comprised of three submersible Myers pumps. The current RPS pumps are identical to those installed in the IPPS; however, the pumps are oversized and cannot be operated at a low enough speed to provide the appropriate RAS flow rate to the aeration basin under normal operating conditions. The primary driver for this condition is suspected to be insufficient head pressure in the force main to adequately control the pump discharge via variable frequency drive (VFD).

Flow meters also need to be installed so that the RPS and IPPS flows can be accurately monitored. Magnetic flow meters are assumed to be the preferred equipment for all alternatives presented below.

The existing design point of each pump station is 3.6 million Gallons per Day (MGD) (2,500 GPM) at 50 feet of water column. The current max month wet weather flow (MMWWF) for the facility is 2.3 MGD (with reported overnight flows decreasing to 1.0 MGD). At such low flows, the head pressure in the force main is not likely to exceed 30 feet of water column under normal flow conditions, which makes low flows difficult to achieve for the existing pumps even with a VFD. It is also probable that the low flows in the 14-inch, IPPS-only section of the force main do not provide adequate velocity to keep solids suspended and prevent accumulation in the force main, which could lead to further operational difficulties in the future.

Furthermore, if the RPS and IPPS pumps are operating simultaneously, it is reported that the IPPS check valves close frequently causing the IPPS pumps to shut down. The exact root cause of this condition is not currently known, but it is suspected to be related to the sizing of the pumps and force main relative to the actual flows. RAS pumping upgrades will not affect the WWTRRF's Waste Activated Sludge (WAS) system and waste pumps, as the WAS flow is routed through a separate wet well independently of the RAS.

7.1.2.2.1 Replace Existing RAS Pump Station (RPS) Pumps and Use Existing Force Main

The first alternative is to replace the existing RPS pumps with new submersible pumps that are appropriately sized for the design flows. The design point of the new pumps would be 1.7 MGD (1,200 GPM) at 30 feet of water column. These design criteria are suitable for selecting pumps that are capable of operating within a sufficient range to accommodate low flow conditions using a single pump with VFD as well as high flow conditions using multiple pumps at full speed.

One disadvantage of this alternative is that the current layout of the piping from the RAS station is tight and would require additional construction costs, beyond pump replacement, to accommodate the flow meter with potential impacts to operations. It is likely that the 12-inch header, running parallel to the force main, will need to be modified to achieve the upstream and downstream straight pipe lengths required for accurate flow measurement. The IPPS flow meter will be installed in the 14-inch section of the existing force main within a vault to accommodate maintenance access.

In addition, the RPS pumps discharge almost directly into the combined force main, which is oversized for the current design flows and does not develop appreciable friction loss. Even a pump that is correctly sized for the design flows will be operating within a narrow range of head pressure as a result of the pipe size, despite pump speed, which could result in a limited range of discharge under VFD control.

This alternative also does not address the interaction between the RPS and the IPPS pumps discharging into the same force main at different locations. It is not known whether new RPS pumps would resolve the issue of the IPPS check valves closing and the IPPS pumps shutting down.

The capital cost of this alternative is $298,000. The 20-year net present worth of O&M cost is $304,000.

7.1.2.2.2 Construct New Independent Force Main and Replace Existing RPS Pumps

Another alternative is to construct a new independent force main from the RPS to the aeration basin splitter box and replace the RPS pumps with smaller submersible pumps. The existing IPPS pumps will remain in service and continue to utilize the existing force main for primary effluent conveyance. The 12-inch header from the RPS would be continued as an independent force main to the aeration basin splitter box, which is expected to accommodate a flow meter installation. The IPPS flow meter will be installed in the 14-inch section of the existing force main within a vault to accommodate maintenance access. The new RPS pumps would have the same design point as those described in Section 7.1.2.2.1 above.

This option eliminates the limitations to achieving low RAS flow rates and the effect of the RAS pumps on the IPPS pump station. A 12-inch, independent force main and the proposed RPS pumps are suitable for circulating RAS at the projected MMWWF rate of 3.5 MGD (2,400 GPM) with two pumps operating at full speed and greater than 78 percent efficiency. A single pump can be reduced to a flow rate of 0.7 MGD (500 GPM) at 66 percent speed and greater than 70 percent efficiency. The existing IPPS pumps will not be influenced by the operation of the RPS pumps and VFD control of the pump discharge will not be limited by reduced head pressure in a large pipe.

One disadvantage to this alternative is that it may be difficult to install the new RAS force main along the route of the existing force main without potential impacts to other underground piping or infrastructure. Alternate paths may need to be evaluated to route the new force main around the aeration basin to the west or use directional drilling to install the force main below it.

The capital cost of this alternative is $386,000. The 20-year net present worth of O&M cost is $304,000. See Figure 7-5 for the RAS Pump Station New Force Main Plan.

7.1.2.2.3 Convey RAS from RPS to IPPS and Use Existing Force Main and IPPS Pumps

The third alternative is to convey RAS from the RPS wet well to the IPPS. The existing submersible pumps in the IPPS will be used to pump the combined contents of the IPPS wet well through the existing force main to the aeration basin. RAS transfer is anticipated to be accomplished using gravity from the secondary clarifier without a need for pumps. The existing RPS pumps will be removed for long-term storage and the associated plug valves will be closed under this alternative.

A new 12-inch, high density polyethylene (HDPE) pipeline will be installed from the RPS wet well for gravity transfer of RAS to the IPPS wet well, where RAS and the primary clarifier effluent will be combined and mixed. The outlet of the RAS pipe will be set above the high-high level switch position to enhance mixing in the wet well and to maintain approximately 5 feet of total fall for gravity transfer. A preliminary hydraulic evaluation suggests that this configuration may support a maximum flow rate of approximately 3,500 GPM, which exceeds the RAS requirement under the projected flows and loads.

RAS flows to the aeration basin will be controlled by intermittently opening an actuated valve adjacent to the RPS. A magnetic flow meter installed between the actuated valve and the RPS will be integrated with the Supervisory Control and Data Acquisition (SCADA) system to achieve the target RAS flow set by the operators. Both the flow meter and the actuated valve will be located in a vault for maintenance access. The section of pipeline where the flow meter is set will be configured to maintain full pipe condition for reliable flow measurement. The IPPS flow meter will be installed in the 14-inch section of the existing force main within a vault to accommodate maintenance access.

The capital cost of this alternative is $119,000. The 20-year net present worth of O&M cost is $205,000. See **Figure 7-6** for the RAS Pump Station Gravity to IPPS Plan.

7.1.2.2.4 RPS and IPPS Upgrade Options Summary

Table 7-2 shows a comparison of CIP cost and 20-year net present worth of O&M costs of all three alternatives.

Table 7–2
RPS and IPPS Upgrade Options Summary

RPS and IPPS Upgrade Alternatives	CIP Costs	20-Year NPW O&M
Alt 1: Replace Existing RPS Pumps	$298,000	$304,000
Alt 2: New RPS Force Main	$387,000	$304,000
Alt 3: Convey RAS to IPPS	$119,000	$205,000

Notes:
1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration

7.1.2.2.5 Recommendation

Alternative 3 is recommended, as constructing a new force main is unnecessary. Plus, the removal of the RPS pumps reduces the overall pump maintenance required for this unit process. This option is also the least costly of the three.

7.1.2.3 Secondary Process Aeration Blower (AB) Upgrade

Currently, the WWTRRF can use the three K Turbo blowers and one Aerzen blower during summer months when the rate of oxygen uptake is the greatest in the aeration basin. During cooler months, only the Aerzen blower is necessary to meet the oxygen requirements of the basin. A flow of 325 cubic feet per minute (CFM) is reported to be a suitable target during this time of year. The existing Aerzen blower cannot be turned down sufficiently as it is currently configured in the SCADA and supplies more air to the process than is necessary, which results in excessive energy consumption. The three options moving forward are to modify the SCADA system to turn down the existing Aerzen blower output, to install a new smaller blower with no VFD, or to install a new smaller blower with VFD.

7.1.2.3.1 Modify the SCADA system to turn down existing Aerzen blower output

The existing blower has more capacity than is needed for the existing process during the winter months, but the available range of VFD operation is limited by the current SCADA system settings. VFD control in the SCADA system is configured to a minimum setting of 54 percent, which is the low range of operability associated with the K Turbo blowers. The existing Aerzen is reported to be operable at a VFD setting of 30 percent according to the manufacturer, which corresponds to an output of approximately 325 CFM at a design pressure of 15 pounds per square inch (psi). The SCADA will be modified under this alternative to separate VFD control of the Aerzen blower from the K Turbo blowers to turn down the Aerzen to 30 percent speed. A SCADA modification is approximated to cost $10,000.

7.1.2.3.2 Add new smaller Aerzen blower without VFD

Another option is to install a new blower appropriately sized to supply the correct amount of air to the process during colder months. No VFD turndown will be incorporated under this alternative and so the rate of supplied air will be fixed and designed to meet the cold weather oxygen uptake rate. This unit would also be designed to run in parallel with the existing Aerzen blower in the warmer months when oxygen uptake rates are greater. The primary disadvantage of this alternative is a lack of versatility to accommodate potential variations in process requirements.

The capital cost of this alternative is $99,000. The 20-year net present worth of O&M cost is $180,000.

7.1.2.3.3 Add new smaller Aerzen blower with VFD

A third option is to install a new blower appropriately sized to supply the correct amount of air to the process during colder months using a VFD. This configuration would require a blower that is smaller than the existing blower, but larger than that described above. The addition of a VFD to the configuration would provide a range of operation that would accommodate variable oxygen uptake rates. This unit would also be designed to run in parallel with the existing Aerzen blower in the warmer months when oxygen uptake rates are greater and would add greater versatility of operation. The addition of another smaller blower provides redundancy. This alternative also includes modifying the SCADA system to allow for greater turndown as discussed above.

The capital cost of this alternative is $137,000. The 20-year net present worth of O&M cost is $180,000.

7.1.2.3.4 Blower Upgrade Options Summary

Table 7-3 shows a comparison of CIP cost and 20-year net present worth of O&M costs of all three alternatives.

Table 7–3
Blower Upgrade Options Summary

Blower Upgrade Alternatives	CIP Costs	20-Year NPW O&M
Alt 1: Modify SCADA	$10,000	-
Alt 2: New Smaller Blower w/out VFD	$99,000	$180,000
Alt 3: New Smaller Blower w/ VFD	$137,000	$180,000

Notes:

1. Est Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration

7.1.2.3.5 Recommendation

Alternative 3 is the recommended plan for upgrading the AB system. The addition of a second, smaller blower will allow for a redundant unit, and the SCADA programming modification will allow for added operational flexibility.

7.1.2.4 Disinfection Methods

Chlorine gas is currently used at the WWTRRF as the primary disinfecting agent, and the solution is injected into the effluent after secondary treatment. Maintaining and operating the system involves storage and handling of hazardous chemicals, which will require additional safety and updated chemical storage equipment to achieve regulatory compliance. Three disinfection methods proposed as alternatives to chlorine gas are bulk delivery of Sodium Hypochlorite, onsite generation of Sodium Hypochlorite, or an ultraviolet (UV) system.

The disinfection building currently has side swinging doors and it is recommended to install a roll up door and a loading dock for chemical delivery for all alternatives presented, except the UV system option.

7.1.2.4.1 Chlorine Gas and Improve Disinfection Building Loading Bay

The current chlorine gas system requires a few upgrades to optimize treatment performance, improve operations, and meet safety regulations. In addition to the roll up door and loading dock installations described above, recommended improvements include installing new chlorine gas cylinder scales and updating the SCADA system programming to improve disinfection operations.

While the existing chlorine injection system provides adequate disinfection, it is labor intensive and costly to operate. One disadvantage of this alternative is additional cost for safety equipment and training of all current and new staff. Safety equipment (SCBA) has many components and safety-related testing requirements are extensive, almost doubling the cost of this chlorine gas disinfection alternative. Consideration of this alternative must also include the inherent risk to staff who work with and around the system in comparison to other alternatives.

Operator labor for chlorine gas disinfection is currently quantified as approximately 160 hours a year, per Operator records. Improvements to the chlorine gas system would not significantly reduce or increase the number of hours required for operation and maintenance.

The estimated capital cost for continuing to operate a chlorine gas disinfection system, including installing a roll up door and loading dock and other appurtenances is $110,000. The estimated 20-year net present worth O&M cost of this option is $494,000.

7.1.2.4.2 Onsite Sodium Hypochlorite Generation and Improve Disinfection Building Loading Bay

A MIOX on-site sodium hypochlorite generation system for disinfection eliminates the storage and handling of hazardous materials. A packaged system is a means of generating a dilute, non-hazardous sodium hypochlorite solution within a contained unit with a relatively small footprint. This generation system requires only water, common salt, and electricity to create the disinfection solution. An example of a successful MIOX installation is Tacoma Treatment Plant No 3.

Preliminary sizing of this system suggests that two 75 pounds per day MIOX units are sufficient for full redundancy and to meet the chlorine demands of the WWTRRF for adequate disinfection. The MIOX system will require a new building and storage tank.

Labor costs associated with this alternative are moderate, but far less than those for the existing chlorine gas disinfection system. About half as many hours are anticipated for operation and maintenance of an onsite sodium hypochlorite generation system.

The capital cost of this alternative is approximately $1,400,000. The 20-year net present worth of O&M cost is $813,000.

7.1.2.4.3 Bulk Sodium Hypochlorite Delivery with Storage and Improve Disinfection Building Loading Bay

A third alternative is to use sodium hypochlorite solution delivered by a third-party supplier. This requires an 8,000-gallon tank that would be insulated and located outside adjacent to the existing chlorine building. New metering pumps are required; however, the existing tubing from the disinfection building to the injection port would be used.

Operator labor for this alternative is much less compared to the onsite sodium hypochlorite generation alternative and less than half of what is required to upkeep the current chlorine gas system.

The capital cost of this alternative is $83,000 for materials, equipment, and installation. The 20-year net present worth of O&M cost is $157,000. See **Figure 7-7** for the Bulk Sodium Hypo Delivery Alternative.

7.1.2.4.4 UV Disinfection

UV disinfection is a fourth alternative to improve the disinfection process at the WWTRRF. This form of disinfection will require a conversion of one of the existing chlorine contact basin trains to a channel to house the UV system. Other costs associated with operating a UV disinfection system include maintenance, replacement of light bulbs, and power supply.

A redundant UV system is recommended to ensure disinfection is achieved in case one of the units fails unexpectedly or is taken offline for maintenance. These redundant units should be installed in series, in the same channel. It is recommended to construct a concrete wall in the South section of the chlorine contact chamber to form the channel for UV disinfection. Concrete must be poured in the bottom of the channel to form a pedestal for the UV units to be installed on. See **Figure 7-8** for the UV Disinfection Plan.

Newer UV units require minimal operation and maintenance. Operator labor will be necessary only to change out the UV bulbs annually, anticipated to take a maximum of 2-3 days.

The capital costs to convert to a UV system is estimated at $700,000. Transitioning to UV disinfection would also provide a cost savings of $47,000 on dechlorination chemical, which would not be necessary in this alternative. The concrete repairs to the concrete chamber are still applicable for this option. The 20-year net present worth of O&M cost is $799,000.

7.1.2.4.5 Disinfection Method Options Summary

Table 7-4 shows a comparison of CIP cost and 20-year net present worth of O&M costs of all four alternatives.

Table 7–4
Disinfection Method Options Summary

Disinfection Alternatives	CIP Costs	20-Year NPW O&M
Alt 1: Chlorine Gas (Current System)	$110,000	$494,000
Alt 2: Onsite Generation of Sodium Hypochlorite	$1,400,000	$813,000
Alt 3: Bulk Delivery of Sodium Hypochlorite	$83,300	$157,000
Alt 4: UV Disinfection	$700,000	$799,000

Notes:
1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.

2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration

7.1.2.4.6 Recommendation

Alternative 3, Bulk Delivery of Sodium Hypochlorite, is recommended to replace the current chlorine gas system. This option has the lowest long-term costs and will eliminate handling and storage of chlorine gas. If alternative 2 is pursued, pilot testing is recommended before implementation.

7.1.2.5 WWTRRF Final Effluent Flow Measurement

The final effluent flow is measured with a submersible, ultrasonic flow meter in the second outfall manhole, just outside of the fence. Although the existing flow meter's sensor was recently replaced, the accuracy of the meter readings is questionable. A 36-inch outfall pipe carries final effluent from the chlorine contact chamber to the outfall, and options were explored to replace the submersible flow meter with an alternative that would fit reasonably into the 36-inch diameter effluent channel. A Parshall flume will fit in the existing manhole and would require extensive concrete work. A doppler radar-type flow meter and a magnetic flow meter are both viable alternatives.

7.1.2.5.1 Doppler Radar-type Flow Meter Installation

In this alternative, the doppler radar-type flow meter will be installed within the second outfall manhole. Therefore, a new structure to house the sensor is not required. Electrical conduit is necessary to power the sensor and connect it to SCADA.

The estimated capital cost for this alternative is $42,000. The 20-year net present worth of O&M cost is $39,000.

7.1.2.5.2 Magnetic Flow Meter and a New Vault

Installing a magnetic flow meter will require the installation of a new precast concrete vault over the existing outfall pipe. The 14-inch flow meter will require a reducer and an expander coupling within the vault on either side of the flow meter. This magnetic flow meter system would also require electrical components and connection to SCADA.

The estimated capital cost for this alternative is $65,500. The 20-year net present worth of O&M cost is $40,000.

7.1.2.5.3 Parshall Flume and Extending the Chlorine Contact Chamber (CCC) Effluent Channel

The last alternative involves installing a Parshall flume within the CCC effluent channel. The Parshall flume would have a 9-inch throat (minimum), and it would be coupled with an ultrasonic level sensor to monitor flows. The system would be connected to SCADA for remote monitoring of effluent discharge rates. To accommodate the Parshall flume, the effluent channel of the CCC would be expanded.

The estimated capital cost for this alternative is $89,000. The 20-year net present worth of O&M cost is $36,000.

7.1.2.5.4 Final Effluent Flow Measurement Options Summary

Table 7-5 shows a comparison of CIP cost and 20-year net present worth of O&M costs of both alternatives.

Table 7–5
Final Effluent Flow Measurement Options Summary

Effluent Flow Measurement Alternatives	CIP Costs	20-Year NPW O&M
Alt 1: Doppler Radar-Type Flow Meter	$42,000	$39,000
Alt 2: Magnetic Flow Meter	$65,500	$40,000
Alt 3: Parshall Flume Flow Meter	$89,000	$36,000

Notes:

1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration

7.1.2.5.5 Recommendation

The recommended upgrade is Alternative 3, which involves installing a Parshall flume within an expanded effluent channel of the CCC. This is the preferred alternative due to the ability to be installed in an existing structure while having similar accuracies to the other alternatives.

7.1.2.6 Long-term Temperature Compliance Alternatives

As discussed in Section 3 of this report, the effluent temperatures in the City's National Pollutant Discharge Elimination System (NPDES) Permit were based on requirements in the Oregon Temperature Standard and the Umatilla River Basin Temperature total maximum daily load (TMDL); however, the City was not able to meet the new temperature limits. In addition, a lawsuit by the Northwest Environmental Associates (NWEA) sued the United States Environmental Protection Agency (EPA) over the Temperature TMDL limits. Because City was unable to meet the permit criteria, the City and Department of Environmental Quality (DEQ) entered into a Mutual Agreement and Order, which allowed for temporary removal of the temperature limit. While the City does not currently have a temperature discharge criterion, a recent judge order requires DEQ to prepare new temperature TMDLs in the near future. It is likely that the City will be required to meet a limit during the next permitting cycle.

The WWTRRF NPDES permit established temperature compliance criterion by assuming that 25 percent of the river volume is available for mixing but was superseded by the 2007 Cumulative

Effects Analysis (CEA). The Temperature Compliance memo concluded that the potential for temperature violations increases substantially under this criterion. If the 2007 CEA is nullified, this criterion would be applicable. Because of the uncertain outcome of the litigation and potential for regulatory changes, this section evaluates temperature-reducing measures equivalent to diverting 2.0 MGD from the WWTRRF discharge based on data presented previously. Following the resolution of current litigation, it is anticipated that alternatives for long-term temperature compliance will be revisited.

The majority of the violations occurred during the summer season. Therefore, finding alternative disposal methods include cooling by diurnal storage, hyporheic discharge, mechanical cooling, or creating Class A or C recycled water to be used for irrigation or other approved non-potable water uses from the WWTRRF effluent.

7.1.2.6.1 Current Facility Plan Recommended Plan – Membrane Bioreactor (MBR) Conversion with Diurnal Storage and Discharge to River

The current Facility Plan recommends conversion of the aeration basin to a MBR which is capable of filtering mixed liquor suspended solids (MLSS) without the need for secondary clarification. Under this plan, the secondary clarifiers will be permanently converted to cooling basins for treated effluent prior to discharge during the summer months. A permanent conversion of the secondary clarifiers means that the new MBRs will be required to displace the treatment capacity of the secondary treatment process entirely. This conversion will require treatment capacity for the projected 2040 peak day flow (PDF) of 4.22 MGD, which can be achieved with a three-train MBR conversion of the existing aeration basin. Two trains will be capable of treating the 2040 MMWWF of 3.47 MGD, with the third providing redundancy.

The existing secondary clarifiers will be retrofitted to accommodate convective cooling of the treated effluent through the base, sidewalls, and surface of the converted clarifiers. Mechanical mixing will be utilized to encourage heat transfer and prevent stratification. Other methods of optimization, such as solar insulation or induced air flow across the basin surface, may also be considered as necessary to achieve the required thermal reductions. The existing clarifiers have a combined capacity of 1.7 million gallons, which provides storage for approximately 50 percent of the max month dry weather flow (MMDWF). Depending upon temperature criteria applied to the WWTRRF as a result of current litigation, the capacity of these basins to store and cool the treated effluent must be further evaluated in detail.

The best-case scenario under this alternative relies upon cooling overnight followed by a blended discharge of the cooled effluent from the storage basins with effluent directly from the disinfection unit process. Blending could be limited to periods when thermal reduction of the effluent is required to meet discharge criteria in order to optimize cooling capacity. The degree of cooling achievable in the existing storage basins would rely heavily upon the equipment selected and would need to be further evaluated for the required reductions to meet the final discharge criteria.

One potential concern of this option is that adequate storage capacity may not be available in the existing secondary clarifiers to achieve the required cooling. The need for additional storage to expand the diurnal cooling capacity should be re-evaluated following resolution of the current litigation.

The capital cost of this alternative is $5.67 million. The 20-year net present worth of O&M cost is $3.0 million. See **Figure 7-9** for the MBR Conversion with Diurnal Storage Schematic.

7.1.2.6.2 Hyporheic Discharge

Piloting efforts were completed for the City of Pendleton to consider hyporheic zone discharge as a method of effluent cooling previously. Cooling is passively accomplished as the effluent percolates through the soil. The zone of effluent discharge would need to be located toward the direction of McKay creek due to the impermeable levee construction on the Umatilla River side of the WWTRRF.

The outfall pipeline would be modified by installing a branched diversion structure in the 24-inch section to the south of McKay Creek. The diversion would be controlled by a gate to direct final effluent to the hyporheic discharge field and prevent it from discharging directly to the Umatilla River. This configuration assumes that the entire final effluent flow will be diverted and does not require additional flow monitoring or control devices as would a partial diversion configuration. The 2040 average dry weather flow (ADWF) of 3.18 MGD represents the anticipated flow on days which hyporheic discharge will be required. Based on the 2006 piloting efforts, it is assumed that a hyporheic discharge field capable of accommodating the entire WWTRRF flow would occupy 15 acres along the Umatilla River.

The capital cost of this alternative is $4.64 million. The 20-year net present worth of O&M cost is $276,000. See **Figure 7-10** for the Hyporheic Discharge Schematic.

7.1.2.6.3 Stage Based River Discharge with Seasonal Class A Recycled Water Irrigation

During the summer months when there is both a demand for irrigation water and a need to reduce thermal loading in the Umatilla River from final effluent discharge, diversion of a Class A recycled water slipstream can effectively reduce this load while simultaneously providing a public benefit. In order to produce Class A recycled water, one train of the aeration basin must be converted to MBR. This conversion is similar to that described in **Section 7.1.2.6.1** above but does not displace the requirement for secondary clarification as it does under that alternative.

This alternative would require a single-train MBR conversion, a recycle water pump station, and force main(s) to irrigation location(s). A 2.0 MGD MBR treatment train is currently estimated to be required in order to effectively reduce thermal loading on the Umatilla River.

Sufficient acreage, based on local agronomic application rates, would need to be allocated to accept the Class A recycle irrigation water with long-term agreements in place to ensure reliability of the slipstream diversion. Possible sites for Class A recycled water for irrigate include the I-84 median strip, the Eastern Oregon Regional Airport industrial area, potential future biosolids land application sites, and other beneficial use sites. This evaluation considers a booster pump station to transfer Class A recycled water from the chlorine contact chamber with an assumed flow of 1.0 MGD per pump and a total dynamic head of 300 feet.

The capital cost of this alternative is $6.1 million. The 20-year net present worth of O&M cost is $3.0 million. See **Figure 7-11** for the Class A Recycle Water Schematic.

7.1.2.6.4 Stage Based River Discharge with Seasonal Class C Recycled Water Irrigation

During the summer months when there is both a demand for irrigation water and a need to reduce thermal loading in the Umatilla River from final effluent discharge, diversion of a Class C recycled water slipstream can effectively reduce this load while simultaneously providing a public benefit. Class C recycled water requires oxidation and disinfection of wastewater before discharge; however, it does not require a filtration step. This will allow a portion of the effluent wastewater to be used for irrigation without needing extensive process upgrades.

Sufficient acreage, based on local agronomic application rates, would need to be allocated to accept the Class C recycled irrigation water with long-term agreements in place. Possible sites for Class C recycled water for irrigate include the I-84 median strip, the Eastern Oregon Regional Airport industrial area, potential future biosolids land application sites, and other beneficial use sites. This evaluation considers a booster pump station to transfer Class C recycled from the chlorine contact chamber with an assumed flow of 1.0 MGD per pump and a total dynamic head of 300 feet.

The capital cost of this alternative is $3.3 million. The 20-year net present worth of O&M cost is $0.9 million. See **Figure 7-12** for the Class C Recycle Water Schematic.

7.1.2.6.5 Mechanical Cooling

Mechanical cooling, using chillers and cooling towers, is the most energy intensive option for temperature compliance. Capital improvement costs include the installation of major mechanical equipment, pumps, and piping. In addition, there are high operational costs associated with the energy consumption and replacement of refrigerant. Preliminary evaluation of this option suggests that the cooling capacity of the system would need to be approximately 30 refrigeration tons (RT) per MGD per degree Fahrenheit (F). Assuming that the ADWF of 3.18 MGD must be cooled by 5 degrees F to maintain compliance, the required cooling capacity of the system would be approximately 500 RT.

The total required cooling can be accomplished by installing a slipstream mechanical chiller in the disinfection unit process. The slipstream flow will be reduced substantially, and the cooled water will be blended with the remainder of the final effluent to reduce the thermal loading of the discharge on the Umatilla River.

The capital cost of this alternative is $819,000. The 20-year net present worth of O&M cost is $15.2 million. See **Figure 7-13** for the Mechanical Cooling Schematic.

7.1.2.6.6 Class A Tertiary Filtration

A portion of the south train of the chlorine contact chamber would be converted for a side-stream tertiary filtration system in order to divert up to 2.0 MGD from discharge into the Umatilla River. The filtered effluent would be used as Class A recycled water for irrigation offsite. The side stream system would consist of the tertiary membrane filtration process, liquid sodium hypochlorite disinfection, a booster pump station, and a pipeline to the irrigation site(s). Thermal loading on the Umatilla River will be reduced, as necessary, by diverting the side stream from the outfall. Current prospective irrigation sites include the I-84 median and the airport industrial area.

Two tertiary ceramic membrane filtration (TMF) basins are required to treat the full side stream volume in peak summer months. Reinforced concrete walls would be constructed to partition the existing south train of the chlorine contact chamber into two TMF basins and one fully redundant chlorine contact chamber.

The capital cost of this alternative is $3.3 million. The 20-year net present worth of O&M cost is $3.1 million. See **Figure 7-14** for the Class A Tertiary Filtration Schematic.

7.1.2.6.7 Long-term Temperature Compliance Options Summary

Table 7-6 shows a comparison of CIP cost and 20-year net present worth of O&M costs of all alternatives.

Table 7-6
Long-Term Temperature Compliance Options Summary

Effluent Flow Measurement Alternatives	CIP Costs	20-Year NPW O&M
Alt 1: MBR Conversion w/Diurnal Storage	$5.7 M	$3.0 M
Alt 2: Hyporheic Discharge	$4.6 M	$0.28 M
Alt 3: Class A Recycled Water Irrigation	$6.1 M	$3.0 M
Alt 4: Class C Recycled Water Irrigation	$3.3 M	$0.9 M
Alt 5: Mechanical Cooling	$0.82 M	$15.2 M
Alt 6: Class A Tertiary Filtration	$3.3 M	$3.1 M

Notes:

1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration

7.1.2.6.8 Recommendation

The recommended option is Alternative 4. This would see a conversion to Class C recycled water allowing the plant to split effluent flows between surface water discharge and irrigation during the summer months when temperatures are peaking, and river flows decrease. This option provides a cost-effective means to address temperature compliance.

7.2 Solid Stream Unit Process Options

This section addresses deficiencies identified during the WWTRRF condition assessment and regulatory requirement review for the solids stream unit processes. The Existing WWTRRF Evaluation section summarizes and categorizes recommended improvements into three groups, Operations and Maintenance (O&M), Capital Improvements (CIP), or To Be Determined (TBD), based on cost ranges. This section discusses in greater detail the recommended solid stream improvement projects that fall outside of the O&M category. The following areas were identified as needing larger upgrades based on the condition assessment:

- **Primary Sludge Pumps** – Improvements are needed to replace aging equipment and provide better access for maintenance;
- **Primary Digester Complex** – Improvements are needed to ensure redundancy, facilitate more appropriate chemical management practices, address equipment-SCADA connectivity limitations, and complete appurtenance improvements identified in the condition assessment;
- **Secondary Digesters Complex** – Improvements are needed to replace aging equipment, ensure redundancy, address equipment-SCADA connectivity limitations, and complete appurtenance improvements identified in the condition assessment;
- **Digester Gas** – Improvements are needed to replace the aging digester gas flare, facilitate more functional digester gas storage, address issues in the gas conditioning system, and address issues with the cogeneration microturbines;
- **Dewatering Building** – Improvements to the area around the Dewatering Building are needed to address drainage issues and facilitate easier biosolids management; and
- **Sludge Drying Beds** – Improvements are needed to keep the drying beds in good working order and facilitate easier biosolids management.

This section also presents a preliminary analysis of the options available to address deficiencies or increase capacity of solid stream unit processes, where required. Each option includes a description of the unit process, installation requirements, capital costs, and 20-year lifecycle costs. The following Unit Processes with alternatives are evaluated:

- **Primary Sludge Pumps** – Improvements to the primary sludge pump stations are needed to replace aging equipment and facilitate easier maintenance;
- **Secondary Digester Complex** – Improvements are needed to keep the Secondary Digester Complex operable; and
- **Optimize Cogeneration System** – Improvements to the cogeneration system are required to optimize gas and power production.

See **Figure 7-15** for the Overall Site Plan.

7.2.1 Solid Stream Condition Assessment Related Upgrades

Aging mechanical equipment and structural deficiencies noted in the condition assessment require replacement with like equipment or repairs; therefore, only one option is included for each of the facility improvements listed below. The majority of the upgrades to existing aging facilities are included in the Recommended Plan section to follow.

7.2.1.1 Primary Digester Complex

The Primary Digester Complex was partially renovated during the most recent upgrade project, but a few deficiencies were uncovered during the condition assessment. WWTRRF staff indicated that plug valves in the lower digester complex are frozen and in need of repair.

WWTRRF staff experimented with the addition of ferric chloride in the digesters and the pilot was successful in increasing the dewaterability of the biosolids. It is recommended to install a permanent ferric chloride injection system. This system would include chemical storage tanks, injection pumps, and piping. The injection system should also be connected to the WWTRRF's SCADA system for monitoring and control.

There is currently no redundant sludge pump for mixing and transferring digester sludge. If the pump is down for maintenance, WWTRRF staff have trouble moving and mixing sludge. It is recommended to install an additional sludge mixing pumps for redundancy, along with associated pipes and valves. See **Figure 7-16**, Primary Digester Complex Improvements.

The estimated capital cost for these improvements to the Primary Digester Complex is $135,000.

7.2.1.2 Digester Gas Flare

The digester gas waste flare burns off excess digester gas and is partially fed by natural gas to ensure constant operation. The existing waste flare burns gas from both the primary and secondary anaerobic digesters, with all secondary digester gas routed to the waste flare to avoid gas leakage out of the floating roof. Per the Condition Assessment, the flare is showing visible signs of age, is approaching the end of its useful life, and should be replaced.

There are two gas pipe runs to the waste flare from the digesters, one from the Primary Digester Complex and the other from the Secondary Digester Complex. Both pipes are underground and were not replaced during the last upgrade project. These pipes and valves should be replaced.

In addition to replacing the flare and gas piping, it is recommended to move the gas flow meter from the Gas Handling Room to the flare and install a new gas flow meter in its place. This will measure the digester gas more accurately and help to optimize the cogeneration system. See **Figure 7-17**, Gas Flare Improvements.

The estimated capital cost to replace the flare and gas piping, to move the gas flow meter, and install a new thermal mass flow meter is $567,000.

7.2.1.3 Dewatering Building

Topography around the dewatering building does not currently allow for stormwater to adequately drain into the stormwater collection system. Pooling occurs in low points in the surrounding asphalt and around the dewatering building foundation. The area never fully drains in the winter. Minor grading and installation of a catch basin and storm sewer is recommended, which will allow this area to drain.

There is an existing temporary ecology block wall adjacent to the back of the dewatering building. It is used to contain dried solids leaving the dewatering screw press, and it protects the dewatering building from solids handling equipment. The temporary wall should be replaced with a permanent wall which will allow for the use of heavy equipment to collect and transport the biosolids. See **Figure 7-18**, Dewatering Building Improvements.

The area behind the dewatering building also contains remnants of a sludge drying bed, which has been decommissioned. These remnants include the walls which contained the sludge. In order to improve equipment storage and operating space, demolishing this wall is recommended.

The estimated capital cost to improve drainage around the dewatering building, install a permanent wall for biosolids handling, and demolish the extraneous sludge drying bed wall is $53,500.

7.2.1.4 Sludge Drying Beds

According to the Condition Assessment, the drying beds are poor condition. There are four drying beds to the southwest of the dewatering building that are original to the plant, Drying Bed Nos. 1 through 4. Drying Bed No. 7 is on the eastern side of the WWTRRF site and was constructed later.

The walls of the Drying Bed Nos. 1-4 are in severe disrepair, and the valving and flow splitting are also in bad shape and create unnecessary safety risks to operators. Currently, to access the valves, operators must walk along a narrow concrete wall to the center of the basins. The concrete wall is deteriorating. Along the same wall, the flow is split between drying basins using manually operated wooden slide gates. These gates leak and require additional support to route flow properly. It is recommended to replace the basin walls, valves, and piping. This will require reworking the basin isolation system and replacing inlets and inter-basin piping.

All work on the walls of the drying beds will include provisions allowing the installation of a retractable greenhouse roof. This roof would enable plant staff to continue to use the sludge drying beds during the winter months for solids storage.

Drying Bed No. 7 is significantly larger than and has a volume greater than the original four beds combined. The size of the basin and the sloped asphalt walls make it difficult for operators to remove dried solids. It is recommended to construct vertical, concrete walls on the north, east and south side of Drying Bed No. 7 splitting the drying bed into three discreet cells. These improvements will make solids removal easier and increase the available volume for dried biosolids storage. See **Figure 7-19**, Sludge Drying Bed Improvements.

The estimated capital cost for improvements to the drying beds is $1.2 million.

7.2.2 Solid Stream Unit Process Alternatives

7.2.2.1 Primary Sludge Pumps (East & West)

There are two primary sludge pumps that convey co-thickened sludge from the primary clarifiers to the primary digester. One is a piston pump while the other is a disk pump. Both pumps are near or beyond their planned service life, require increased maintenance, and are to be replaced. The pumps are installed below grade, which requires access via stairs and hinders maintenance activities due to the size and weight of the pumps. Additionally, the west pumphouse drain connects to the 36-inch primary clarifier effluent line and can flood during power outages if the water level in the In-Plant Pump Station reaches 10 feet.

Operators have expressed a preference for progressive cavity pumps as the replacement equipment as well as a desire to raise the floors of the pumphouses. Raising the pump house floors is not a recommended option with progressive cavity pumps as the elevation increase will situate the pumps above the primary clarifier water surface. Without a flooded suction pipe, the pumps will be required to self-prime and the interface between the rotor and the stator could be damaged. If the pumphouse floors are to be raised, rotary lobe pumps are recommended. See **Figure 7-20**, Primary Sludge Pump Improvements.

7.2.2.1.1 Option 1 – New Rotary Lobe Pumps and Raised Floors

This option consists of new rotary lobe pumps of the same make and model as the existing primary digested sludge pump(s). This model can convey primary sludge at a wide range of rates, including those currently being performed by the existing primary sludge pumps.

New concrete pedestals will be installed to support the pumps and the existing piping will be reconfigured for the new pump installation. A grated floor will be affixed between the existing walls of the pumphouses and the support pedestal, which will create a sump for access to the conveyance piping via the existing stairs. Concrete was considered as a method to raise the floor but was excluded because it severely limits options for future piping reconfiguration as well as access for repairs. The sump will be accessible via a hatch installed over the existing stairs or by removing the grating for more extensive work.

Flow meters will be added to each pump house and all equipment will be connected to SCADA. The west pump house drain will be rerouted to the west primary clarifier scum pit to prevent flooding during power outages. See **Figure 7-21**, Primary Sludge Pumps – Option 1.

The estimated capital cost for installing new rotary lobe pumps and installing grating for the raised pump station floors is $437,000. The 20-year net present worth of O&M cost is approximately $40,000.

7.2.2.1.2 Option 2 – New Progressive Cavity Pumps and Maintenance Hoist

This option consists of new progressive cavity pumps installed at the same elevation as the existing pumps to accommodate a flooded suction pipe. Maintenance activities will be assisted by a new overhead hoist and trolley and a roll-up door. This will enable operators to handle pumps, piping, and tools safely and more efficiently. This evaluation assumes that the pumphouses will require some extent of structural upgrade to support the new hoists and improve access from the pumphouse exterior.

Flow meters will be added to each pump house and all equipment will be connected to SCADA. The west pump house drain will be rerouted to the west primary clarifier scum pit to prevent flooding during power outages. See **Figure 7-22**, Primary Sludge Pumps – Option 2.

The estimated capital cost for installing new progressive cavity pumps and maintenance hoists is $274,000. The 20-year net present worth of O&M cost is approximately $40,000.

Primary Sludge Pumps (East & West) Options Summary

Table 7-7 shows a comparison of CIP cost and 20-year net present worth of O&M costs of both alternatives.

Table 7-7
Primary Sludge Pumps (East & West) Options Summary

Primary Sludge Pumps (East & West)	CIP Costs	20-Year NPW O&M
Alt 1: New Rotary Lobe Pumps	$437,000	$40,000
Alt 2: New Progressive Cavity Pumps	$274,000	$40,000

Notes:
1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration

7.2.2.1.3 Recommendation

Option 2, progressive cavity pumps and maintenance hoist, is recommended.

7.2.2.2 Secondary Digester Complex

The secondary digester complex consists of the WWTRRF's original two digesters, associated piping, and appurtenances. The majority of the equipment in the complex is currently functional, but much of it is beyond its design life and improvements are required to maintain functionality.

These improvements include new piping, valves, boiler, and heat exchanger. The new boiler will be the same make and model as the primary boiler based on operator feedback. The new heat exchanger will have a capacity of 350 thousands of BTUs per hour (MBH), which is sized to accommodate the operation of both secondary digesters simultaneously.

Additionally, improvements have also been identified to enhance functionality, which include an external mixing system, recirculation pump redundancy, ferric chloride injection, and SCADA connectivity. The new recirculation pump will be installed parallel to the existing unit for redundancy and alternating duty to extend the useful life of both pumps. This new configuration will be incorporated into the new piping layout. A ferric chloride injection system will be included in the new equipment layout with three injection ports installed in the return recirculation pipe to the digesters. See **Figure 7-23**, Secondary Digester Complex Improvements.

The estimated capital cost for these improvements to the Secondary Digester Complex is $1.02 million.

7.2.2.3 Optimize Cogeneration System

The microturbines operate under substandard conditions as a result of the inconsistent digester gas supply, which can be at a low pressure and have a high moisture content. Both conditions affect the performance and maintenance needs of the units. In order to optimize the system, the digester gas infrastructure will be modified to consolidate storage and allow better control of supply gas pressure over a planned window of operation.

In addition, SCADA modifications can be made that will allow the microturbines to run solely on natural gas or remain idle while the system accumulates digester biogas. The fuel supply infrastructure would need to be reconfigured to utilize natural gas. This will enable the microturbines to be used at fuller capacity. The manufacturer reported that the existing units can utilize natural gas without major modification. One unit can be run on natural gas while the other unit runs on digester gas for a planned window of operation in which the required pressure can be maintained. The microturbine can be switched to natural gas if necessary, until the digester gas supply is replenished. Alternatively, the microturbines can be left idle provided that neither microturbine will experience more than one start-up/shut-down cycle per day.

Moisture content in the digester gas supply is reported to be problematic because condensation accumulates in low-lying sections upstream of the conditioning system and adequate drainage points are not available for effective removal. It is believed that the digester gas is saturated with moisture as a result of this condition and the dryer cannot effectively treat the gas. The excess moisture is reported to impact both the microturbines as well as the iron sponges. WWTRRF staff have installed a few valves at low points to manually bleed off the moisture.

7.2.2.3.1 Digester Gas Storage Option 1

This option consists of a ground-based gas storage unit installed on a concrete pad. Gas from both digesters will be routed from the gas handling room to the storage unit through a lateral storage leg until the volume is sufficient to supply digester gas at the required operating pressure for at least eight hours continuously.

The storage unit consists of a collapsible bladder inside of a rigid outer membrane set upon a concrete slab. Control equipment consists of a blower, control valves, and monitoring equipment. The projected volume of the unit is 25,000 cubic feet with a diameter of 40 feet. The slab is estimated to be 50 feet by 60 feet to accommodate the storage unit and control equipment.

Gas enters the unit through a pipe in the center of the slab and fills the bladder, which is monitored by an ultrasonic level sensor. Gas is expelled through the same pipe when ambient air is forced into the space between the bladder and the outer membrane. This action generates a pressurized supply and flow is controlled by actuated valves to route the gas through the conditioning system prior to being sent to the microturbines.

One disadvantage of this option is that condensation from the stored gas will drain through the center of the slab into the underground gas pipe and will have to be managed. It is also possible that gas from the digesters may have to be flared while stored gas is being sent to the microturbines. See **Figure 7-24**, Cogeneration Improvements.

The estimated capital cost for this option is $841,000. This cost includes equipment to alternate the microturbine fuel supply between natural gas and digester gas. The 20-year net present worth of O&M cost is $866,000.

7.2.2.3.2 Digester Gas Storage Option 2

This option consists of a digester gas holding cover installed on the south secondary digester. Gas from the primary digester will be routed through a new underground line to the secondary digester where it will be stored until a sufficient supply, as described above, has been accumulated. The combined digester gas will be routed to the gas handling room through the underground piping before being conditioned and then supplied to the microturbines.

The system shares several functional similarities with the ground-based unit. The primary difference is the installation location and related considerations. Gas is stored inside of a collapsible bladder and is transferred to the gas handling room by forcing ambient air into the space between the bladder and the outer membrane. This installation may require structural considerations for the digester in addition to new piping and control valves.

Condensation from stored gas is not a concern with this option. However, it is possible that some portion of the primary digester gas will have to be flared while stored gas is being sent to the microturbines. See **Figure 7-24**, Cogeneration Improvements.

The estimated capital cost for this option is $1.03 million. This cost includes equipment to alternate the microturbine fuel supply between natural gas and digester gas. The 20-year net present worth of O&M cost is $216,000.

7.2.2.3.3 Optimize Cogeneration Options Summary

Table 7-8 shows a comparison of CIP cost and 20-year net present worth of O&M costs of both alternatives.

Table 7-8
Digester Gas Storage Options Summary

Primary Sludge Pumps (East & West)	CIP Costs	20-Year NPW O&M
Alt 1: Digester Gas Storage Option 1	$0.84 M	$500,000
Alt 2: Digester Gas Storage Option 2	$1.03 M	$296,000

Notes:

1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration

7.2.2.3.4 Digester Gas Storage Recommendation

Option 2, digester gas holder installed on the south secondary digester, is recommended due to potential moisture problems with the ground-based option. In addition, this option will not take up a large portion of the adjacent area like Option 2.

7.2.2.3.5 Digester Gas Moisture Reduction Option 1

This option consists of a float drain trap and collection sump in the digester gas pipeline immediately downstream of the gas handling room and assumes that one such installation location will be adequate. A lateral leg will be installed in the digester gas pipeline that will direct condensation to the float drain trap, keeping the piping clear. As liquid accumulates, the float will open the valve to allow excess liquids to drain into the sump where it will be pumped to a drain. The valve is designed to maintain enough liquid to prevent digester gas from escaping.

The estimated capital cost for this option is $25,000. The 20-year net present worth of O&M cost is $220,000.

7.2.2.3.6 Digester Gas Moisture Reduction Option 2

This option consists of a new gas drying unit installed immediately after the gas handling room. This installation location will assist in removing moisture from the gas piping before it is routed underground where condensation accumulates. This initial drying stage will eliminate sufficient moisture to supplement the existing gas drying units.

The primary advantage of installing a supplemental unit at this location is to reduce condensation in the underground pipeline that would otherwise be difficult to remove. Another advantage is that freezing in the iron sponge is likely to be reduced.

The estimated capital cost for this option is $298,000. The 20-year net present worth of O&M cost is $271,000.

7.2.2.3.7 Digester Gas Moisture Reduction Option 3

The final option involved enclosing the existing skid with insulated panels and a unit heater. This option would provide operators with a heated space to work on the gas conditioning equipment, and the heater would prevent freezing of the pipes. The enclosure would also include a roll-up door to provide efficient access should any equipment need removal or replacement.

The estimated capital cost for this option is $91,000. The 20-year net present worth of O&M cost is $66,000.

7.2.2.3.8 Digester Gas Moisture Reduction Options Summary

Table 7-9 shows a comparison of CIP cost and 20-year net present worth of O&M costs of both alternatives.

Table 7-9
Digester Gas Moisture Reduction Options Summary

Primary Sludge Pumps (East & West)	CIP Costs	20-Year NPW O&M
Alt 1: Digester Gas Moisture Reduction Option 1	$25,000	$220,000
Alt 2: Digester Gas Moisture Reduction Option 2	$298,000	$271,000
Alt 3: Digester Gas Moisture Reduction Option 3	$91,000	$66,000

Notes:
1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration

7.2.2.3.9 Digester Gas Moisture Reduction Recommendation

Option 3 is recommended as it will provide a heated space to allow better performance of the gas conditioning equipment as well as freeze protection of all pipes and appurtenances. The enclosure will also provide an enclosed space for maintenance activities.

7.3 Class A Biosolids Options

This section evaluates options for year-round production of Class A biosolids for beneficial reuse to address City concerns related to long-term disposal of Class B biosolids. Current operations include dewatering of anaerobically digested sludge in the drying beds or the screw press in the dewatering building. Vector attraction reduction requirements are accomplished through greater than 38 percent volatile solids reduction in the primary digester, which a review of the Discharge Monitoring Reports (DMRs) indicates is typically greater than 50 percent. Pathogen reduction requirements for Class B biosolids are also met in the primary digester by maintaining a minimum solids retention time (SRT) of 15 days above 30 degrees celsius.

Additional treatment will be necessary to meet pathogen reduction requirements for Class A biosolids. Dewatering prior to or simultaneous with treatment is still required and so each option includes screw press operation. No changes are necessary to continue meeting vector attraction reduction requirements. In addition, each option, except for the greenhouse, includes a pole barn constructed along the south side of the facility for storing treated Class A biosolids prior to transport offsite.

Biosolids records from 2013 through 2017 were reviewed and indicate that an average of 338 dry tons of biosolids were hauled annually. The annual totals were divided by the corresponding populations to determine the average loading factor of 0.02 tons per capita. The average factor was applied to the projected 2040 population of 25,006 used as the basis of planning. The projected annual biosolids generation for the 2040 planning horizon is 500 tons.

The evaluation considered the following options:

- Class A FKC Screw Press – Replace existing screw press with unit designed to produce Class A Biosolids using a heated screw for pasteurization;
- Manual Greenhouse Solar Drying – Install solar greenhouse dryers in place of existing drying beds to achieve greater than 90 percent solids;
- Biosolids Composting – Install compost piles in place of existing drying bed 7 to reduce pathogens through aerated composting;
- Biosolids Dryer – Extend dewatering building to south and install dryer to reduce pathogens through pasteurization; and
- Lime Stabilization – Extend dewatering building to south and install lime stabilization unit to reduce pathogens through exothermic chemical reaction and ammonia generation.

The following sections include a description of the unit process, installation requirements, and capital and lifecycle costs, where applicable.

7.3.1 Class A FKC Screw Press

This option considers procurement of two new Class A biosolids screw presses. FKC, the manufacturer of the existing screw press, can provide upgraded screw presses that are capable of producing Class A biosolids through a steam-heated screw. The major differentiating components of the Class A equipment include:

- A pressure-rated screw that heats sludge indirectly via steam flowing through the interior;

- An offset drive gear system with design elements to accommodate the flow of steam into the screw as well as condensate out; and

- A boiler skid for steam production.

The existing screw press, manufactured in 2011, cannot be upgraded to provide similar functionality without substantial retrofit as the existing screw is not pressure-rated and the drive gear system would not accommodate a steam input. It is unlikely that retrofitting the existing equipment would be a cost-effective option by comparison to procuring new equipment that is wholly designed to produce Class A biosolids. It is also possible that a retrofitted screw press may not perform optimally or as reliably as new equipment.

The Class A unit has a maximum capacity of 255 pounds per hour-unit and would replace the existing screw press, which has a capacity of is 641 pounds per hour according to FKC's records. The dewatering building will accommodate one unit, which would need to be operated for 78 hours per week (with two weeks scheduled annually for maintenance) to process the projected 500 annual dry tons of biosolids. This schedule is constrictive, and a second unit will be required for both redundancy and additional capacity to maintain the current hours of operation. An expansion of the dewatering building will be required to accommodate the additional press.

The CIP cost of this alternative is $4.55 million for materials, equipment, and installation. The 20-year net present worth of O&M cost is $14.3 million, which includes 0.2 full time equivalents (FTE) at an hourly rate of $50. This alternative displaces the operating cost of the existing screw press, which have not been quantified in this analysis. All other alternatives assume continued operation of the existing screw press. See **Figure 7-25**, Class A Biosolids FKC Screw Press Upgrades.

7.3.2 Manual Greenhouse Solar Drying & Storage

The identified equipment for this option is a greenhouse manufactured by Cravo with an automated, retractable roof. The greenhouse is designed for agricultural applications and has excellent applicability for drying dewatered cake. The Cravo greenhouse requires manual solids turning and is capable of producing comparable results as the Huber fully automated solar dryer for a fraction of the cost. An array of climate control sensors can be configured to monitor conditions in the greenhouse and control the retractable roof. Greenhouse dryers have been demonstrated to produce Class A biosolids through confirmation sampling when 90 percent solids have been achieved.

The maximum open span is 42 feet with a gutter height up to 18 feet, which is adequate to create drying bays that allow access for solids handling equipment. Structural supports are typically required at 12-foot intervals along the length of the drying bays and can be expanded to 24 feet if necessary. The length of each drying bed will be 84 feet. The configuration consists of five bays installed over the current location of drying beds 1 through 4. The drying beds will be removed, and new knee walls will be installed between each planned drying bay to prevent contamination of finishing batches. Access to each bay will be from the north along the existing paved roadway. The total footprint of the installation will be 84 feet by 210 feet.

Dewatered cake will be stored in the greenhouse drying bays during the winter months when solar insolation is low. The roof will remain closed to keep the cake from being rewetted. Some mixing may occur during this period, but storage is anticipated to be the primary function. As temperatures rise and rainfall subsides in the spring, moisture removal will be enhanced by turning the cake more frequently and active management of the retractable roof to optimize conditions in the greenhouse for drying. Inventory in the greenhouse will be reduced significantly through the summer and fall in preparation for winter storage.

A conveyor will transport dewatered cake from the existing screw press to the greenhouse for drying. Operators will select the desired drying bay to deposit the cake through the use of diverters. Once deposited in the bay, dewatered cake will be manually distributed into a uniform layer for drying. As the cake dries, it will be turned using a tractor to keep moisture exposed on the surface and optimize the drying process. A variety of implements can be used for this process, including a bucket, cultivator, snowblower, rotary hoe, etc. Each option will require a health and safety evaluation to identify potentially hazardous conditions from airborne particles in a semi-enclosed space. Estimated equipment costs below include procurement of a new tractor with a front bucket and snowblower attachment. Once dried to greater than 90 percent solids, samples will be collected to confirm that Class A biosolids criteria based on pathogen density have been met.

The CIP cost of this alternative is $2.29 million for materials, equipment, and installation. The 20-year net present worth of O&M cost is $1.8 million, which includes 0.75 FTEs at an hourly rate of $50. See **Figure 7-26**, Class A Biosolids Greenhouse Drying.

7.3.3 Biosolids Composting

Sustainable Generation provides a Gore® composting system that utilizes a cover, aeration piping, and a control unit to meet the requirements of the static aerated pile composting method described in 40 CFR Part 503. Green waste is mixed 1:1 by weight (3:1 by volume) with cake to support air flow through the pile and provide additional nutrients. The incorporation of green waste also has the potential to offset other costs associated with green waste management for the City as well as improve the cosmetic quality of the Class A biosolids over other options.

The cover is constructed of a waterproof, breathable material that is effectively sealed at the base of the pile with in-ground aeration piping beneath the pile to maintain aerobic conditions. The control unit monitors temperature and oxygen using probes inserted into the pile through the cover and regulates flow through the aeration lines accordingly. The system can operate effectively in a wide range of conditions that encompass the seasonal climate of Pendleton. The aeration lines would also serve as leachate collection lines with valved connections to a common header conveying leachate to the headworks via a new pump station.

Each unit has a total footprint of 30 feet by 100 feet and a total of eight units are estimated to be sited where drying bed 7 is currently located. A batch would require a minimum of six weeks of processing to be suitable for land application, with one turning after four weeks. Eight weeks of processing is recommended if the batch is to be bagged.

This option will require additional equipment for screening and blending. A finished pile will contain a substantial amount of woody material that can be screened out for reuse, which can balance the green waste input as well as introduce beneficial microbes to a fresh pile. The characteristics of the green waste added to the dewatered solids should also be optimized to maintain an effective process and quality product. A rotary screen is recommended to remove overs from a finished pile as well as to process fresh green waste as necessary. In addition, mixing equipment and a green waste chipper should be considered to improve the efficiency of the operation and the consistency of the compost blend.

The CIP cost of this alternative is $2.38 million for materials, equipment, and installation. The 20-year net present worth of O&M cost is $4.0 million, which includes 1.6 FTEs at an hourly rate of $50. See **Figure 7-27**, Class A Biosolids Composting.

7.3.4 Biosolids Dryer

The Andritz Paddle Dryer is an indirect, twin-shaft dryer that uses a thermal oil to dry the dewatered cake to Class A biosolids. Dewatered cake from the screw press will be collected in a hopper to ensure that sufficient cake is on hand for a planned, continuous operation. A thermal oil is heated in a dedicated boiler to 410 degrees Fahrenheit and circulated through the trough, shaft, and paddles of the dryer as solids progress through the unit. Steam and any particulates generated in the drying process are contained within the unit's cover and captured by a scrubber. Class A biosolids, which exit the dryer at 210 degrees Fahrenheit and greater than 95percent solids, are passed through a cooler before being transferred to a proposed biosolids storage pole barn. Biosolids require a minimal duration at 210 degrees Fahrenheit to meet the criteria in 40 CFR Part 503 for Class A.

The dryer operates most efficiently when used for continuous batches to prevent unnecessary heating and cooling cycles of the thermal oil. The recommended frequency is weekly, which would require coordinated operation of the screw press to generate sufficient solids to accommodate the continuous batch. It is anticipated that each batch will have a duration of 55 hours per week over the course of 50 weeks to process the projected 500 annual dry tons.

The dryer would be located inside an extension of the dewatering building with the existing south wall as a partition. The existing conveyor will load dewatered cake into the dryer's hopper. It is estimated that an 80-foot extension of the dewatering building would be adequate for the new equipment.

The CIP cost of this alternative is $6.65 million for materials, equipment, and installation. The 20-year net present worth of O&M cost is $6.8 million, which includes 0.2 FTEs at an hourly rate of $50. See **Figure 7-28**, Class A Biosolids Dryer.

7.3.5 Lime Stabilization

The Schwing Bioset is a lime stabilization process that relies upon the exothermic reaction of lime and water to produce Class A biosolids through pasteurization. Dewatered cake is fed into a screw mixer with lime and dry sulfamic acid before entering a reactor. This mixture is brought to a temperature of 55 degrees celcius for 40 minutes, which has been approved by EPA as a Process to Further Reduce Pathogens (PFRP) due to the ammonia generated by the process in addition to pasteurization.

The new equipment would be located inside an extension of the dewatering building with the existing south wall as a partition. The existing conveyor will load dewatered cake into the screw mixer. A lime silo will be located on the exterior of the dewatering building extension. The reactor outlet can be configured to exit the building to transfer Class A biosolids to a proposed biosolids storage pole barn. The heat generated for the pasteurization process is the result of an exothermic chemical reaction, so only the electricity necessary to power the equipment will be required.

The addition of lime into the Class A process almost doubles the volume of the biosolids, which can pose problems with storage and distribution of the finished product. Also, receiving deliveries, storing, and handling lime is labor intensive and messy.

The CIP cost of this alternative is $3.56 million for materials, equipment, and installation. The 20-year net present worth of O&M cost is $3.4 million, which includes 1 FTE at an hourly rate of $50. See **Figure 7-29**, Class A Biosolids Lime Stabilization.

7.3.6 Class A Biosolids Options Summary

Table 7-10 shows a comparison of CIP cost and 20-year net present worth of O&M costs of all five alternatives.

Table 7-10
Class A Biosolids Options Summary

Class A Biosolids Alternatives	CIP Costs	20-Year O&M Costs	FTE in O&M
Alt 1: FKC Screw Press	$4.55M	$14.3M	0.2
Alt 2: Manual Greenhouse Solar Drying & Storage	$2.29M	$1.8M	0.5
Alt 3: Biosolids Composting	$2.38M	$4.4M	1.6
Alt 4: Biosolids Dryer	$6.65M	$6.8M	0.2
Alt 5: Lime Stabilization	$3.56M	$3.4M	1.0

Notes:
1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration.

7.3.7 Recommendation

Greenhouse solar drying and storage is the recommended alternative for Class A biosolids. The capital and O&M costs are much lower than other alternatives with a moderate increase in FTE. Additionally, the greenhouse is the most versatile piece of infrastructure as it can be used for drying, storage, or a combination of both.

Biosolids composting is an attractive option; however, limited local green waste sources would make this alternative difficult to implement without realizing extra costs for these materials. Should additional green waste sources become available, this alternative should be reconsidered.

While lime stabilized Class A biosolids is potentially cost-competitive, the addition of a lime stabilization process downstream of the existing dewatering screw press would have a major impact on operations and would not lower the volume of solids to be processed. This functionality can be combined with other options, such as a heated drying, in the future if desired.

7.4 Architectural Evaluation, Access Control, and Protective Systems

This section presents results from the Architectural Evaluation including ADA review and programming, and addresses site access control and protective system deficiencies identified during the condition assessment and regulatory requirement review for the WWTRRF. The following areas were identified as needing improvements:

- Admin/Lab Building – ADA compliance upgrades and space programming;
- New Admin Annex Building – Construction of a new building to accommodate functions lost in the existing Admin/Lab Building remodel;
- New Storage Building – Construction of a centralized storage building for parts, chemicals, lawn equipment, and safety equipment;
- Main Shop Expansion – Addition to Main Shop including three bays to store equipment displaced from demolishing the parts storage/welding shop;
- Site Access Control – Installation of an automatic entrance gate, upgrade security fencing around the WWTRRF site, and install security cameras and;
- Protective Systems – Addition of emergency eyewash and drench showers in hazardous chemical storage and point of use locations.

7.4.1 Architectural Evaluation

The following section outlines the architectural evaluation of the Admin/Lab Building and Breakroom and addresses WWTRRF storage needs due to eliminating various buildings around the campus. Recommendations for improvements are also included.

7.4.1.1 ADA Compliance Review

MWA Architects performed a review of the existing administrative facilities regarding compliance with current ADA regulations. **Appendix J** includes a memorandum to capture the deficiencies.

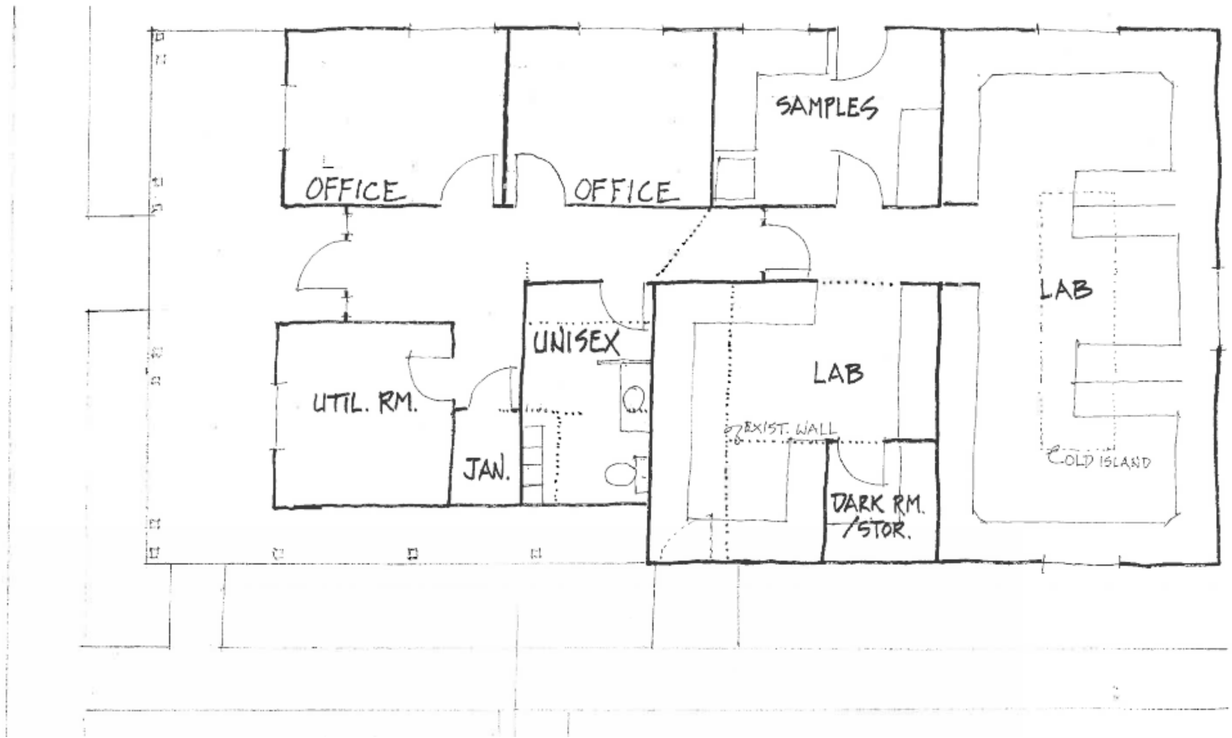
The review found minor site access, parking, ingress/egress issues that are easy to address; however, the majority of the building's interior is severely deficient. The hallway corridor width, door opening widths, the mechanical room, the laboratory, and both men's and women's restrooms are not ADA compliant.

The breakroom, kitchen, and women's locker room located adjacent to the Secondary Digester Complex also have problems with compliance. The breakroom counters and sink are not at the appropriate height and the restroom and women's locker room have several issues.

7.4.1.1.1 Recommendations

Remodeling the Admin/Lab Building and Breakroom is recommended to address deficiencies found during the code review. Below, **Figure 7-30** shows a conceptual Admin/Lab Building layout.

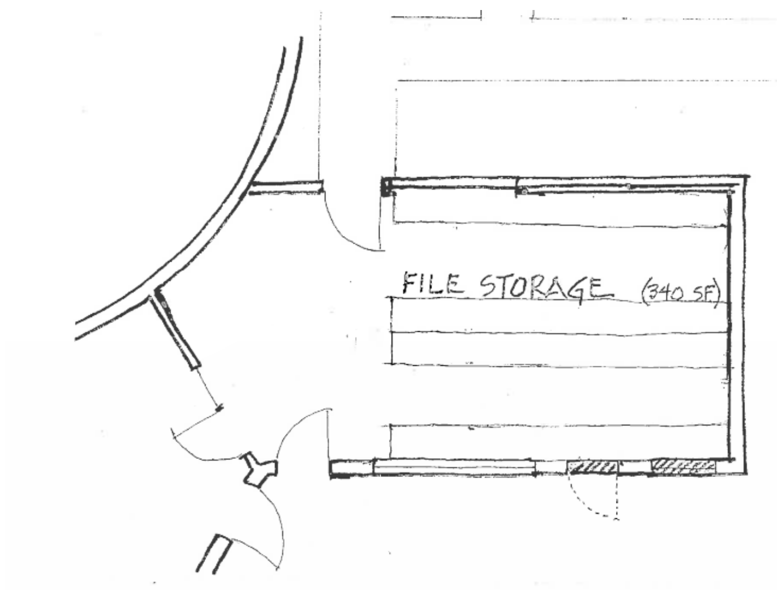
Figure 7-30
Proposed Admin Building Layout



In this concept, the proposed changes to the Admin/Lab Building include expansion of the lab, addition of a unisex ADA compliant restroom, and reconfiguring the floorplan so that the hallway is ADA compliant. Some features lost in the remodel would be added to a new Admin Annex Building. The final layout will be determined during the preliminary design phase.

Figure 7-31, below, shows converting the existing Breakroom, which is adjacent to the Secondary Digester Complex, to a file storage area. This concept would allow for a central location for file storage and separate the breakroom from a unit process area. The island would be demolished and the door to the Secondary Digester Complex would be replaced with a wall to separate the space.

Figure 7-31
Proposed Breakroom Layout



The estimated CIP cost for demolition and remodeling of the Admin/Lab Building and Breakroom is approximately $778,000.

7.4.1.2 New Admin Annex Building

A new building is proposed to accommodate the functions lost in the existing Admin/Lab Building and Secondary Digester Complex remodel. These include both men's and women's restroom, showers, and lockers; breakroom and kitchen; administrative receiving; and storage/laundry room. **Figure 7-32** shows a conceptual proposed floor plan and is included at the end of this section. Costs were developed for a conventional residential style building with a metal roof, similar to the existing Admin/Lab Building.

As shown on **Figure 7-33**, this new building would be located across the driveway to the north of the existing Admin/Lab Building. Additional parking spaces would be added at the front of the building adjacent to the driveway. The estimated CIP cost for a New Admin Annex Building is approximately $1.35 million.

7.4.1.3 New Storage Building

A new storage building is proposed to house all the miscellaneous parts, chemicals, lawn equipment, and safety equipment stored throughout the WWTRRF site. The proposed location for this building is to the east of the IPPS adjacent to the driveway, as shown on **Figure 7-33**. This is a central location for accepting deliveries and storing parts, chemicals, safety, and lawn equipment. Plus, all required utilities are close and could easily serve the new building. The new building will require demolition of the existing lawn equipment shed and chemical storage building.

The overall building dimensions are 40-foot by 70-foot and functional areas include a parts storage room, chemical storage room with containment, lawn equipment storage room, and safety equipment storage room. Costs were developed for an insulated prefabricated metal building. The estimated CIP cost for the New Storage Building is approximately $748,000.

7.4.1.4 Main Shop Expansion

Expansion of the main shop is recommended to add three bays (approximately 30-foot by 40-foot) to store equipment displaced from demolishing the parts storage/welding shop building. A new Welding Shop, approximately 20-foot by 25-foot, would be constructed on the southern side of this expansion.

The expansion would include room for the tool cat, compressor, diesel pump, welding and metal fabrication equipment, plus other smaller displaced equipment. Costs were developed for an insulated prefabricated metal building with roll-up doors, a welding ventilation system, and retaining wall to accommodate the access drive around the perimeter of the WWTRRF site.

The estimated CIP cost for the Main Shop Expansion is approximately $282,000 and the upgrades are shown on **Figure 7-33**.

7.4.2 Site Access Control Upgrades

Site access control was reviewed during the condition assessment and a few flaws were discovered. This section describes improvements to address these deficiencies.

7.4.2.1 Security Fence and Automatic Gate

The current fencing around the WWTRRF is not uniform in style or size, not continuous around the site, and can be easily climbed south of the original drying beds. The gate is manually locked and unlocked by WWTRRF staff which causes inefficient use of resources when they are required to come on weekend or off-hours to unlock and open the gate. Also, the barbwire on the fence north of the solar array is facing the wrong direction and should be corrected.

Demolition of interior fencing and installation of perimeter fencing is proposed along with an automatic entrance gate. Near the entrance, the FFA gate adjacent to the WWTRRF gate should be moved westward to improve access to the FFA land and keep traffic from using the new gate.

The new gate would allow ingress and egress into the site using RFID key cards with remote capabilities.

The estimated CIP cost for the fence upgrades and automatic gate is approximately $105,000. The fence upgrades and automatic gate are shown on **Figure 7-33**.

7.4.2.2 Security Cameras

Installation of additional security cameras will help mitigate the risk of unauthorized personnel accessing the site outside of the normal operating hours of the WWTRRF. As shown on **Figure 7-33**, a new security camera would be mounted on the Aeration Basin and Primary Digester Complex to monitor the site. The cameras would be tied to SCADA for remote access and monitoring. The estimated CIP cost is approximately $21,000.

7.4.3 Protective Systems

Eyewash and shower facilities are required within the work area for immediate emergency use per the Occupational Safety and Health Administration (OSHA) 29 CFR 1910.151(c) for all areas where the eyes or body of any person may be exposed to injurious, corrosive materials. Injurious corrosive chemicals used at the WWTRRF include sodium hypochloride, chlorine gas, citric acid, calcium hydroxide (lime), sodium hydroxide (caustic), ferric chloride, cement, polyaluminum chloride, and sodium thiosulfate.

The WWTRRF has eyewash and shower stations in a few critical locations but they are lacking in other areas. These locations include the Primary Digester Complex, Secondary Digester Complex, and Dechlorination Building. Ferric Chloride is used in the Primary Digester Complex and is proposed for the Secondary Digester Complex. The Dechlorination Building houses calcium thiosulfate, which is a relatively safe chemical, but will irritate the eyes and skin if exposed.

Health and safety codes call for tepid water in eyewash and shower stations which require a hot water heater installed at the point of use. The estimated cost of materials and construction for three eyewash stations and drench showers, along with hot water heaters, is $31,000. The proposed locations for new emergency eyewash and shower stations are shown on **Figure 7-33**.

7.4.4 Summary of Recommendations

Upgrades to the Admin/Lab Building and Breakroom are recommended to comply with current ADA regulations. These are proposed in conjunction with a new Admin Annex Building to house displaced functions. A New Storage Building is recommended for parts, chemicals, lawn equipment, and safety equipment storage. Expanding the Main Shop is recommended to provide storage for displaced equipment and provide a new Welding Shop.

To improve site access and safety, it is recommended to install uniform security fencing around the perimeter, add additional security cameras at critical points, install a new security gate with

RFID control, and install eyewash stations and drench showers at all code required locations. Below, **Table 7-11** summarizes the costs associated with these upgrades.

Table 7-11
Cost Summary

Description	CIP Costs
Remodel Admin/Lab Building and Breakroom	$778,000
New Admin Annex Building	$1,350,000
New Storage Building	$748,000
Main Shop Expansion	$282,000
Security Fence and Automatic Gate	$105,000
Security Cameras	$21,000
Eyewash and Drench Shower Stations	$31,000

Notes:
1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration.

7.5 Electrical, Instrumentation, and Controls Options

This section addresses WWTRRF Electrical, Instrumentation, and Controls (E,I&C) deficiencies identified during the condition assessment and presents a preliminary analysis of options available for improvements, including recommendations for upgrades to keep the plant in good working order.

This section includes:

- Existing WWTRRF E,I&C equipment
- E,I&C O&M Considerations
- Recommended Plan

7.5.1 Electrical

The WWTRRF is served by a 480-volt, 3-phase, 4-wire electrical power distribution system. The incoming service and main switchgear were upgraded in 2011 and are located outside the Secondary Process Building on the east wall at ground level. Most electrical equipment downstream of the main switchgear was also upgraded in 2011. The facility power distribution system consists of the utility service entrance, standby generator, automatic transfer switch, metering, main switchgear, motor control centers (MCC), 480-volt power panels, lighting transformers, and 120/208-volt lighting panels. **Figure 7-33** shows the existing WWTRRF Electrical Buildings and the location of the main switchgear. The MCCs being fed by the main switchgear are located in the dechlorination building, secondary process building, headworks electrical building, and solids electrical building.

The incoming service entrance power is distributed to various processes and buildings around the facility via feeder circuits originating from the main switchgear. The main switchgear consists of two major sections: the service entrance section and the feeders section. The service entrance section consists of the main circuit breaker section, metering section, solar array circuit breaker and ATS section. The feeders section consists of circuit breakers feeding four MCCs and two 480-volt power panels throughout the facility. See **Figure 7-34** for the existing WWTRRF One-Line Diagram. Currently there are nine feeder circuit breakers installed in the main switchgear feeding the following major equipment:

- MBR building panel
- Dechlorination Building MCC
- Secondary Process Building MCC
- Headworks Electrical Building MCC
- Solids Electrical Building MCC
- Administration Building panel
- Three spares for future use

7.5.1.1 Condition Assessment Related Upgrades

Most of the power distribution equipment was installed in 2011 and is in good condition. However, the electrical equipment should be tested, and maintenance performed in accordance with ANSI/NETA MTS-2015 *Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems*. This standard is used worldwide to assure that electrical power equipment and systems operate reliably and safely in conformance with industry and manufacturer standards and tolerances. Performing standardized maintenance testing will help determine whether the electrical equipment is suitable for safe and continued service.

As for the standby generator, it is recommended by NFPA70 (NEC) article 701.3 that throughout the life of the standby system, it shall be tested periodically according to an AHJ-approved schedule to ensure it's in proper operating condition and remains functional. The AHJ will often use IEEE and NETA standards when evaluating the adequacy of the testing program. Also, the standby system equipment shall be maintained in accordance with manufacturer instructions and industry standards. NFPA 110-2016 Chapter 8 provides more information on testing and maintenance of emergency and standby power systems.

The Lawn Equipment Shed is located south of the East Secondary Clarifier and has an electrical service provided through a 220v extension cord from the Chemical Storage Building. The extension cord connects to a breaker panel that is located behind a shelving unit in the Lawn Equipment Shed. In addition, the in-wall heater does not have required clearance around it, making it unsafe. These issues are electrical code violations that should be addressed to meet NEC requirements. It is recommended to install a permanent electrical service to the shed and provide appropriate clearance for the existing breaker panel and heater.

A facility-wide arc flash analysis is recommended for the electrical infrastructure complying with OSHA standard 1910.269 that was made mandatory and put into effect on July 10, 2014. OSHA regulations for arc flash safety apply to all facilities, regardless if an arc flash analysis has been performed or not. Beyond the risk of personal injury or death, arc flashes can lead to business disruption, costly damage to equipment and facilities, legal liabilities, increased insurance premiums, and hefty regulatory fines.

7.5.2 SCADA System

The WWTRRF SCADA system is resident on a PC workstation in the Secondary Process Building Electrical Room, several PC workstations in the Administration Building, and several operator HMIs on local control panels in process areas throughout the facility. **Figure 7-35** shows the existing SCADA Network Diagram. SCADA system software, hardware, and network topology are discussed in the following sections.

The SCADA software present at the WWTRRF is Rockwell Automation (RA) RSView32 running on Microsoft (MS) Windows-XP operating systems. The SCADA system is setup on multiple PCs running independently. RSView32 HMIs allow operators to monitor and control process operations. The software functions adequately with the current system, but developer and engineering support are diminishing as users switch to more modern software. Also, MS Windows-XP has been discontinued and is no longer supported by Microsoft, which creates a major security vulnerability.

Process control hardware in use at the WWTRRF is RA ControLogix PLCs, chassis, and I/O modules. The SCADA HMI automation hardware is MS Windows-XP based PCs, RA VersaView HMI PCs, and RA PanelView HMI terminals. The SCADA networking hardware includes RA Stratix Ethernet switches, fiber optic patch panels, fiber optic cable and connectors, RJ-45 connected copper Ethernet cable and miscellaneous networking devices. The existing hardware is in fair condition and operating as intended.

The SCADA process network at the WWTRRF is configured in a compound star topology. Several network branches are connected to the SCADA workstations via a single spur. This network topology makes the system vulnerable to outages and considerations should be made for improvements.

7.5.2.1 Condition Assessment Related Upgrades

The RSView32 software installed on the WWTRRF SCADA workstations is still viable but only has limited support from the manufacturer as no more software updates are scheduled. RSView32 is run on 32-bit PC operating systems which are no longer supported by MS Windows-XP. Lack of support means no more software service packs or security patches, which is a major security concern. RSView32 is rapidly trending toward legacy status in favor of the newer 64-bit edition FactoryTalk SCADA software suite.

To address this security vulnerability, it is recommended the City backup and replace the existing SCADA PCs in the Secondary Process Building and Administration Building with newer PCs running a 64-bit Operating System (i.e. MS Windows 7, 8, or 10). VMWare software should be installed on these PCs and a virtual machine file should be created for each 32-bit PC currently running RA RSView32. Next, the office SCADA operations should be transferred over to the newer PC's running the WWTRRF HMI in virtual windows. The existing MS Windows XP software on the local HMI touchscreen panels is not as critical and can continue to operate as-is until replaced as part of a larger capital improvement type project. This will protect the system with PCs fully supported by MS until a system wide conversion to 64-bit RA FactoryTalk can be facilitated, which is discussed later in this section.

During the condition assessment, it was discovered that several processes are not currently connected to the SCADA system. The secondary process blowers and primary boiler system control packages need to be connected to the SCADA network. The various equipment package controllers should be connected to the process control network and SCADA process; and trending and alarm annunciation graphic screens should be developed.

The power monitors at the service entrance switchgear outside the Secondary Process Building are capable of data networking but are not connected to the SCADA system. The power usage in the facility should be monitored and trended on the major feeder circuits. This will inform the City as to how power is being consumed within the facility and precisely which feeders are nearing full capacity or have room for future loads. Power monitoring and data archiving is also a very useful tool for energy efficiency planning. The existing power monitors should be investigated to determine the required configuration and/or any upgrades to allow them to be connected to the SCADA process network. SCADA process and trending graphic screens should be developed for the power monitors. Power monitors connected to SCADA should be considered for all other MCCs.

7.5.2.2 Capital Improvement Upgrade Options

Following the condition assessment upgrades presented above, there are three distinct areas in the WWTRRF SCADA system that should be improved as resources allow. Upgrade options for SCADA system software, hardware, and network topology are discussed in the following sections.

7.5.2.2.1 Software

SCADA system software is broken down into three categories: process control, automation visualization, and information management. Process control software mostly uses Programmable Logic Controllers (PLCs) to control unit processes, while automation visualization software runs the screens used for viewing processes in real time. Finally, information management software is used to store, access, and archive actual process data.

Process Control

Currently, the RSView32 SCADA system installed at the WWTRRF is primarily used for Human Machine Interface (HMI), trending process variables, equipment status and runtimes, alarming annunciation, and alarm logging. Moving forward, these SCADA functions should be continued and enhanced. As part of this evaluation, additional features available with the FactoryTalk suite have been considered, as well as other process information data management software.

Process control in the WWTRRF is primarily done with PLCs. The PLCs are housed within local control panels located in strategic positions around the facility. The PLCs control unit processes and are backplane connected to hardwired I/O points in local chassis or network connected to hardwired I/O in remote chassis near the processes. The PLCs run logic application programs which directly control the process equipment connected to them. Also, they collect alarm, equipment status, and process variable information; and perform minor calculations such as scaling, comparison, and PID loop control. The PLCs concentrate raw data for the process automation SCADA HMI and data management systems.

The PLCs run application programs that are developed with Rockwell Automation RSLogix 5000 Standard Edition (English). The most current edition of this software is Studio 5000 Logix Designer Standard Edition (English). The standard edition is a single license which is run on a local PC. Other versions include a networked standard edition, full edition, and professional editions. The network standard edition allows the software to be installed on a network server and shared by multiple networked PCs. Full and professional editions of the software contain more advanced programming functions such as (FBD) Function Block and Drive control editing, (ST) Structured Text editing, (SFC) Sequential Function Chart editing, etc. Standard editions include ladder logic editing and full upload and download capabilities. Standard editions are primarily for users who maintain and troubleshoot existing PLC application ladder programs and do not normally perform higher-level programming functions. The full and professional versions are primarily used by engineering staff, field service engineers, consulting engineers, and systems integrators to develop and start-up new application programs.

Options for process control software include the following:

- Use the existing RSLogix 5000 Standard Edition for maintenance and troubleshooting
- Upgrade to Studio 5000 Logix Designer Standard Edition for maintenance and troubleshooting
- Upgrade to Studio 5000 Logix Designer Full or Professional Edition for higher level program development

Automation Visualization

Automation visualization, commonly referred to as Human Machine Interface (HMI), provides operators, maintenance teams, and management a view on the wastewater processes in real time. Currently, the facility is using RA RSView32 Works and Runtime editions running on single PC installations. The software installations are independent of one another in the sense that when changes are made to the local processes or graphic screen symbology is edited in one area then it does not automatically update across the SCADA system. Each PC running RSView32 must be individually uploaded with the changes to remain current with the rest of the system. Changes to the system can only be made on the PC that has RSView32 Works installed on it. Runtime versions are installed on local HMI PCs where only operator interface is required.

As stated previously RSView32 software systems are outdated and are trending quickly toward legacy status. RA FactoryTalk-SE and FactoryTalk-ME are the latest software suites which replace and enhance the automation visualization functions that are now provided by RSView32. FactoryTalk-SE is a Site Edition software suite which allows FactoryTalk process visualization applications to be developed and run in a server/client configuration on multiple local stations or individually on one local station. FactoryTalk-ME is a Machine Edition software suite which allows FactoryTalk process visualization applications to be developed and run on a single local station.

Using the server/client architecture allows all clients connected to the server to be updated continuously whenever application program changes are made on the server. Machine editions are stand-alone and must be individually updated. An advantage for running FactoryTalk-SE as a server/client system is the capability to operate local clients as Thick Clients or Thin Clients. Thick Clients are system rated PCs running MS Windows operating systems and FactoryTalk-View but are controlled and updated continuously by the server. Thin Clients are stripped down PCs only running Thin Manager software. Thick Clients are much more expensive PCs and FactoryTalk-View is more expensive than Thin Manager software. The advantage for Thick Client HMIs is they keep running locally if the server crashes or network fails. Mobile devices such as tablets may also be run as Thick Clients using FactoryTalk-View. Thin Client operator interfaces cost about half as much as Thick Clients but are a dumb terminal only displaying a server HMI window.

While operating the HMI, a Thin Client is indistinguishable from a Thick Client, except that the Thin Client screen goes blank if the server crashes or network fails. In addition to lower costs, the other advantage for thin client technology is flexibility. Since it's not an intelligent terminal, a spare can drop in anywhere, such as a desktop SCADA workstation or a touchscreen HMI process panel. Simply plug it into a network switch, provide the server it's IP address, assign the thin client's IP address and it will activate. Mobile devices such as tablets may also be run as Thin Clients utilizing ACP's Thin Manager Software. An advantage utilizing tablets as thin Clients is no process data or facility information resides on the tablet, it is just a remote session on the SCADA Server. If the tablet is lost or stolen, once it is out of Wi-Fi range the screen just goes blank and no data can be viewed or accessed. Additionally, you can set up additionally security to deactivate via MAC Address so that it will never be allowed to access the plant network once lost or stolen. If there are a large number of local client workstations and HMIs involved the savings can substantial and help balance the cost of a hardened redundant server system. Additionally, thin clients are easier to maintain. If a thick client crashes, you will need to reload all of the software. If a thin client crashes, it can be set back up in minutes.

Options for automation visualization software include the following:

- Continue using RSView32 Works and Runtime software on SCADA workstations and HMI PCs with 64-bit operating systems using VMWare
- Upgrade to FactoryTalk-ME software on SCADA workstations and HMI PCs
- Upgrade to FactoryTalk-SE software in server/client configuration using Thick Clients

- Upgrade to FactoryTalk-SE software in server/client configuration using Thin Clients
- Upgrade to FactoryTalk-SE software in server/client configuration using both Thick and Thin Clients

Information Management

Information management software systems bring process data from across the facility to a secure central location where it is archived and disseminated for use. Deploying an information management system is a substantial investment in both time and resources and should be closely evaluated before purchase and implementation. Information management systems can be a great set of tools for treatment facility operations and management if selected carefully and used to their potential. They can help streamline processes, identify problems early or before they happen, reduce chemical use and other consumables including energy, reduce effort recording field data and preparing reports, and preform many other time-consuming tasks.

Another benefit of information management is enhanced data storage and retrieval, as the management system should archive data in a tightly compressed format that is very secure and easy to access by standard database interfaces. Two software suites have been evaluated for this Facility Plan Update: FactoryTalk Historian-SE by Rockwell Automation and Water Information Management Solution ‘WIMS’ by Hach.

Rockwell Automation offers FactoryTalk Historian-SE and FactoryTalk Historian-ME as the central components of their information management system. FactoryTalk Historian’s core is based upon OSiSoft’s Pi data compression engine. OSiSoft is a market leader for large data storage and compression. The OSiSoft Pi data compression engine is very good at compacting and maintaining huge amounts of data in very little space. This is possible because it’s access to data is very fast, not requiring user intervention to decompress or view the data within the storage shell. Around this advanced compression engine, a FactoryTalk services wrapper has been added. This allows the historian engine to automatically discover all the tag names within the entire FactoryTalk system, PLCs, SCADA servers, workstations, drives, etc. This allows the user to go through a complete automatically generated tag name pick list and simply choose which ones are to be captured by the historian database. This makes the database configuration very easy to develop and integrate.

This is not usually the case with other information management systems which access process data from SCADA via OPC drivers. OPC data retrieval is not automatic in the same sense as with FactoryTalk services within a FactoryTalk SCADA environment. OPC tag name retrieval must be performed by export/import. Syntax differences must be dealt with and translated, and some data may have to be manually entered which is time consuming and can be error prone.

FactoryTalk Historian when used within a FactoryTalk SCADA and Logix PLC systems is extremely efficient and very cost effective to operate compared to other information management systems. Most database software is costed by measuring the number of tag names that are tracked. Because common tag names are used throughout the entire FactoryTalk system, less tag names are consumed. Therefore, no look-up tables or translators must be built to convert data syntax between software packages.

Because of the FactoryTalk services wrapper, FactoryTalk Historian connects to all other FactoryTalk products automatically. This wrapper provides embedded drivers, security and direct connections to useful user interfaces such as FactoryTalk View and FactoryTalk Vantagepoint. FactoryTalk Vantagepoint is included within the FactoryTalk Historian-SE software module. FactoryTalk Vantagepoint is a single place where users interface the database to access historical and live process data, compare process data to standard values, create custom dashboards, and create reports.

FactoryTalk Historian-SE uses standard database tools such as MS Excel and SQL Server Reporting (SSR), etc. Many optional data management tools within the Rockwell catalog are directly compatible with FactoryTalk Historian such as FactoryTalk Analytics which allows users to keep track of process health and perform predictive control within those processes, and FactoryTalk EnergyMetrix which helps capture, analyze, store and share energy usage data to help optimize and conserve energy.

FactoryTalk software products are very familiar to most consulting engineers and systems integrators and many are very proficient users. Rockwell Automation support through their engineering services and through distributor's technical services is very comprehensive throughout the region. A few FactoryTalk Historian user references for water and wastewater treatment are Three Rivers WWTP in Longview, WA and Spokane Valley Water. Three Rivers WWTP has very similar treatment facility processes and O&M needs as Pendleton WWTRRF. They have fully implemented a FactoryTalk solution in their facility and have developed wastewater process dashboards with EPA and State regulatory reporting forms using FactoryTalk Vantagepoint. Spokane Valley Water has a very similar system in place at their DBO treatment facility.

Hach Water Information Management Solution, or Hach WIMS, is a software suite that brings process data from across the wastewater treatment system to a central and secure location for monitoring and managing operations. Hach WIMS software runs on MS Windows PCs and comes with a standard SQL database that supports MS SQL server and Oracle databases. Hach WIMS interfaces include customizable dashboards which are tailored to the water and wastewater industries. Dashboards may contain process variable trends, Key Process Indicators (KPIs), which show in colors which indicate status, blue for within normal range, yellow for warning and red indicates a problem. Hach WIMS has comparative trending which can record related KPIs such as MLSS, RAS return rates, and clarifier blanket depths. When these parameters are trended together and comparatively analyzed, operators can better understand how they work together affecting SRT, for example.

Data is brought in from outside sources, such as process data from SCADA and laboratory data from Laboratory Information Management Systems (LIMS). Hach WIMS has interface drivers for most SCADA and LIMS software systems in use within the industry worldwide. Hach WIMS also has optional modules that can be added to enhance performance and provide advanced features such as "BOD Manager" which helps improve productivity and data integrity for BOD testing and monitoring. Another optional add on module is "Job Cal Plus", a Computerized Maintenance Management System (CMMS). This is used to track and schedule maintenance and is tailored to the water and wastewater industries.

Another option available through Hach WIMS is a service called "doForms Portable Solution" which enables mobile devices such as tablets and smartphones to collect Hach WIMS data in the field and directly input it to the Hach WIMS database. Hach WIMS has preprogrammed EPA and state reporting forms for most states to save in report development time. There are also over 100 built-in water and wastewater industry specific formulas to perform complex calculations. Once data is entered an audit trail is started so all data is traceable.

Hach WIMS is fully supported by Hach distributors and Hach Engineering Services. Hach WIMS is not as well known to consulting engineers and systems integrators within the region. The most reliable source for start-up and servicing support for Hach WIMS is Hach Engineering Services. Hach WIMS is currently in use in the following Oregon municipalities: Ashland, Medford, Bend, Eugene and McMinnville.

Options for information management software include the following:

- Use limited process trending and historical data storage within SCADA software
- Implement RA FactoryTalk Historian with add-on software modules as necessary
- Implement Hach WIMS with add-on software modules as necessary

7.5.2.2.2 Hardware

The process control hardware in use at the WWTRRF is Rockwell Automation ControLogix PLCs, chassis, and I/O modules. The SCADA HMI automation hardware in use is MS Windows-XP workstation PCs, RA VersaView HMI PCs, and RA PanelView HMI terminals. The SCADA networking hardware includes RA Stratix Ethernet switches, fiber optic patch panels, fiber optic cable and connectors, RJ-45 connected copper Ethernet cable, and miscellaneous networking devices. The existing hardware is in good condition, operating well and can stay in service until upgraded. The obsolete MS Windows-XP operating system on the workstation PCs should be upgraded as soon as possible as mentioned previously.

When looking at hardware options for the process automation and information management levels it is important to consider ease of access for authorized users, reliability, and security as primary factors along with proper equipment for the use, room for future growth, and cost. Computers, peripheral hardware models, and costs change rapidly as technology advances and end users also have purchase agreements and preferences which must be considered when choosing equipment. For the purposes of this Facility Plan Update, hardware brand names and models will not be used unless the equipment can't be otherwise described by type and use.

Should the City choose to operate the facility as-is with SCADA workstations and SCADA HMI running individually the path forward would be to upgrade the existing SCADA workstations to newer 64-bit PCs with adequate performance specifications and memory to run FactoryTalk-ME according to Rockwell Automation's recommendations. The existing touchscreen SCADA HMI PCs in the local panels should have their operating systems upgraded to MS Windows 7, 8, or 10 and reused if possible. If they are too old to be upgraded, then they should be replaced with newer touchscreen PCs, Thin Client terminals, or abandoned in favor of mobile devices.

The following options describe a common architecture for a three-layer industrial SCADA server system. This server setup includes high level performance, flexibility to adapt to changing uses, and the ability for future growth. This typical layered SCADA network architecture deploys a "Defense in Depth" cybersecurity strategy well accepted by both Industrial Process Control and Information Technology regulatory agencies. No outside intrusion can gain access to critical facility processes without first penetrating multiple levels of hardware firewalls and server security services thus giving the system it's best opportunity to respond before damage can be done.

Should the City choose to operate a server/client SCADA system, two redundant server systems should be set up. One process control server system should reside in the Secondary Process Building Electrical Room within the Industrial Process Zone (IPZ) as described in Section 7.5.2.2.3 below. The other information management server system should reside in the Administration Building within the Industrial Demilitarized Zone (IDMZ), also as described in Section 7.5.2.2.3 below. Each server system should include two rack mounted blade servers operating in redundant configuration with hard drive arrays for network storage also provided in redundant configuration. Network memory storage requirements will be determined during design and implementation of the systems. Each server system will also be connected to a network grade rack mounted online Uninterruptible Power Supply (UPS) with sufficient battery capacity to run the server system for at least 4 hours at full capacity. Each server system should also include rack mounted routers, switches, firewalls, and other necessary infrastructure devices. Each server system should also have a rack mounted keyboard and monitor for maintaining the servers. Each server's operating systems and installed services will be optimized for the City's selected application programs.

The Enterprise Zone (EZ) is the third zone as described in Section 7.5.2.2.3 below. In this zone the enterprise server, routers, switches, hardware firewalls and other infrastructure devices shall reside to connect the facility with the outside world. Outside connections would include the City's Wide Area Network (WAN), the Internet Service Provider (ISP), and dark fiber connection to the Water Filtration Plant. The enterprise server would handle server functions for email, telephone, web access, office productivity applications, etc. The enterprise server should be set up to the City's IT server standard and need not be to the same standard as the two industrial server systems.

Each of the three server zones would be securely isolated by managed network switches and hardware firewalls at every network penetration. In each server zone PC workstation, Thick Client PCs and/or Thin Clients PCs may reside as needed. These user workstations and HMIs should be determined and specified by the City, Design Engineer, and Systems Integrator during design and implementation of the SCADA process control, automation visualization, and information management systems upgrade. Options for SCADA hardware for the WWTRRF are solely based on the software chosen by the City.

7.5.2.2.3 Network Topology

The SCADA process network at the WWTTRF is laid out flat in a compound star topology. Network branches are connected to the SCADA workstations via a single spur in at least four places. This network topology leaves the system vulnerable. If there is a failure in any of the spur cables, all the networked controllers, remote I/O, and HMI PCs on the downstream side of the faulted cable will be offline. One of the spurs has four remote I/O chassis and two HMI PCs at risk, while other network spurs have at least two or more nodes at risk. It is understandable how the process network grew and evolved this way over time with improvements added sequentially to one process area at a time. The process control network has grown to a point where the vulnerability in its topology has become acute.

With major SCADA upgrades under consideration, improvements to the process network topology should be evaluated to establish a system that is less vulnerable with more redundancy. The SCADA process network should be designed and constructed in a self-healing redundant ring topology. Instead of having spur cables branch out in star configuration from common points, network cable segments should loop from switched node to switched node in a ring-shaped topology, returning to its source in a closed loop. Ethernet switches at the source and nodes must be redundant ring enabled. While most managed switches are redundant ring, the existing panel switches need to be investigated. In a redundant ring network topology, if any one cable segment or node fails, the rest of the network stays up and running. Data signals are routed in both directions until the intended target is found. If two or more network segments or nodes fail, only the ring segments between the points of failure are lost and the rest of the network continues to operate. Also, managed redundant ring network switches are easier to troubleshoot because they have advanced diagnostics which help locate points of network failure. Existing cable routing between process network nodes needs to be investigated. Some re-routings may be accomplished by connecting existing fibers to spare fibers in patch panels; however, new conduit and fiber optic cable may be required in some instances.

Industrial Process Zone

To be more efficient, reliable, and secure the WWTRRF SCADA system should be segmented into three zones as mentioned in Section 7.5.2.2.2. The first zone is the Industrial Process Zone (IPZ). The IPZ is the lowest zone in the process network and is closest to the physical processes in the WWTRRF. The instrumentation transmitters, sensors, actuators, drives, switches, and other field devices are connected to the SCADA system in the IPZ. The IPZ also contains PLCs, I/O chassis, packaged panels, local SCADA HMIs, process network switches, process network patch panel, local SCADA workstations, SCADA servers, and everything else directly involved with the physical plant process control systems. Also, future FactoryTalk-SE servers and related equipment would reside in this zone. The IPZ can run the WWTRRF process control system on its own should communications be lost with the upper two SCADA zones. For that reason, the equipment in the IPZ is industrially hardened and isolated for security.

All data communications in and out of the IPZ must be routed through servers and services. Transfer of data in the IPZ must be securely limited and the use of insecure transfers such as USB drives, flash drives, memory cards, and mobile phones, for example, should be monitored closely and direct access not allowed unless absolutely necessary. All data passing in and out of the IPZ must be ported through hardware firewalls and managed switches.

Industrial Demilitarized Zone

The second zone is the Industrial Demilitarized Zone (IDMZ). The IDMZ is the middle SCADA system zone and is also very secure. The IDMZ is boxed on all sides with hardware firewalls and managed switches. All data passing in, out, and through the IDMZ must be routed through servers and services and ported through hardware firewalls and managed switches. The SCADA information management system servers and related equipment would reside in the IDMZ. O&M and lab workstation PCs and peripherals would also reside in this zone. Secure wireless process control communications within the WWTRRF such as mobile SCADA HMI tablets could also be tethered within this zone. The SCADA nodes within the IDMZ send and receive both process and business data from the IPZ below and the EZ above through secure managed switches and hardware firewalls only.

Enterprise Zone

The third and top zone of the SCADA system is the Enterprise Zone (EZ). This zone connects to the outside world as described above in **Section 7.5.2.2.2**. The EZ is the business zone and is the least secure, relatively speaking. It is secure to City IT standards, but less secure on an industrial standard level due to the direct connections outside the facility. External cyberattacks would most likely start at this zone. Data passed in and out of the EZ must also run through a server and services and be ported through managed switches and hardware firewalls to be secure. This zone would handle normal office data traffic and potentially contain office PCs for email, network printers, telephones, general Wi-Fi routers for personal phones, etc. The EZ would also securely route encrypted plant process data and informational data to and from the IPZ and IDMZ to remote locations such as the City Public Works Office, the Water Filtration Plant SCADA system and to secure web portals for authorized remote access.

7.5.3 Recommendation

The City has expressed the desire to continue using Rockwell Automation products. The City's existing PLC, HMI, and SCADA equipment, including software, is provided by either Rockwell Automation or a Rockwell Automation Partner. RA is the leading automation supplier in the United States and their equipment and software is currently used by many Municipal and Industrial customers. RA's support and service structure are extensive and covers the Pendleton area well. Nearly all Systems Integrators and Automation Contractors are familiar with RA products and many are very proficient. It would be extremely expensive for the City to switch automation product vendors due to required staff training, stocking different spare parts, and finding new suppliers/service vendors for a different product line. It is recommended that the City continue using RA products within the IPZ. The recommended implementation steps are as follows:

- Develop hardware, software, programming, and commissioning specifications to be bid upon by contractors. See **Figure 7-36** Proposed Network Topology.
  - Contractors will bid based on this design and provide proposed Bill of Materials to satisfy Design and Specifications.
- Migrate to latest FactoryTalk SE Visualization Software utilizing a server-client architecture. RSView 32 is obsolete and will not run on any Microsoft operating system newer than Microsoft XP. This should be completed as soon as possible. Commissioning the new system is parallel is very important to ensure zero downtime.
- Further evaluate reporting solutions, as the top two recommendations are Hach WIMS proprietary reporting solutions and a non-proprietary solution. Examples are attached in the Appendix for reference. Ease of use for operations should be considered, and it is recommended operations staff conduct pilot tests of the different software.
  - See **Appendix K** for Hach WIMS reporting solution
  - See **Appendix L** for Non-Proprietary reporting solution
- Develop relationship with additional qualified systems integration firms proficient in Rockwell's programming platforms as well as hardware and instrumentation. At least one "On-call" contract should be put in place for system integration support to allow for efficient support on an emergency basis.
  - Quality Controls Corporation
    - James Cross 425-778-8280 JamesC@QCCHome.com
  - The Automation Group
    - Gary Jenks 541-359-3755 GJenks@tag-inc.us
- Budgetary costs for planning the SCADA upgrades are as follows:

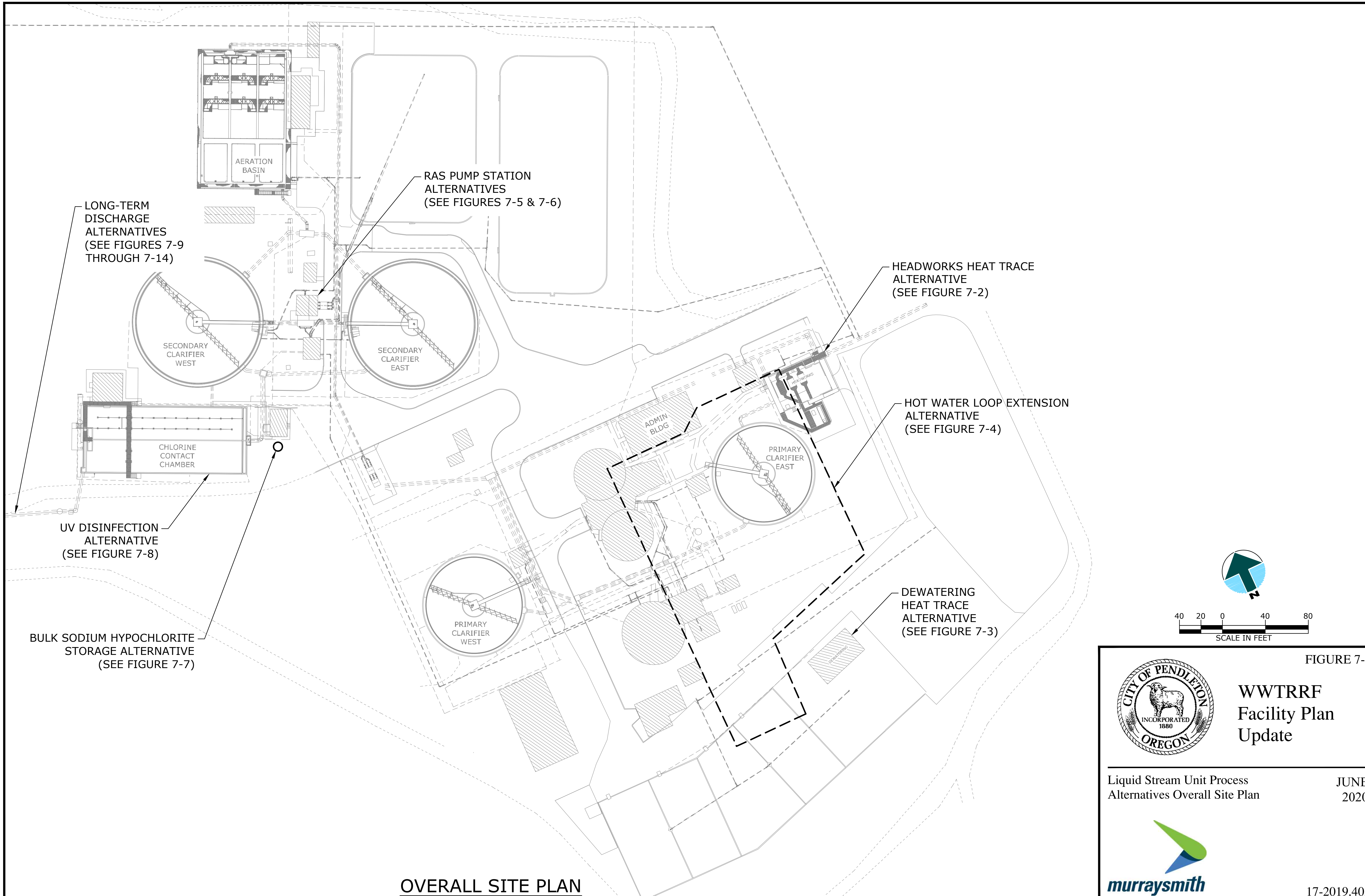
Table 7-12
Cost Summary

Description	CIP Costs
SCADA Upgrade	$486,000

Notes:

1. Estimate is for planning purposes only; AACEI Class 4 estimate ranges from -30 percent to +50 percent.
2. CIP costs include markups for mobilization, general conditions, contractor O&P, contingency, engineering, legal, and administration.

- Training and recruitment are recommended for in-house staff to able to support newer, advanced SCADA system. An additional in-house staffing FTE should be considered and in-house technical expertise transition plan for pending retirements should also be developed. Upcoming Staff Retirement accelerate the urgency. To attract and retain top talent, a new job classification should be considered.
  - Recruiting options to be considered include:
    - Walla Walla Community College's Utilities and Plan Management program
      - Walla Walla, WA
    - Perry Technical Institute's Instrumentation and Industrial Automation program
      - Yakima, WA
    - Bellingham Tech's Instrumentation Program
      - Bellingham, WA
    - Blue Mountain Community College IT Programs
      - Pendleton, OR
- AWWA Cybersecurity guidelines should be followed for remote access utilizing a tiered DMZ approach.
  - This can be downloaded for free at the following location
    - https://www.awwa.org/resources-tools/water-and-wastewater-utility-management/cybersecurity-guidance.aspx



OVERALL SITE PLAN

FIGURE 7-1

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Liquid Stream Unit Process Alternatives Overall Site Plan

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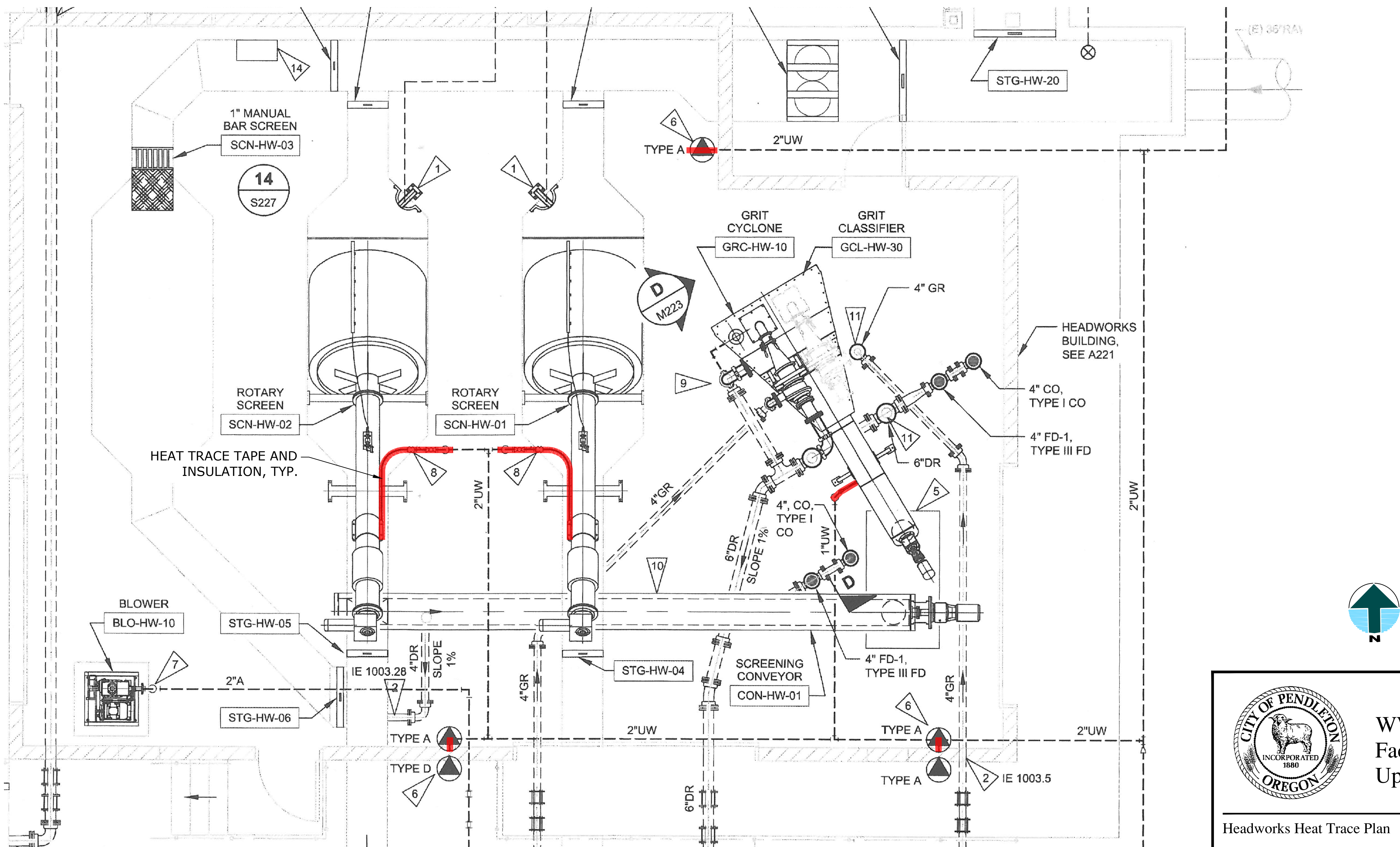

HEADWORKS HEAT TRACE PLAN

FIGURE 7-2

WWTRRF Facility Plan Update

Headworks Heat Trace Plan

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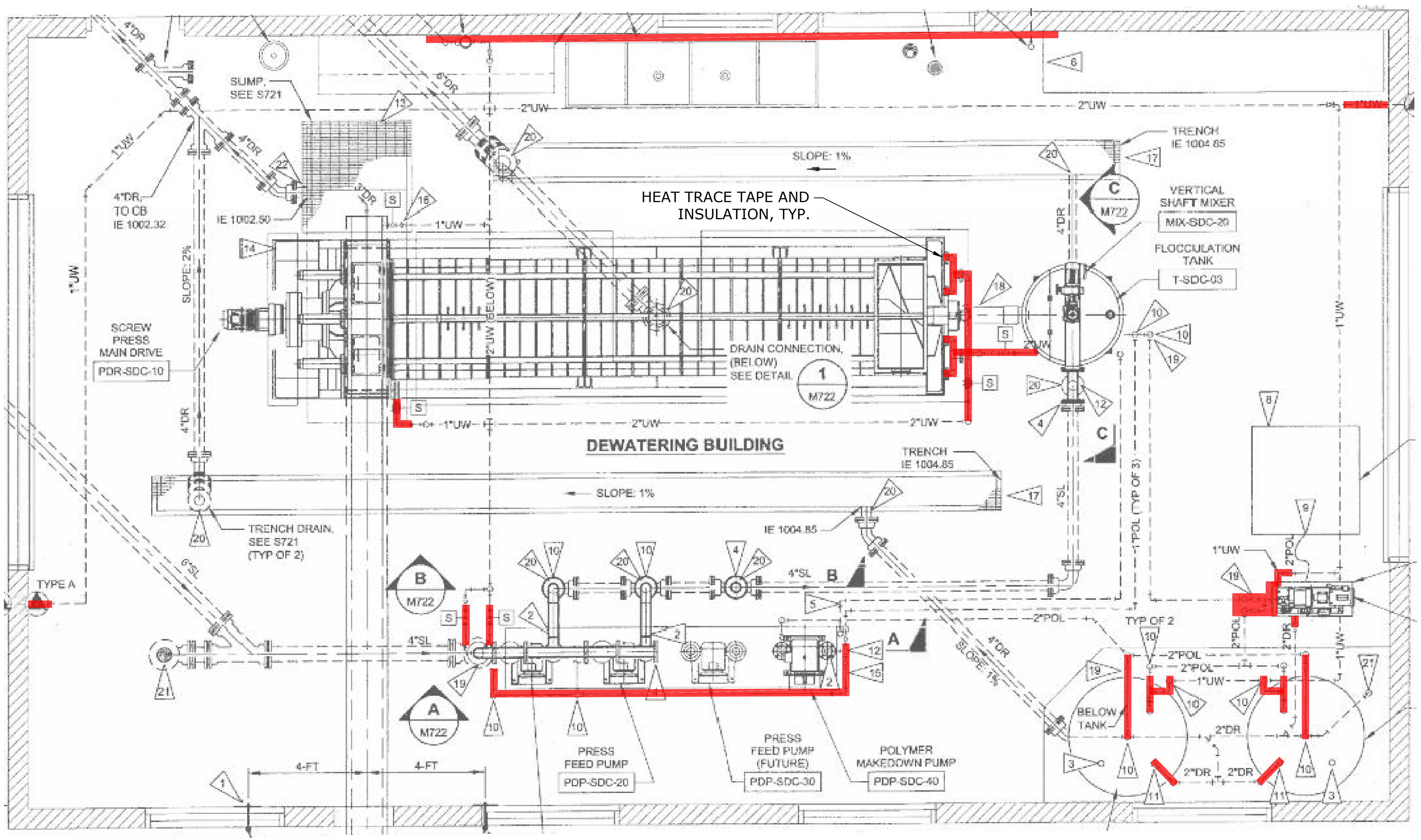

DEWATERING HEAT TRACE PLAN

FIGURE 7-3

WWTRRF Facility Plan Update

Dewatering Heat Trace Plan

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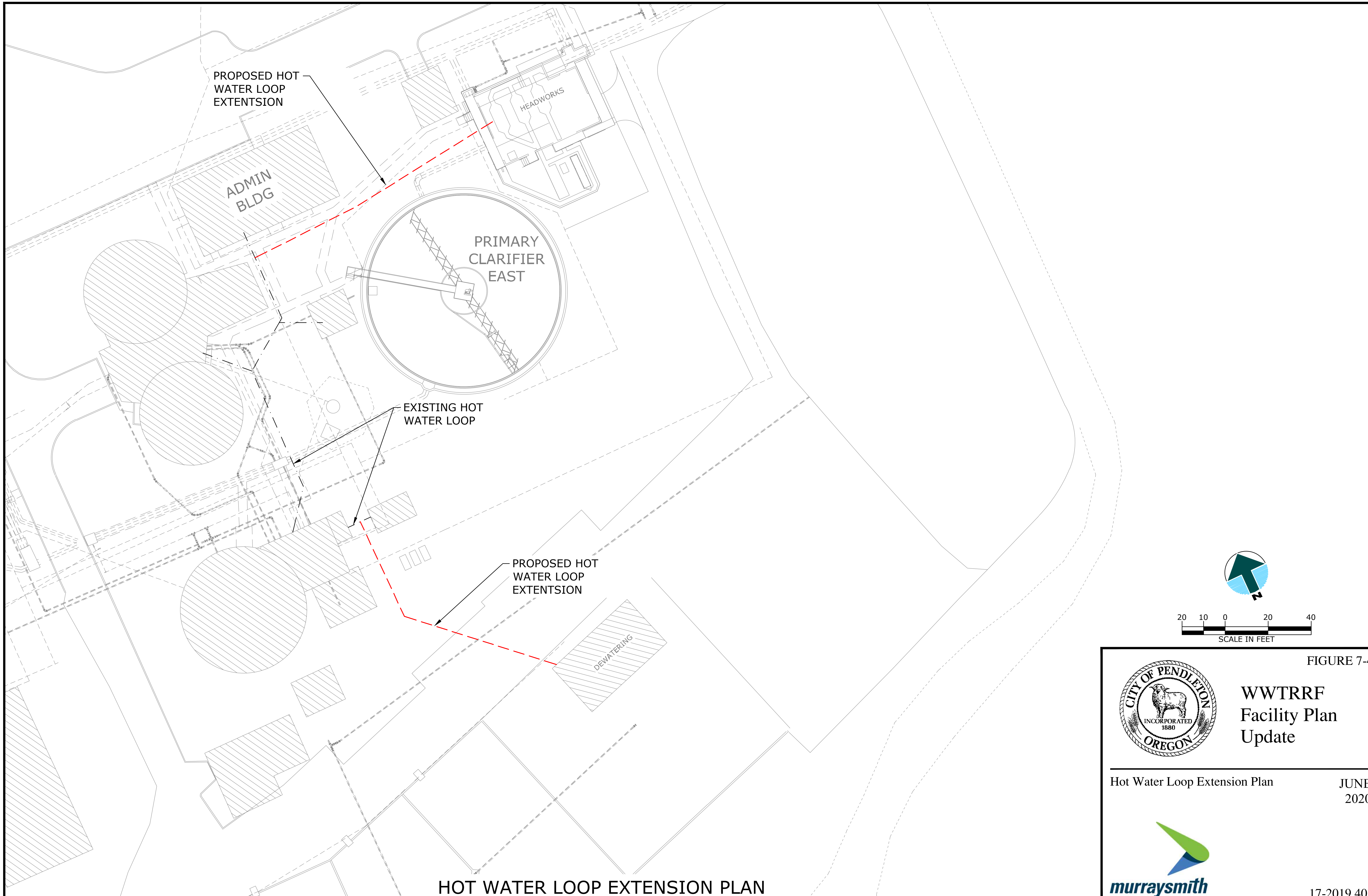

HOT WATER LOOP EXTENSION PLAN

FIGURE 7-4

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF
Facility Plan
Update

Hot Water Loop Extension Plan

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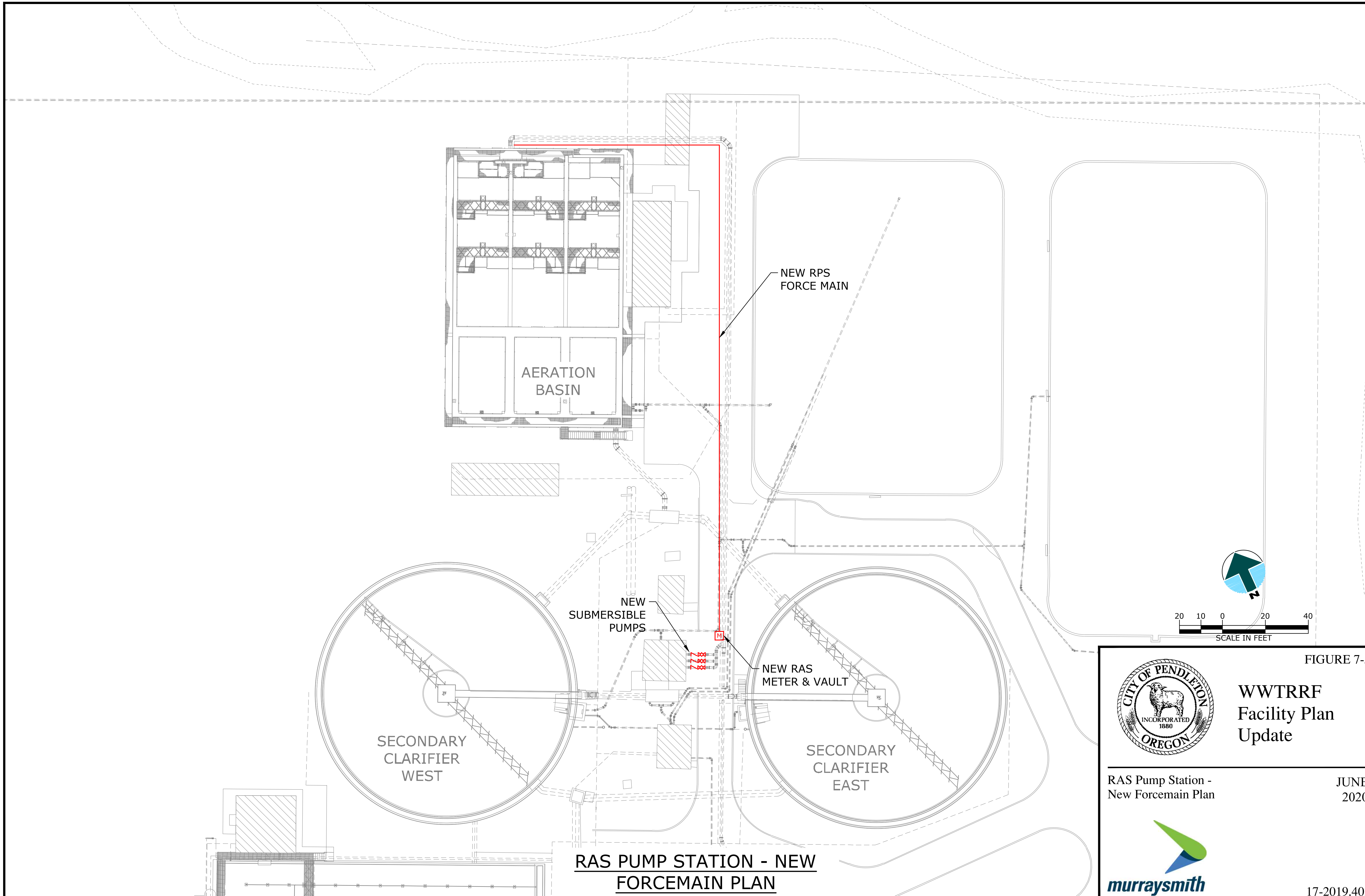

RAS PUMP STATION - NEW FORCEMAIN PLAN

FIGURE 7-5

CITY OF PENDLETON
INCORPORATED 1880
OREGON

WWTRRF
Facility Plan
Update

RAS Pump Station -
New Forcemain Plan

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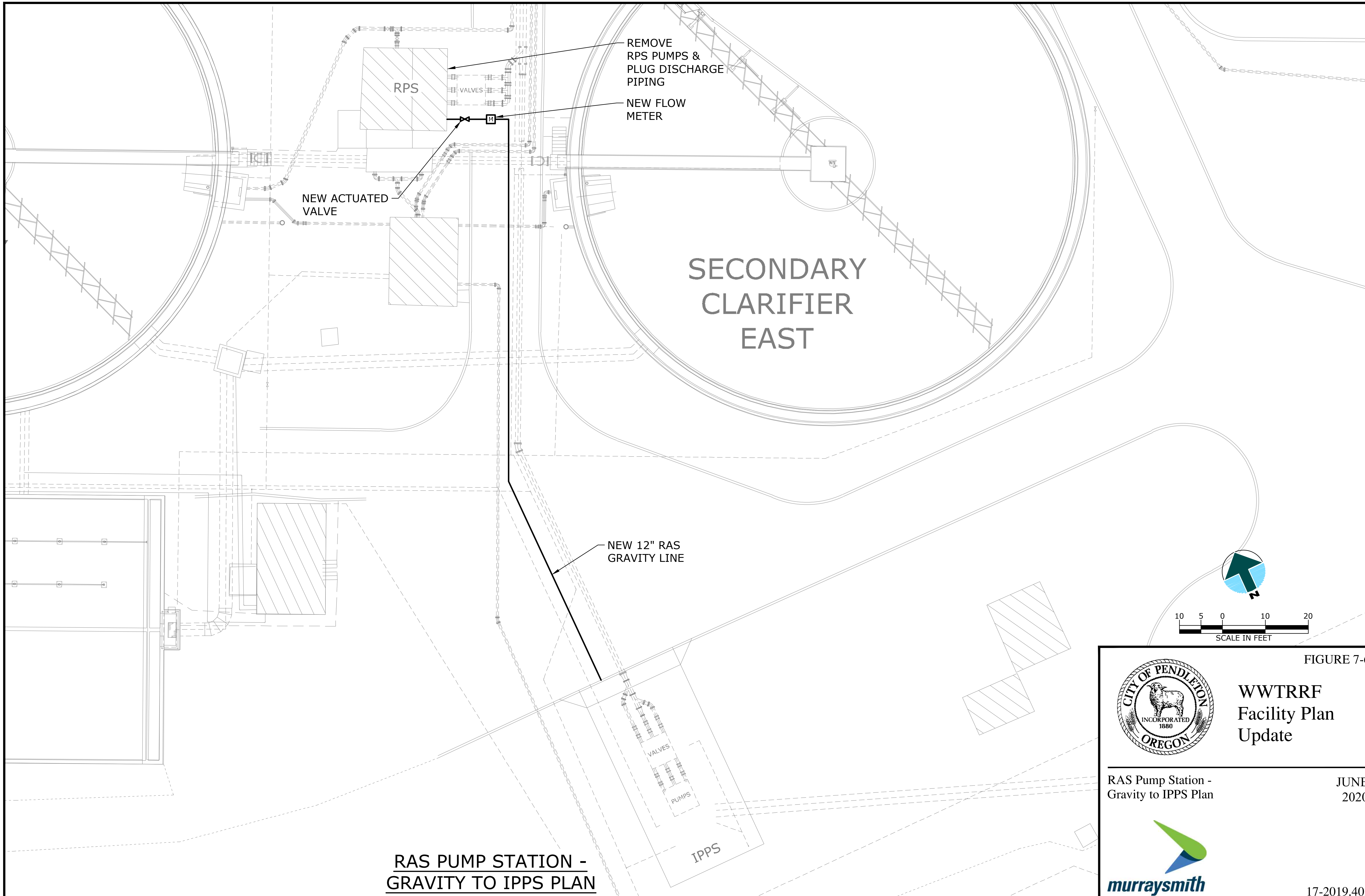

RAS PUMP STATION -
GRAVITY TO IPPS PLAN

FIGURE 7-6

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF
Facility Plan
Update

RAS Pump Station -
Gravity to IPPS Plan

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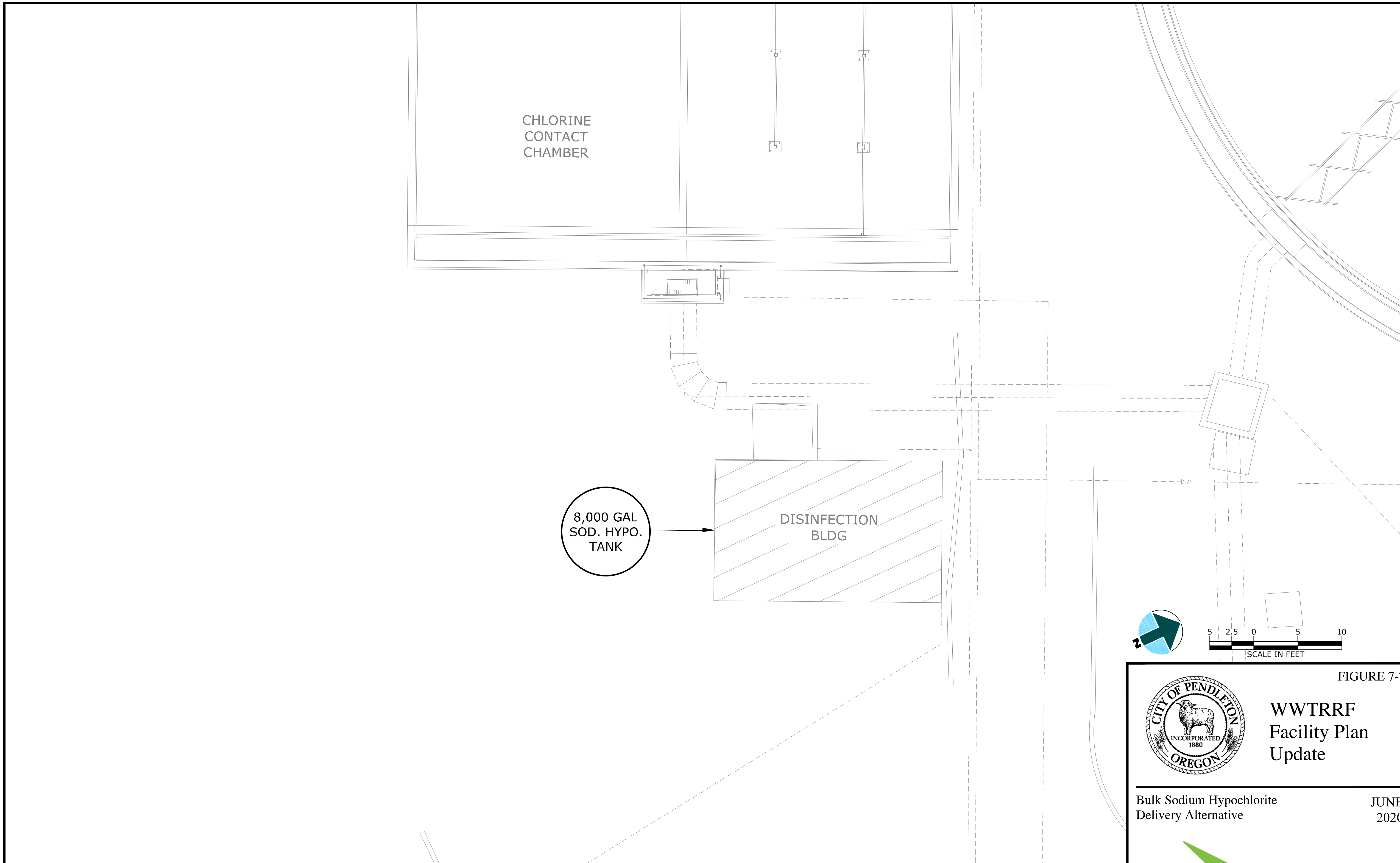

BULK SODIUM HYPOCHLORITE
DELIVERY ALTERNATIVE

FIGURE 7-7

CITY OF PENDLETON
INCORPORATED 1880
OREGON

WWTRRF
Facility Plan
Update

Bulk Sodium Hypochlorite
Delivery Alternative

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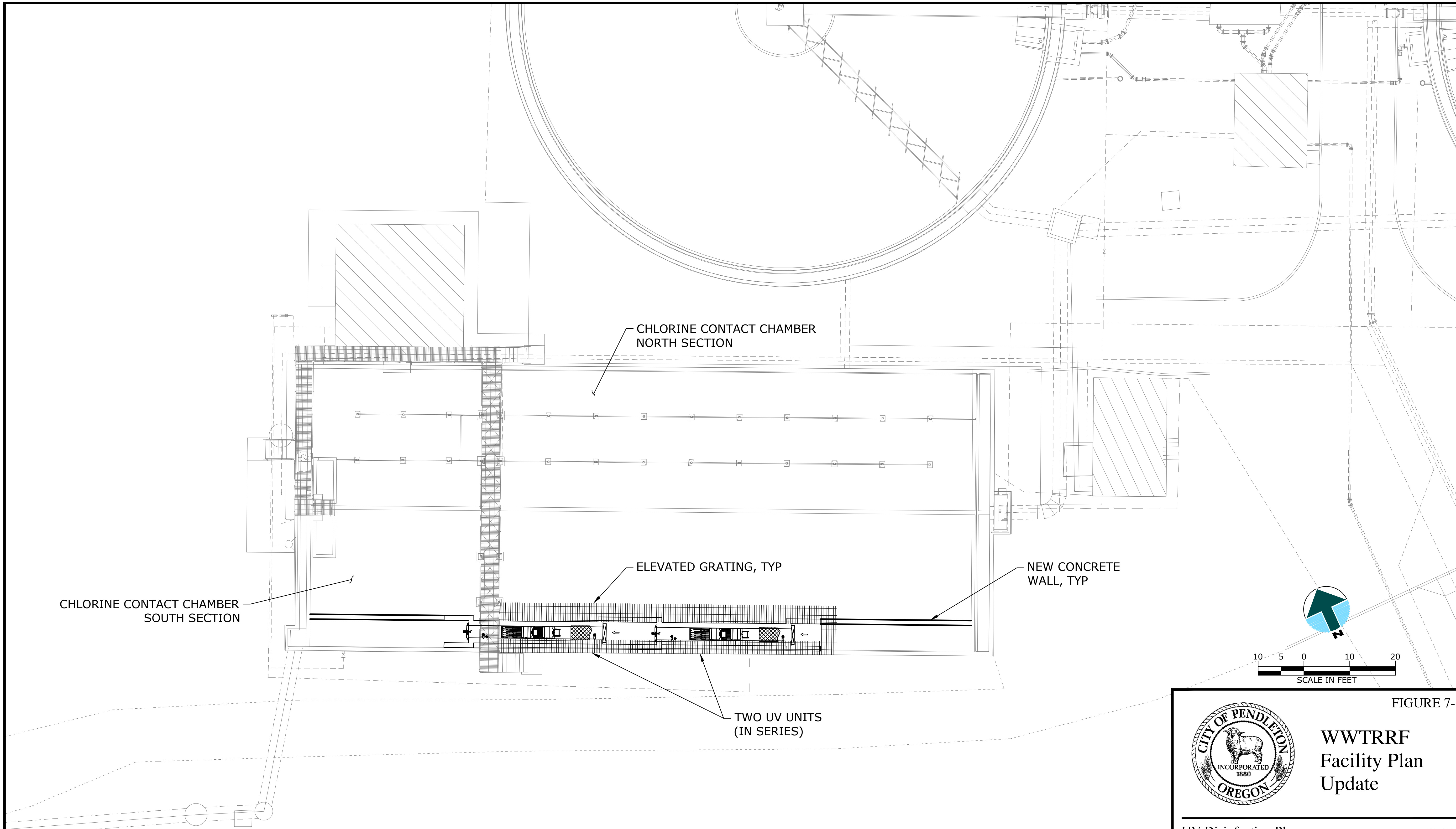

UV DISINFECTION PLAN

FIGURE 7-8

CITY OF PENDLETON OREGON INCORPORATED 1880

WWTRRF
Facility Plan
Update

UV Disinfection Plan

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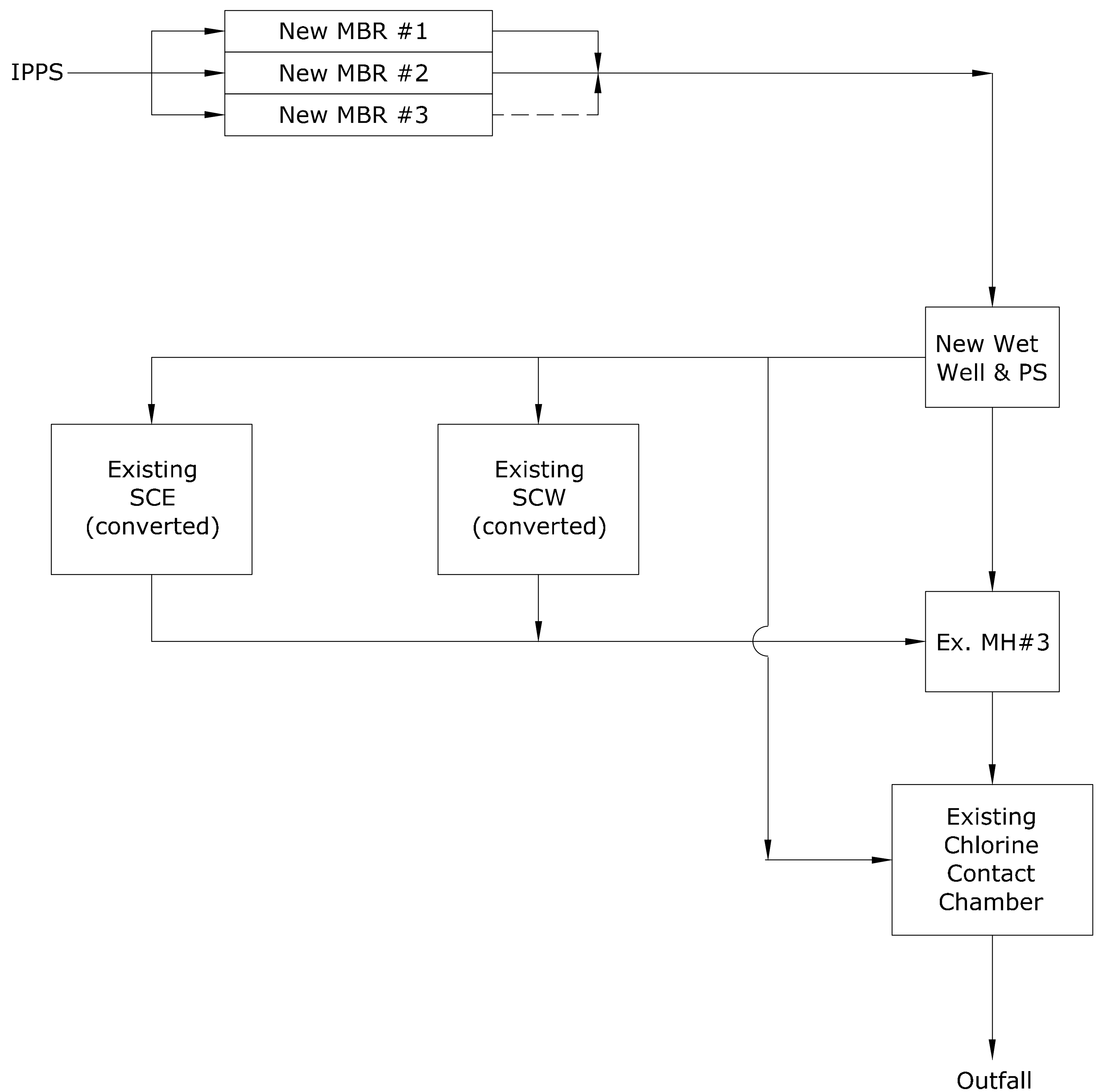

LONG-TERM DISCHARGE - MBR CONVERSION
WITH DIURNAL STORAGE SCHEMATIC

FIGURE 7-9

WWTRRF
Facility Plan
Update

MBR Conversion Storage
Schematic

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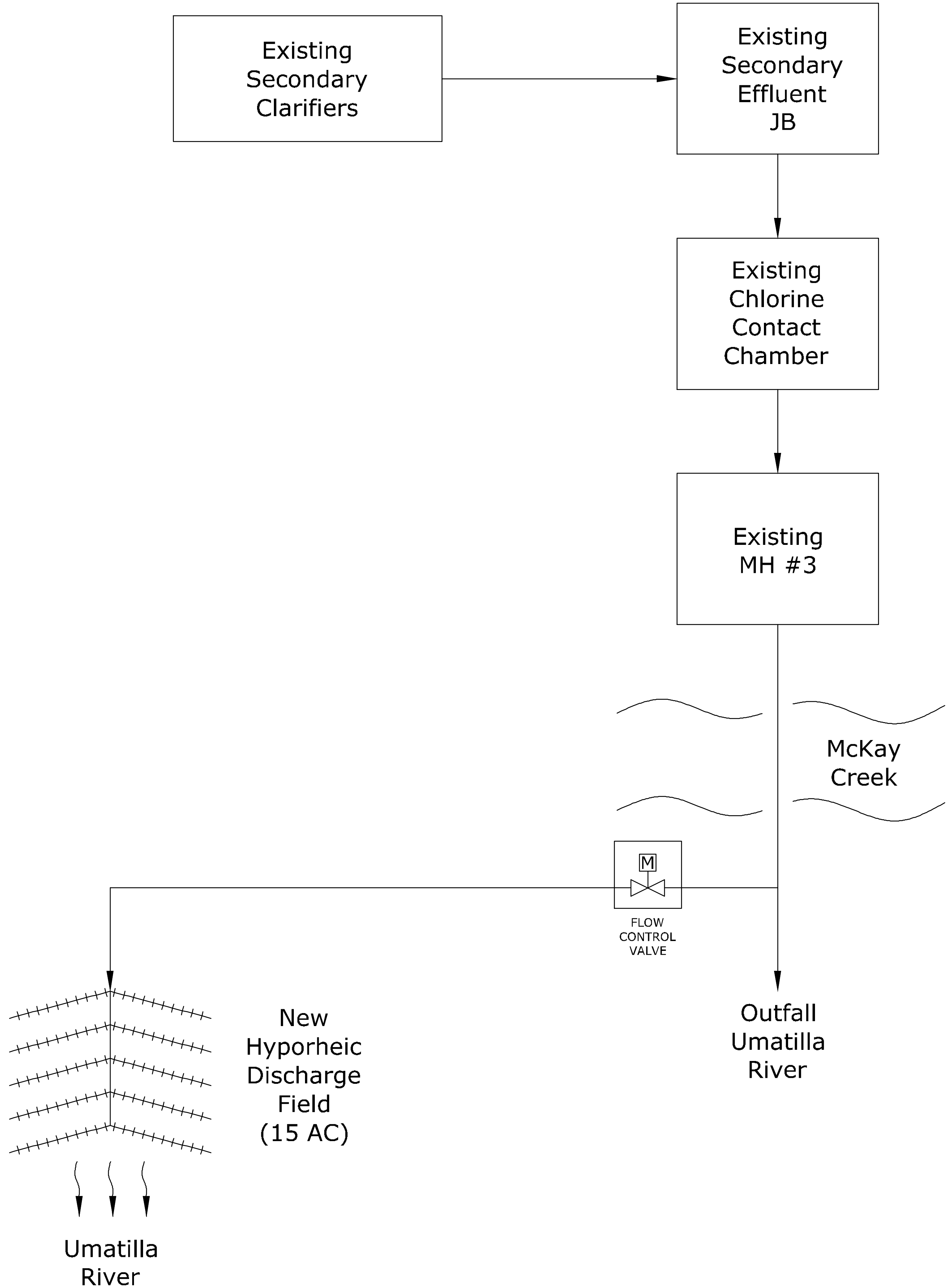

LONG-TERM DISCHARGE - HYPORHEIC DISCHARGE SCHEMATIC

FIGURE 7-10

WWTRRF Facility Plan Update

Hyporheic Discharge Schematic

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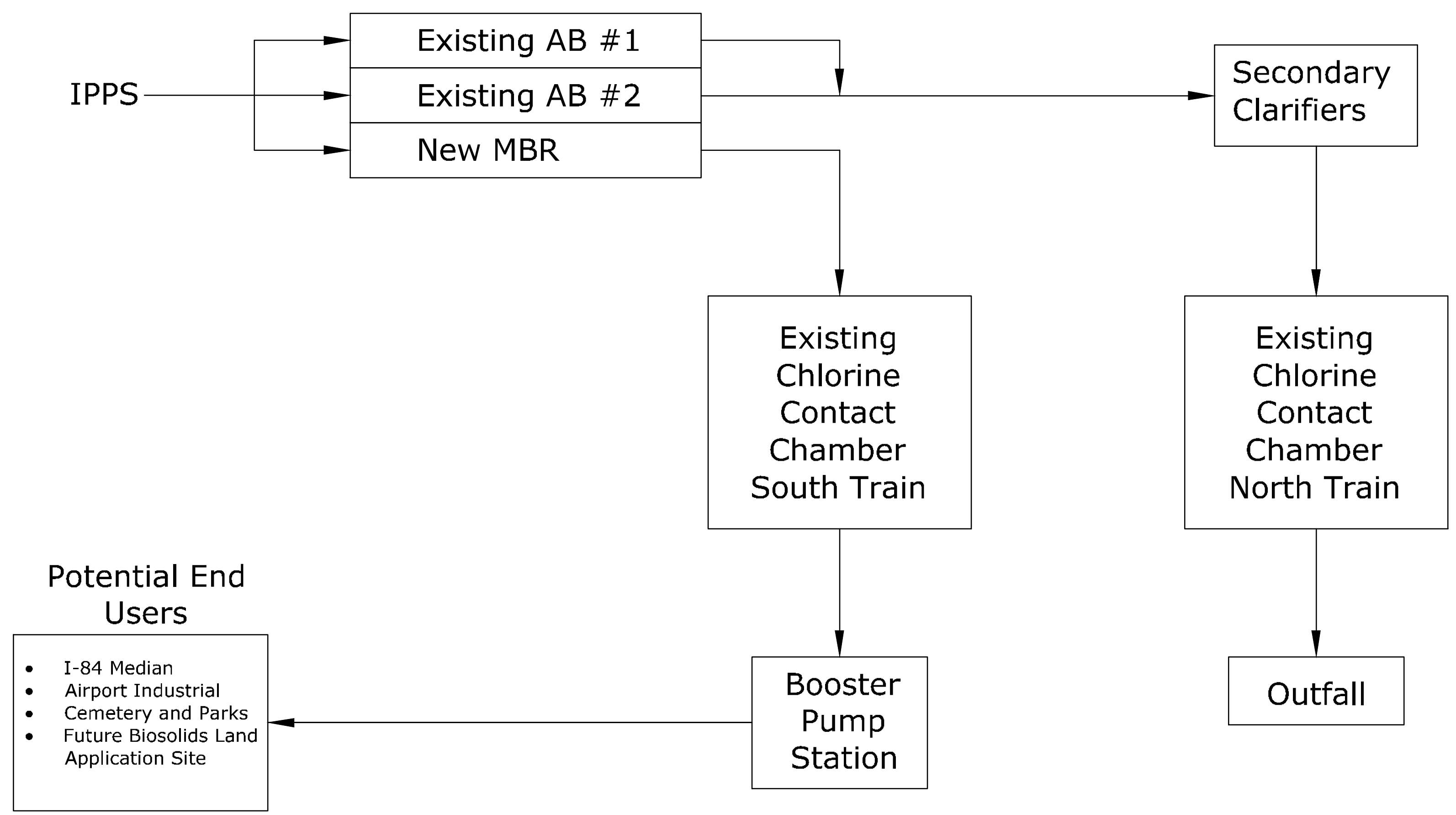

LONG-TERM DISCHARGE - CLASS A RECYCLE WATER SCHEMATIC

FIGURE 7-11

WWTRRF Facility Plan Update

Class A Recycle Water Alternatives

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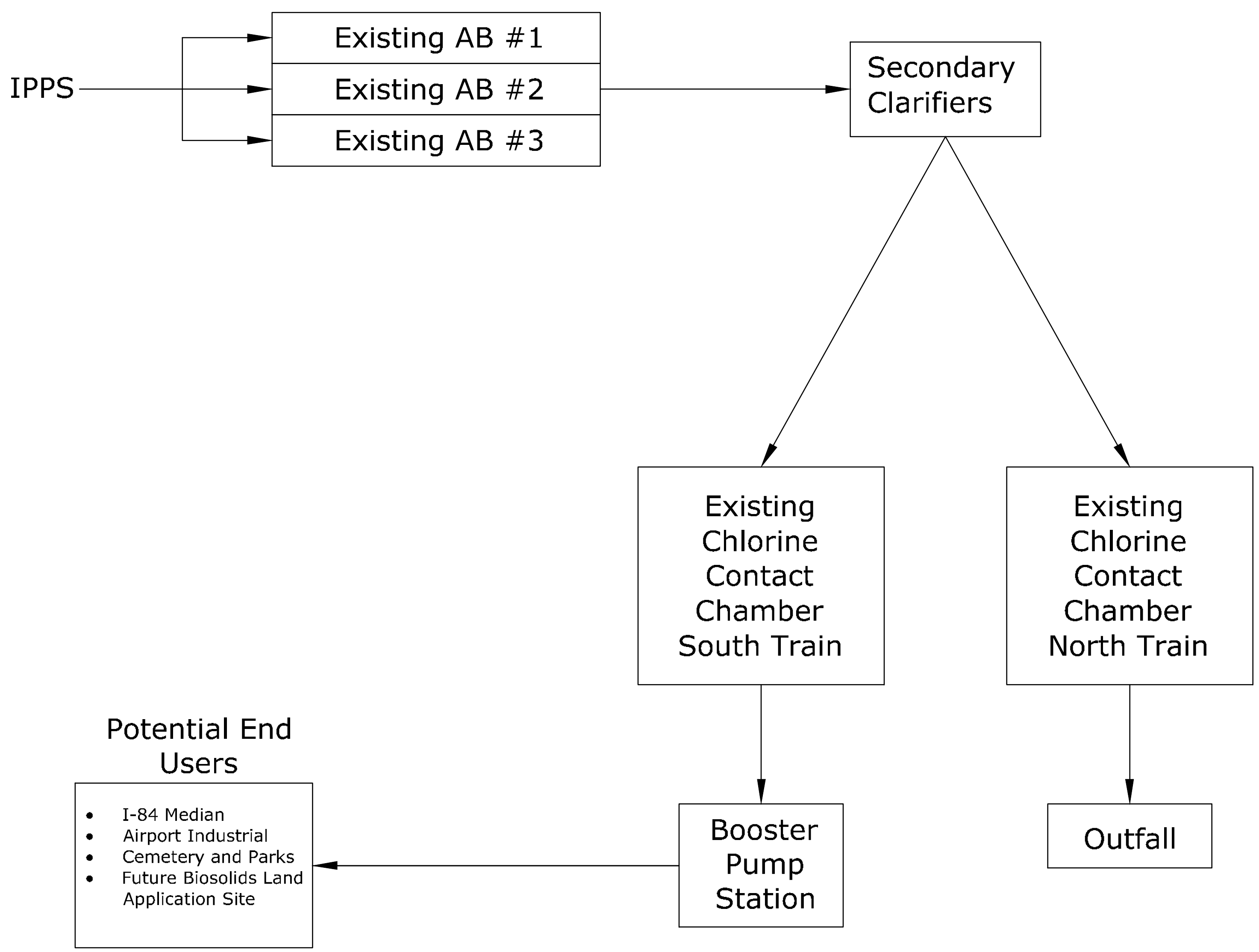

LONG-TERM DISCHARGE - CLASS C RECYCLE WATER SCHEMATIC

FIGURE 7-12

WWTRRF Facility Plan Update

Class C Recycle Water Alternatives

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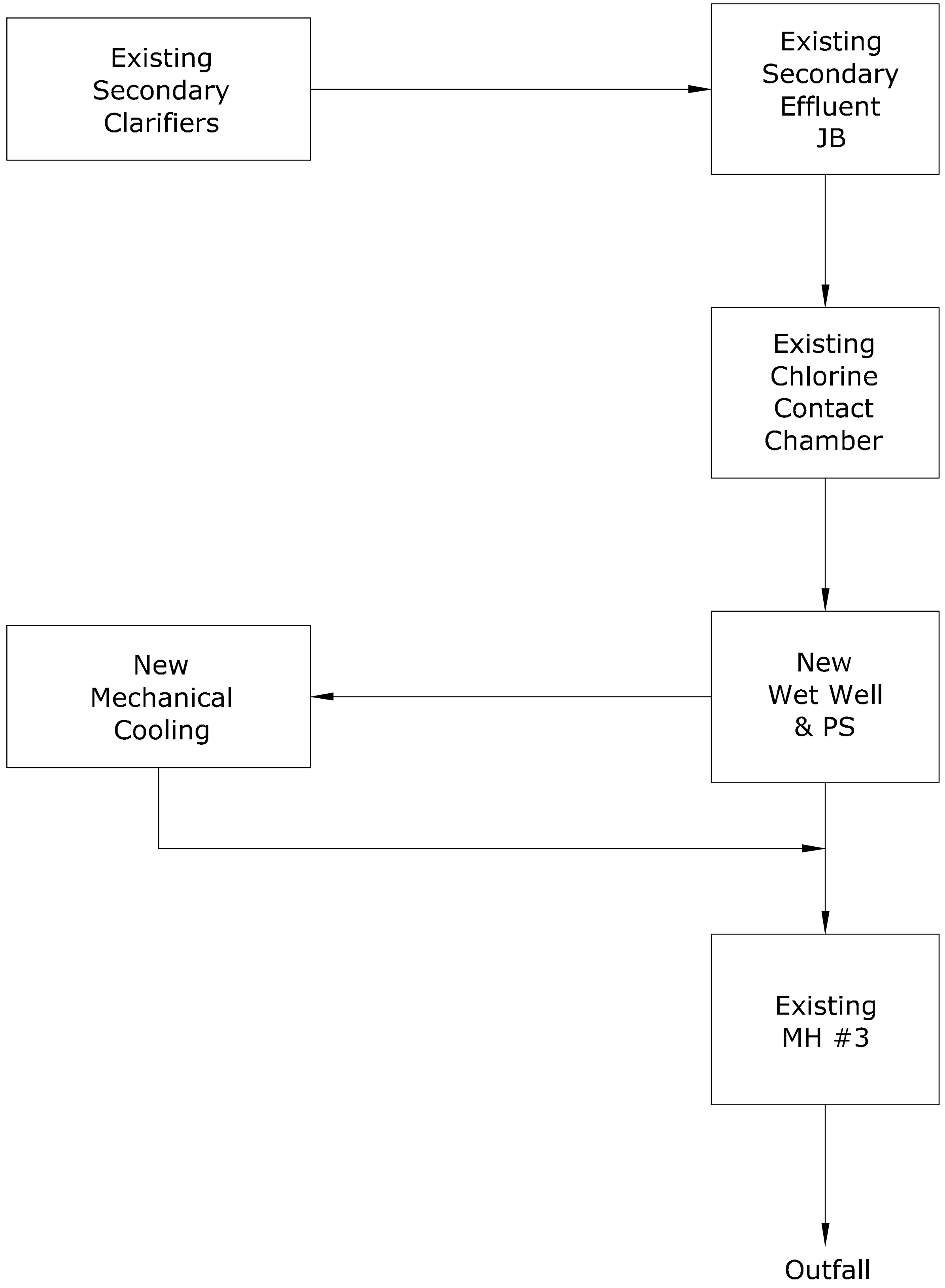

LONG-TERM DISCHARGE -
MECHANICAL COOLING SCHEMATIC

FIGURE 7-13

WWTRRF
Facility Plan
Update

Mechanical Cooling Schematic

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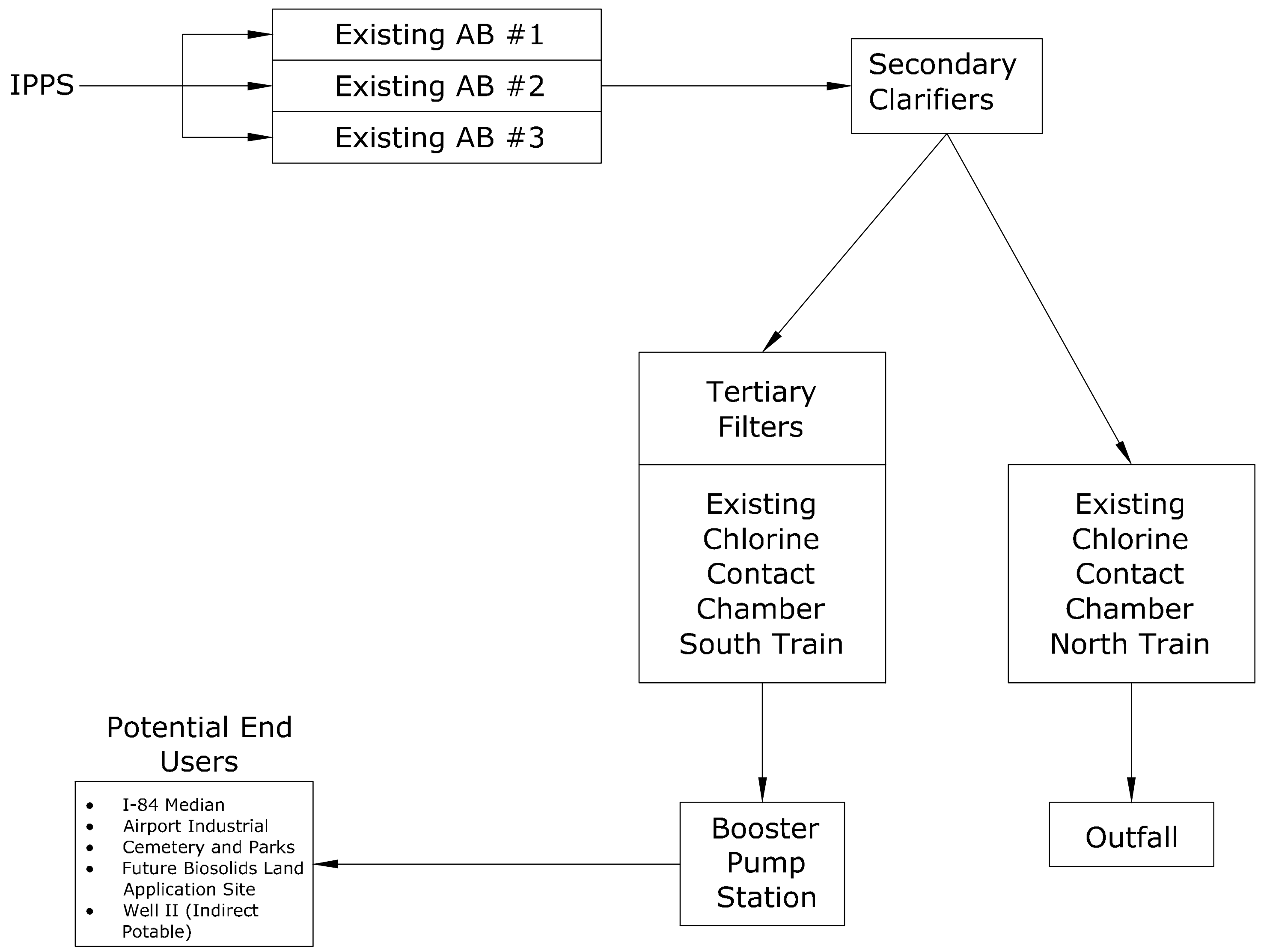

LONG-TERM DISCHARGE - CLASS A TERTIARY FILTRATION SCHEMATIC

FIGURE 7-14

WWTRRF Facility Plan Update

Class A Tertiary Filtration Schematic

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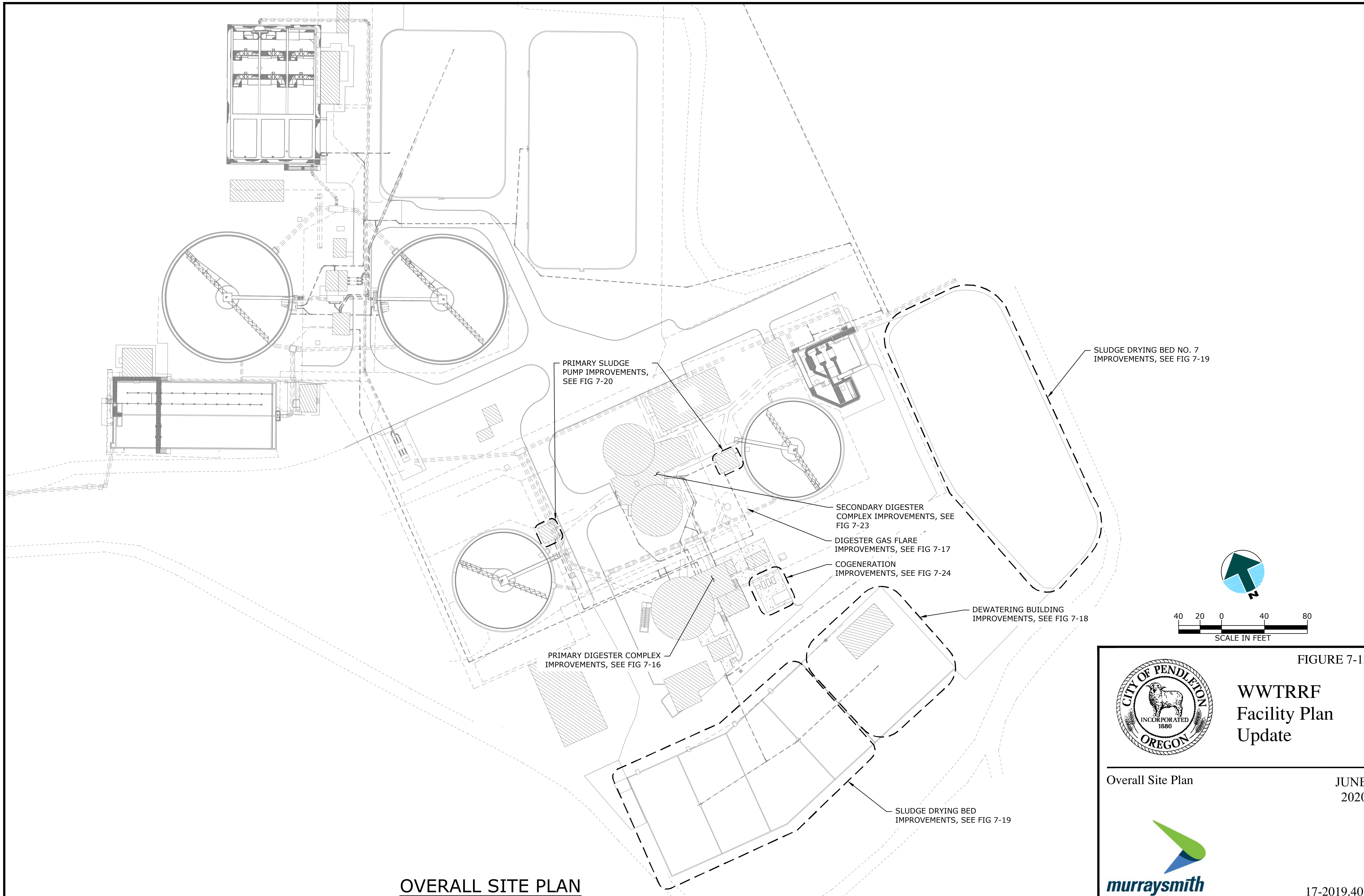

OVERALL SITE PLAN

FIGURE 7-15

WWTRRF
Facility Plan
Update

Overall Site Plan

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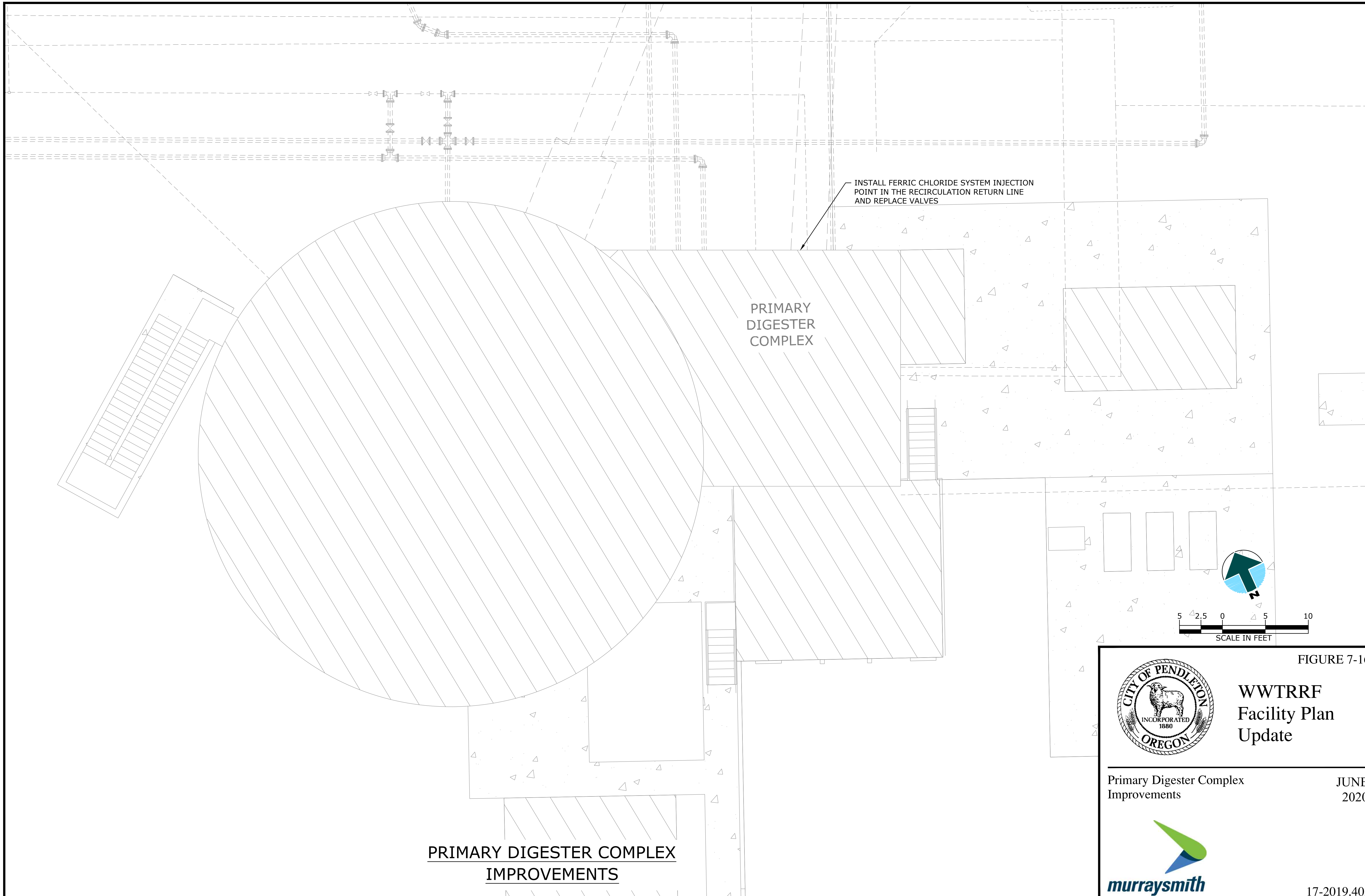

PRIMARY DIGESTER COMPLEX IMPROVEMENTS

FIGURE 7-16

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Primary Digester Complex Improvements

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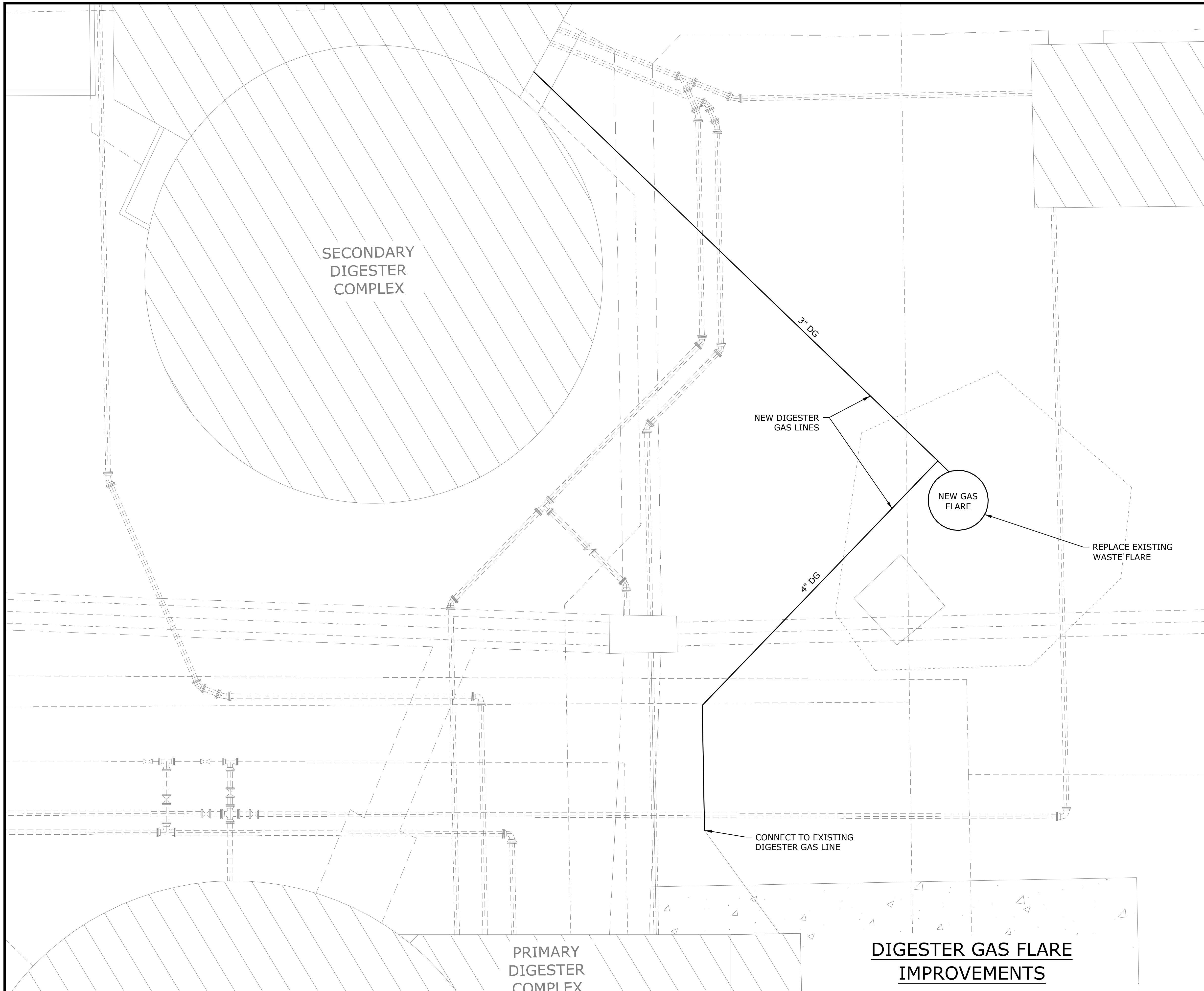

DIGESTER GAS FLARE IMPROVEMENTS

FIGURE 7-17

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF
Facility Plan
Update

Digester Gas Flare Improvements

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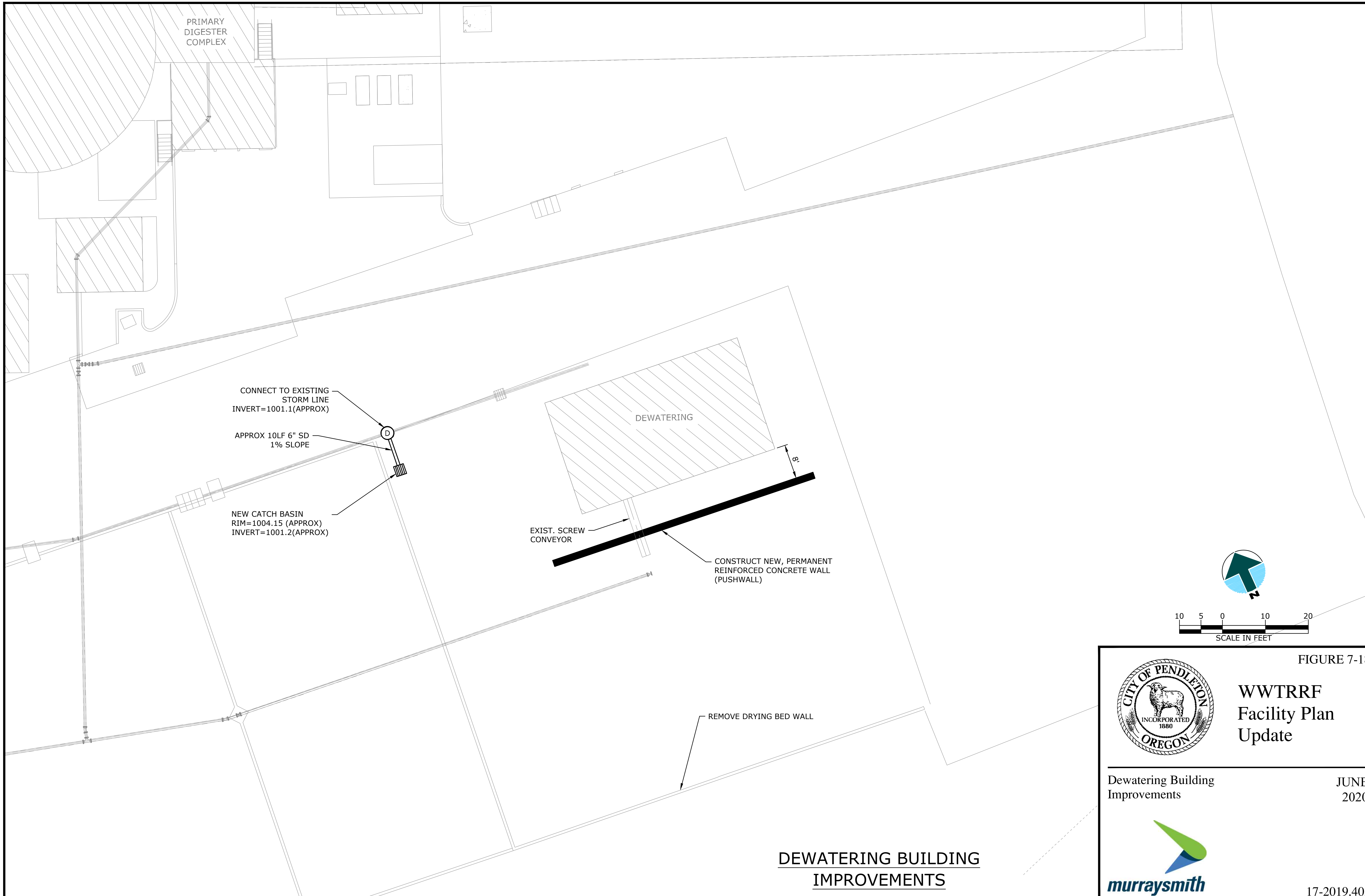

DEWATERING BUILDING
IMPROVEMENTS

FIGURE 7-18

CITY OF PENDLETON OREGON INCORPORATED 1880

WWTRRF
Facility Plan
Update

Dewatering Building
Improvements

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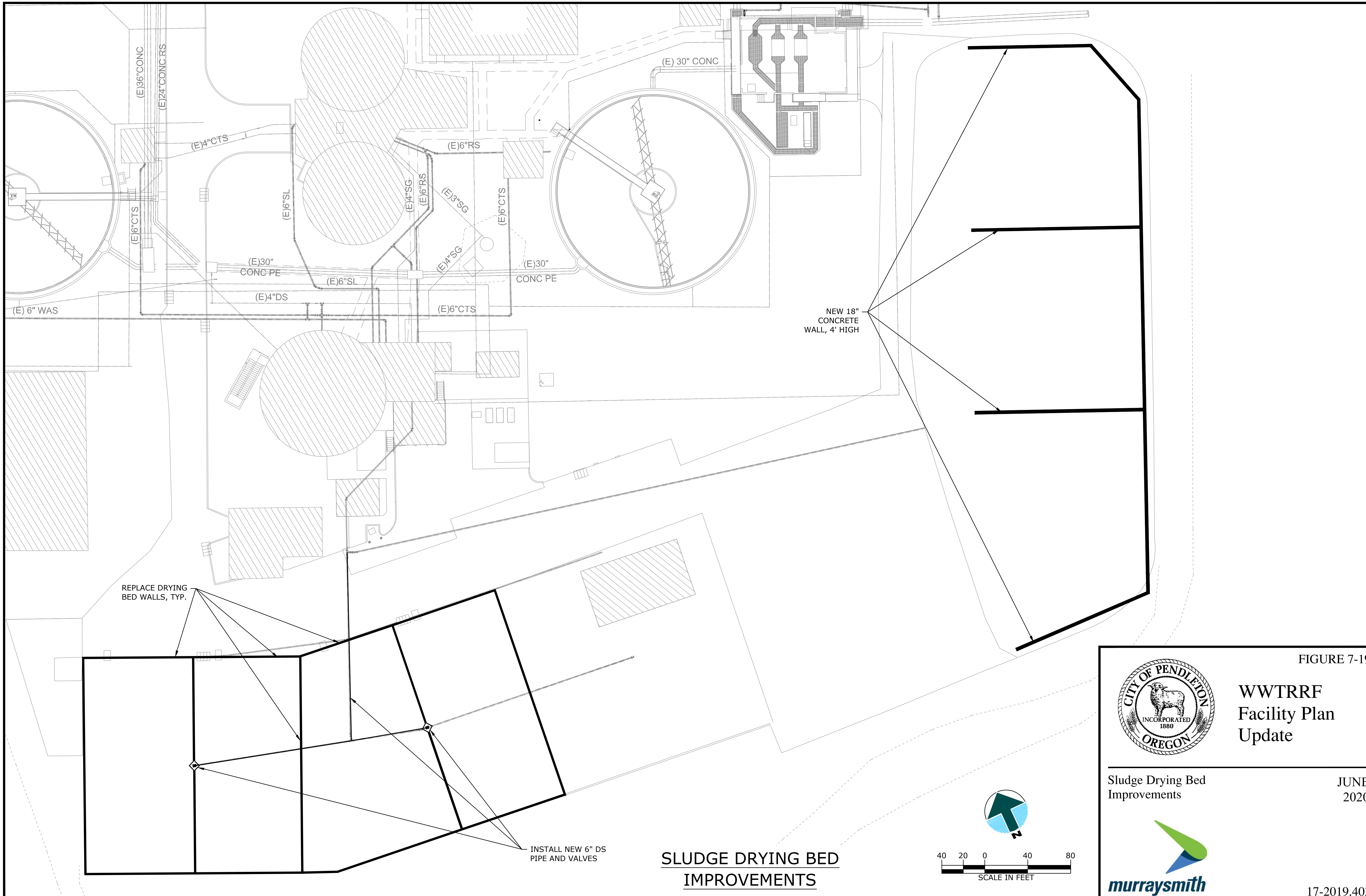

FIGURE 7-19

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Sludge Drying Bed Improvements

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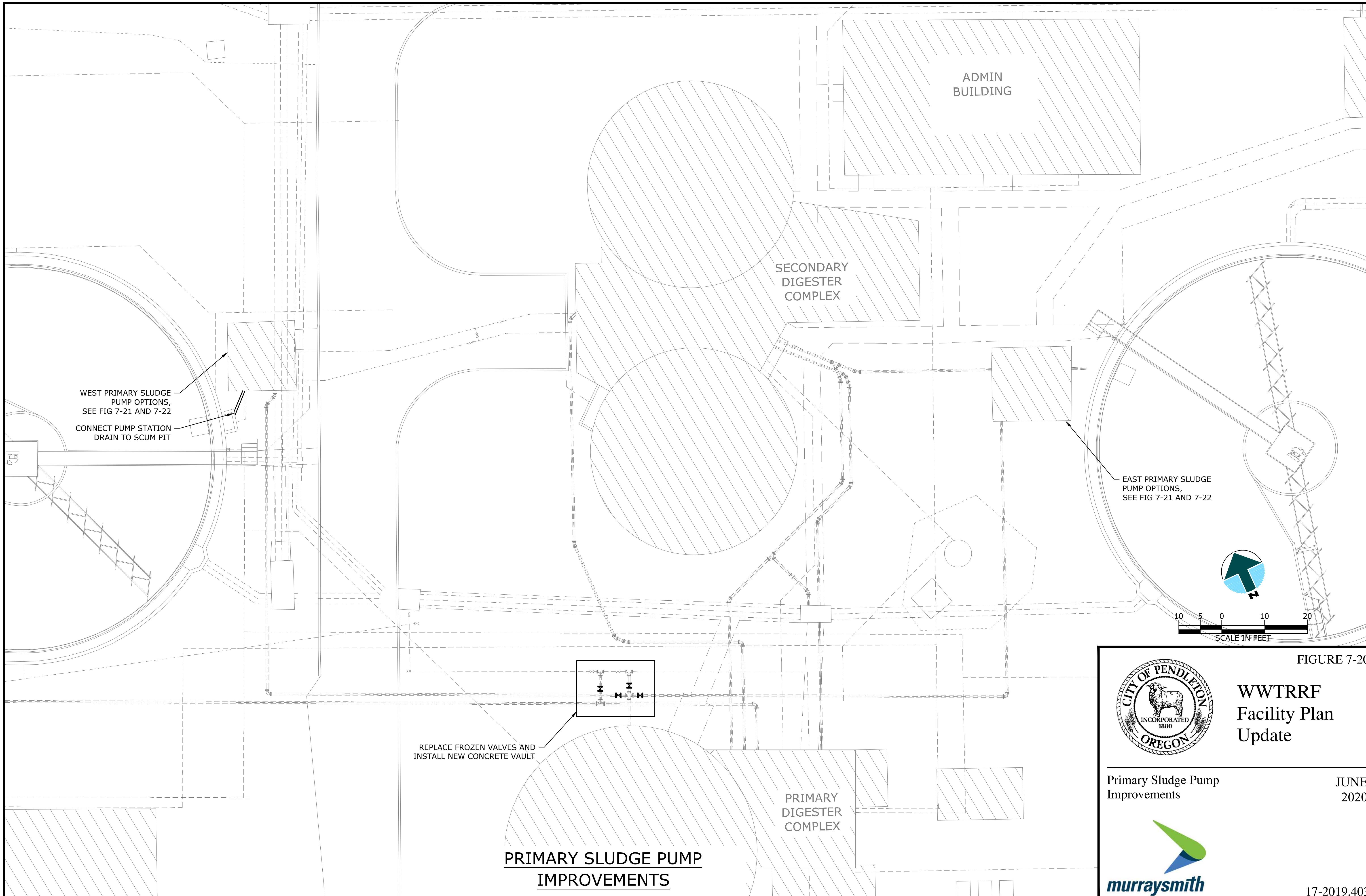

PRIMARY SLUDGE PUMP IMPROVEMENTS

FIGURE 7-20

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Primary Sludge Pump Improvements

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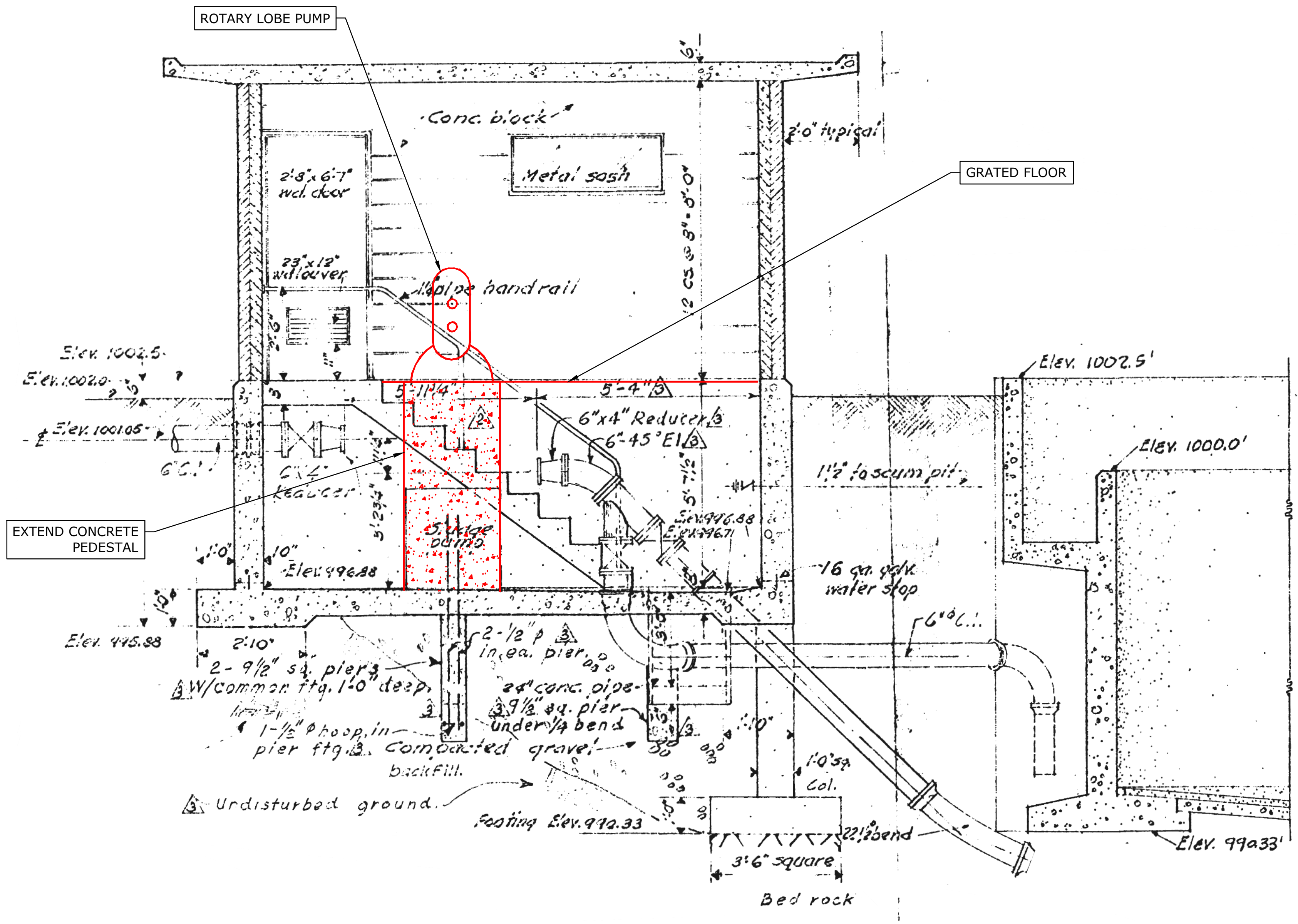
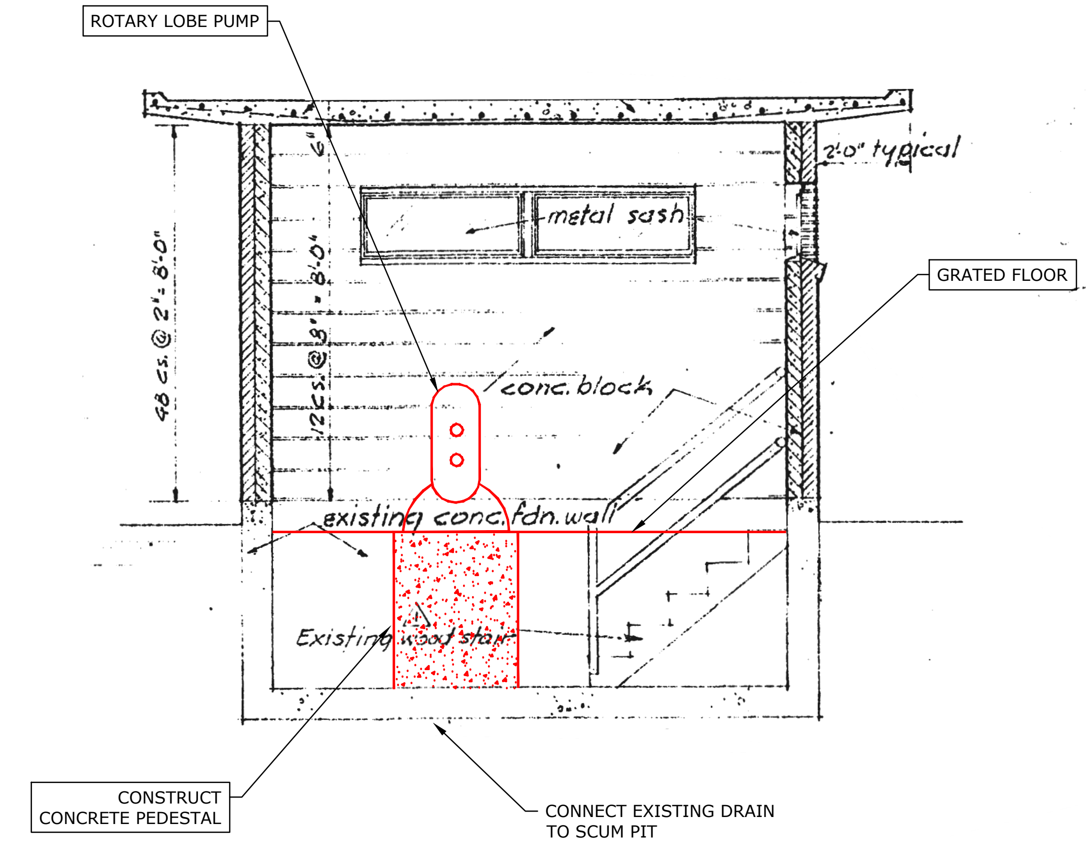


EAST PRIMARY SLUDGE PUMP



WEST PRIMARY SLUDGE PUMP

2 1 0 2 4
SCALE IN FEET

PRIMARY SLUDGE PUMPS
OPTION 1

FIGURE 7-21

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Facility Plan
Update

Primary Sludge Pumps -
Option 1

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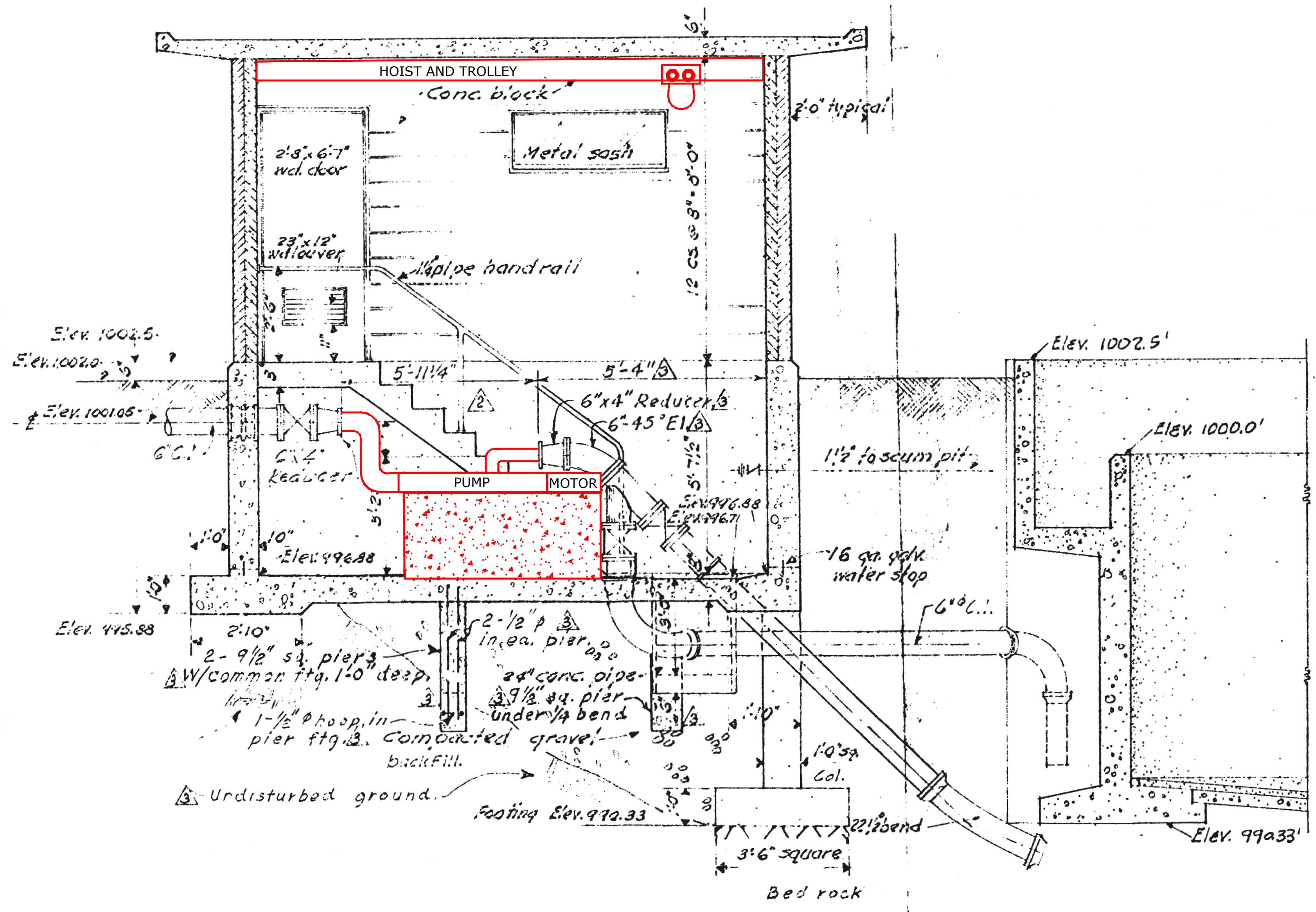
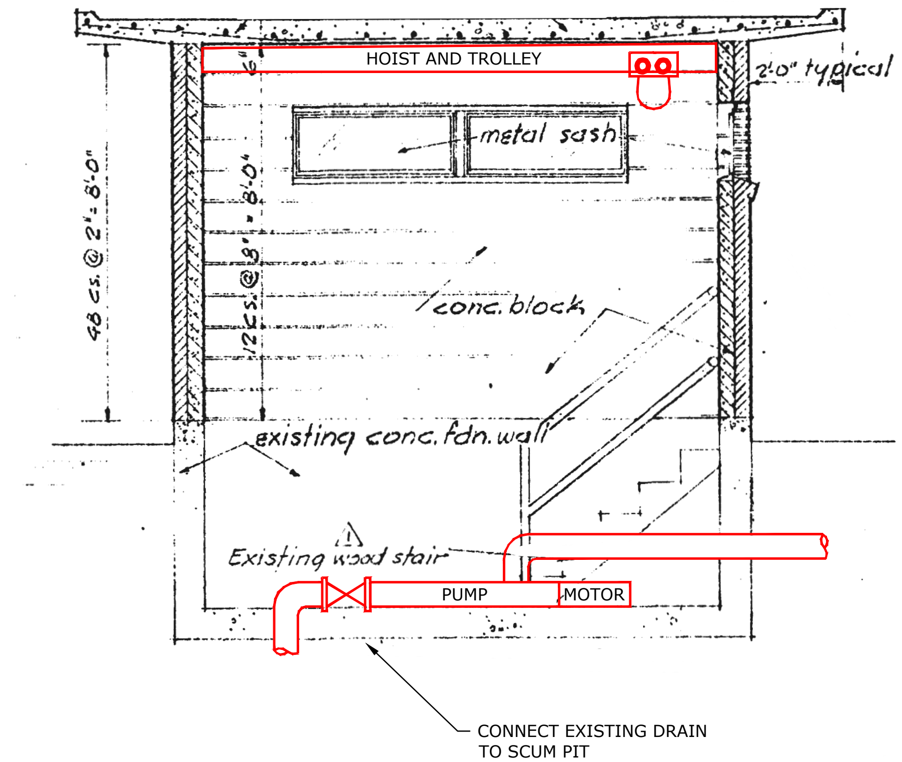


EAST PRIMARY SLUDGE PUMP



WEST PRIMARY SLUDGE PUMP

2 1 0 2 4
SCALE IN FEET

PRIMARY SLUDGE PUMPS
OPTION 2

FIGURE 7-22

WWTRRF
Facility Plan
Update

Primary Sludge Pumps -
Option 2

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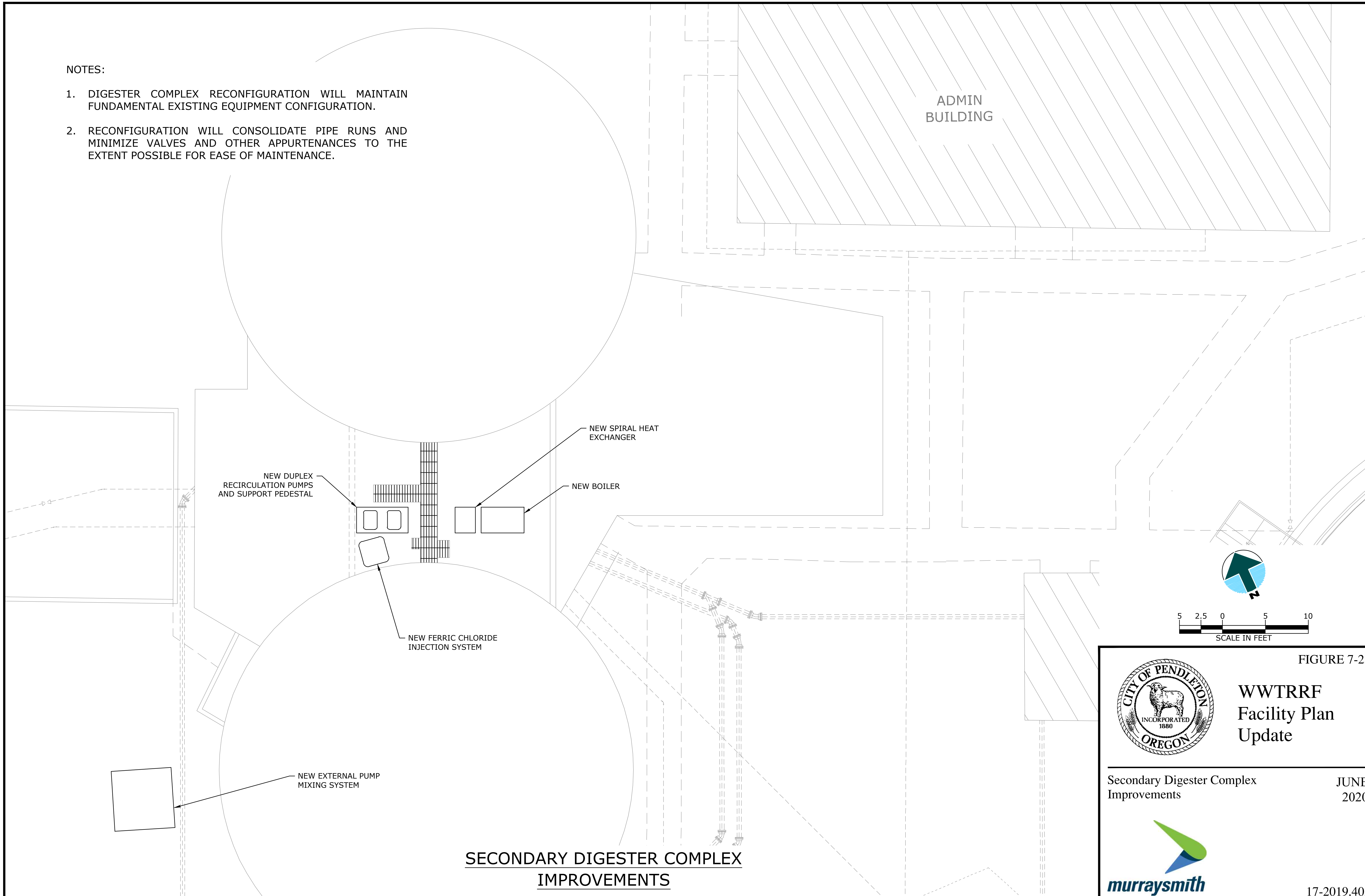
NOTES:

1. DIGESTER COMPLEX RECONFIGURATION WILL MAINTAIN FUNDAMENTAL EXISTING EQUIPMENT CONFIGURATION.

2. RECONFIGURATION WILL CONSOLIDATE PIPE RUNS AND MINIMIZE VALVES AND OTHER APPURTENANCES TO THE EXTENT POSSIBLE FOR EASE OF MAINTENANCE.



SECONDARY DIGESTER COMPLEX IMPROVEMENTS

FIGURE 7-23

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Secondary Digester Complex Improvements

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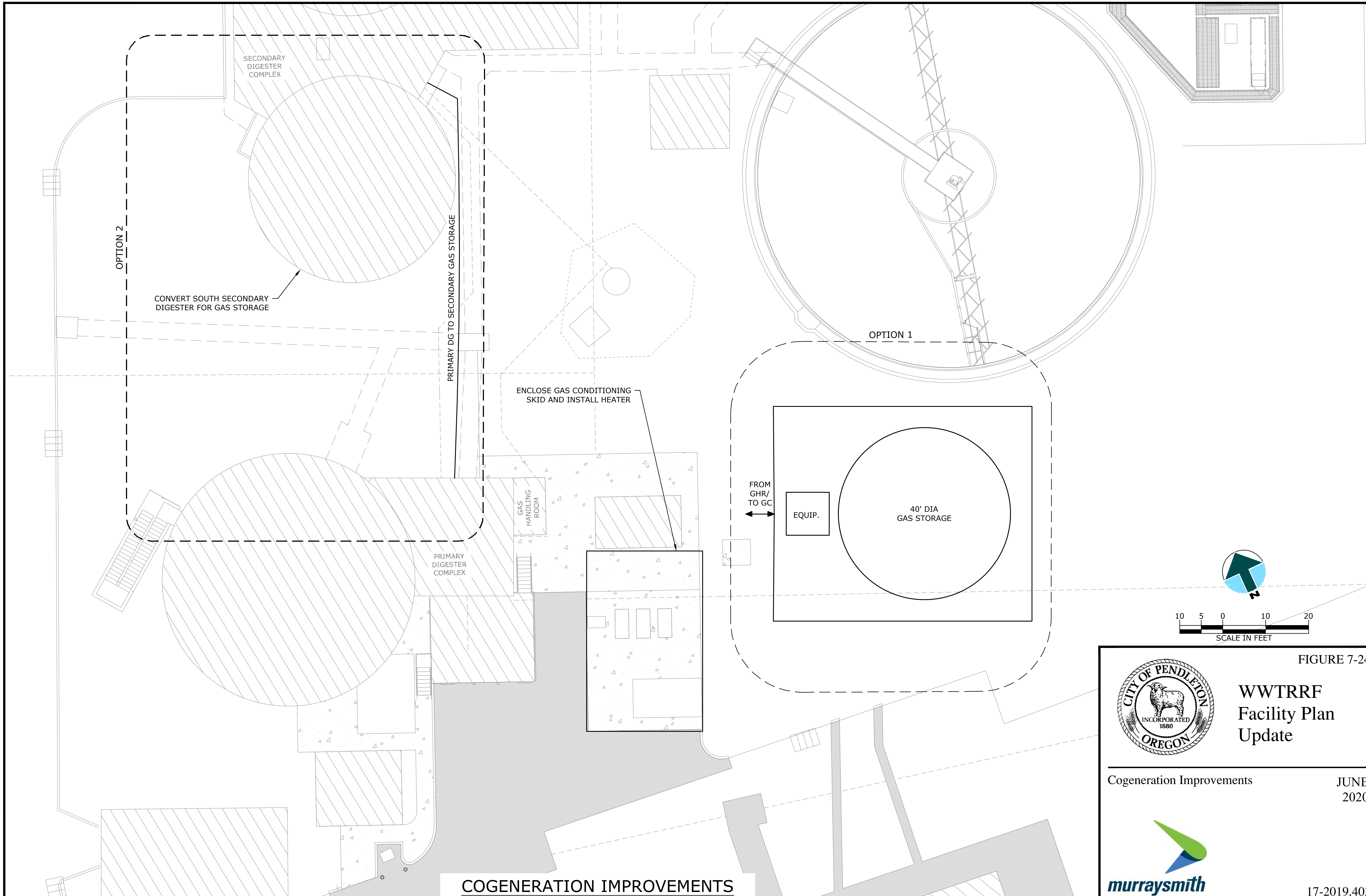

COGENERATION IMPROVEMENTS

FIGURE 7-24

CITY OF PENDLETON OREGON INCORPORATED 1880

WWTRRF Facility Plan Update

Cogeneration Improvements

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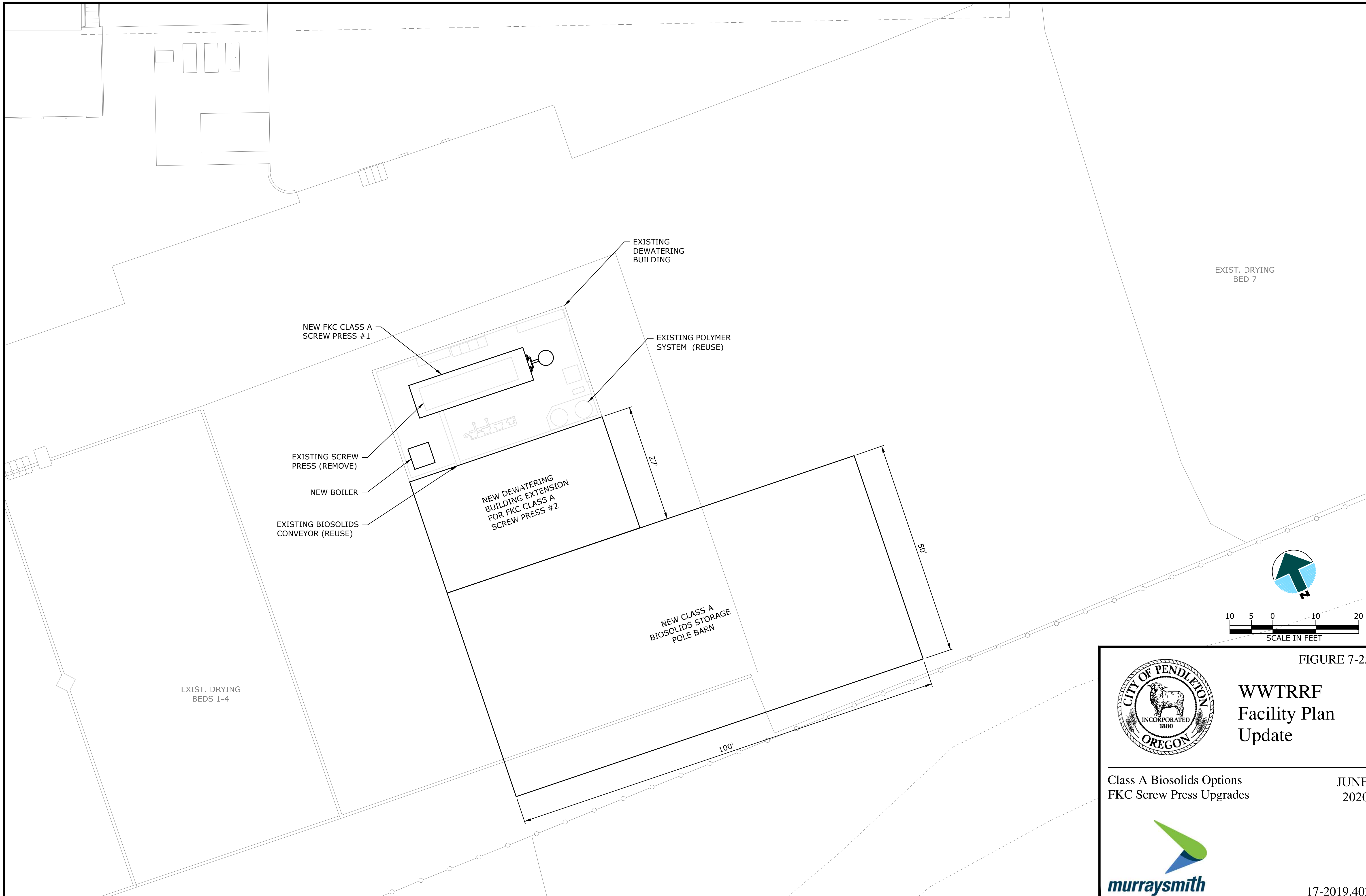

FIGURE 7-25

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF
Facility Plan
Update

Class A Biosolids Options
FKC Screw Press Upgrades

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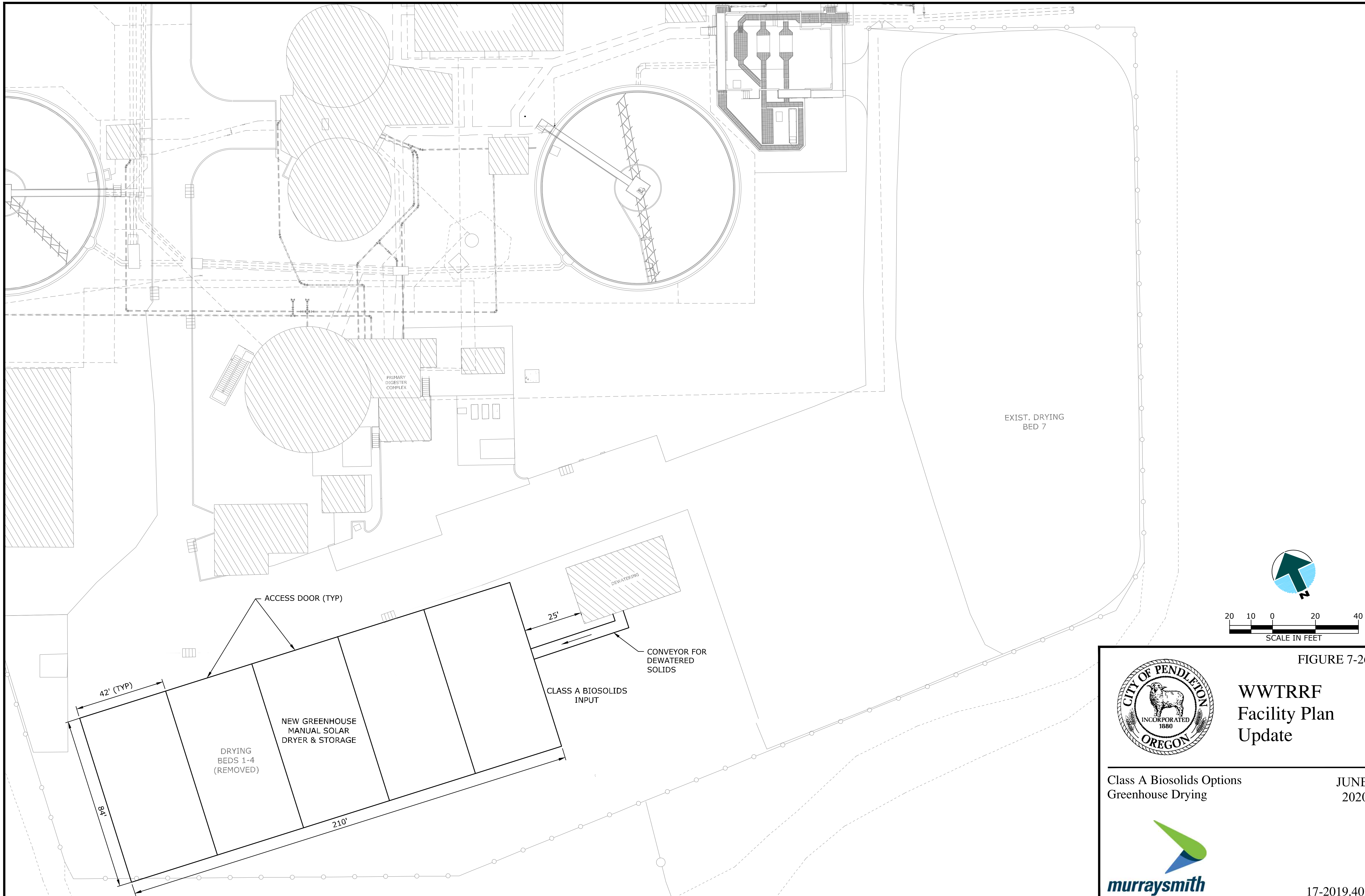

FIGURE 7-26

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF
Facility Plan
Update

Class A Biosolids Options
Greenhouse Drying

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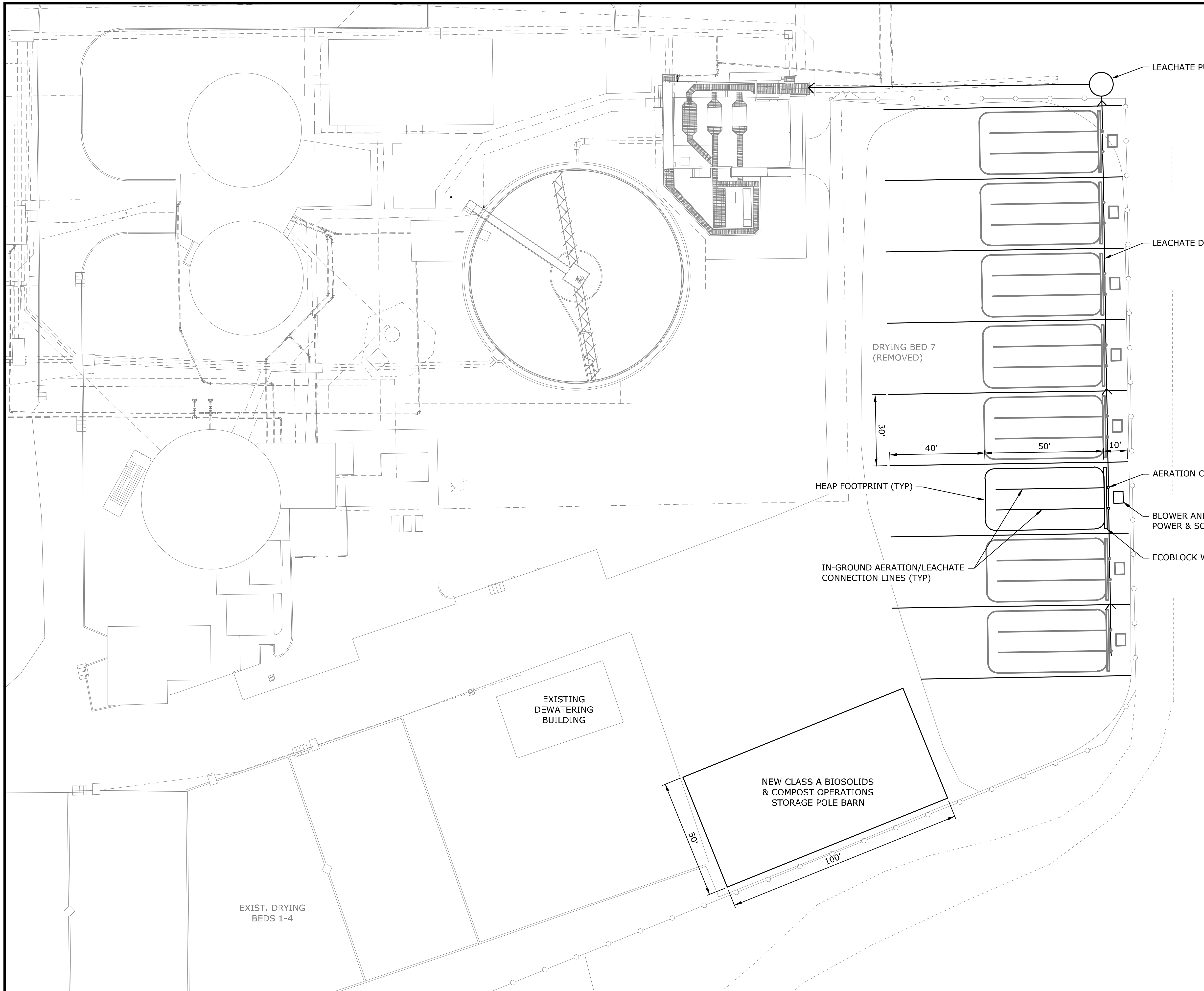

FIGURE 7-27

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF
Facility Plan
Update

Class A Biosolids Options
Composting

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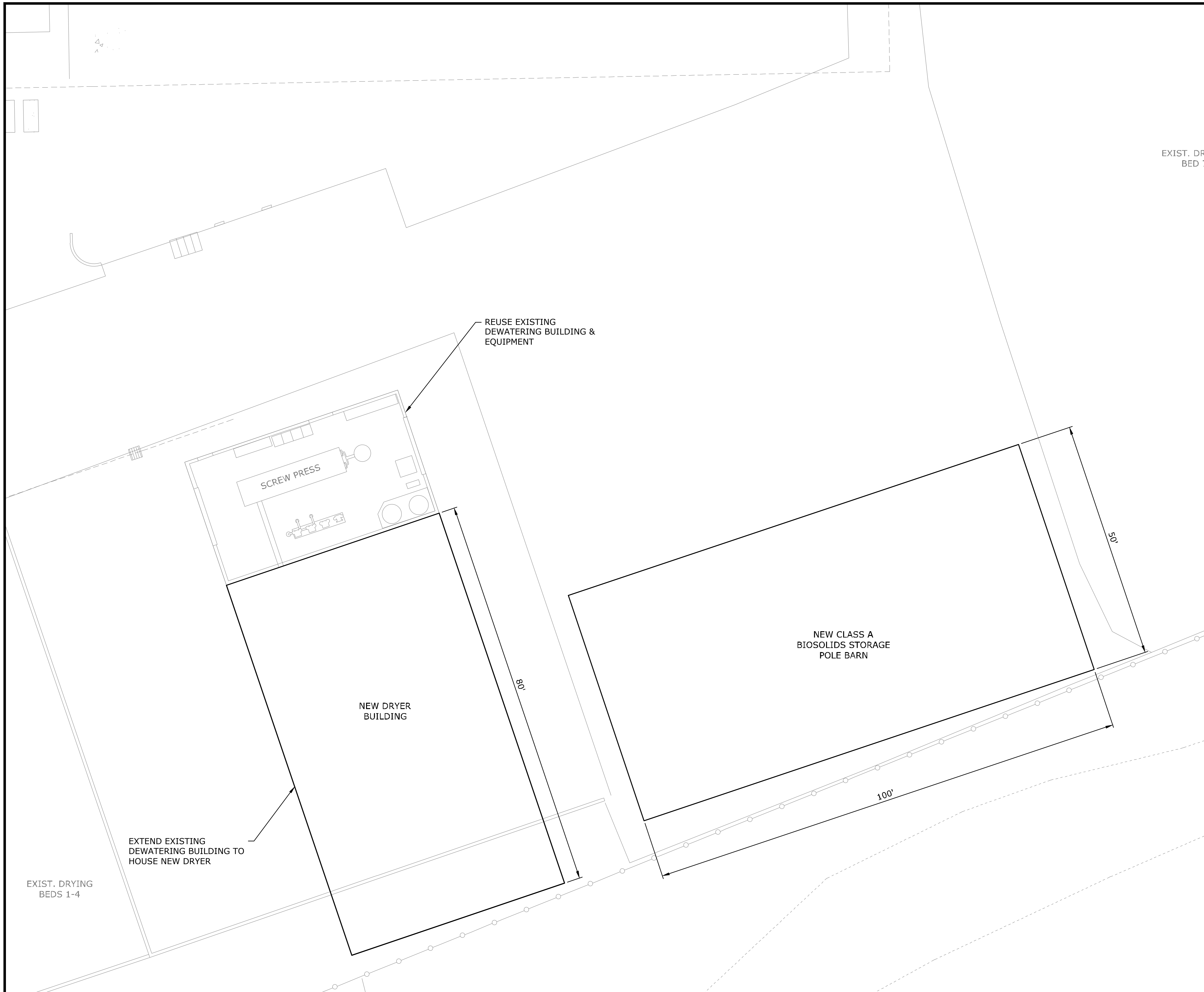

FIGURE 7-28

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF
Facility Plan
Update

Class A Biosolids Options
Dryer

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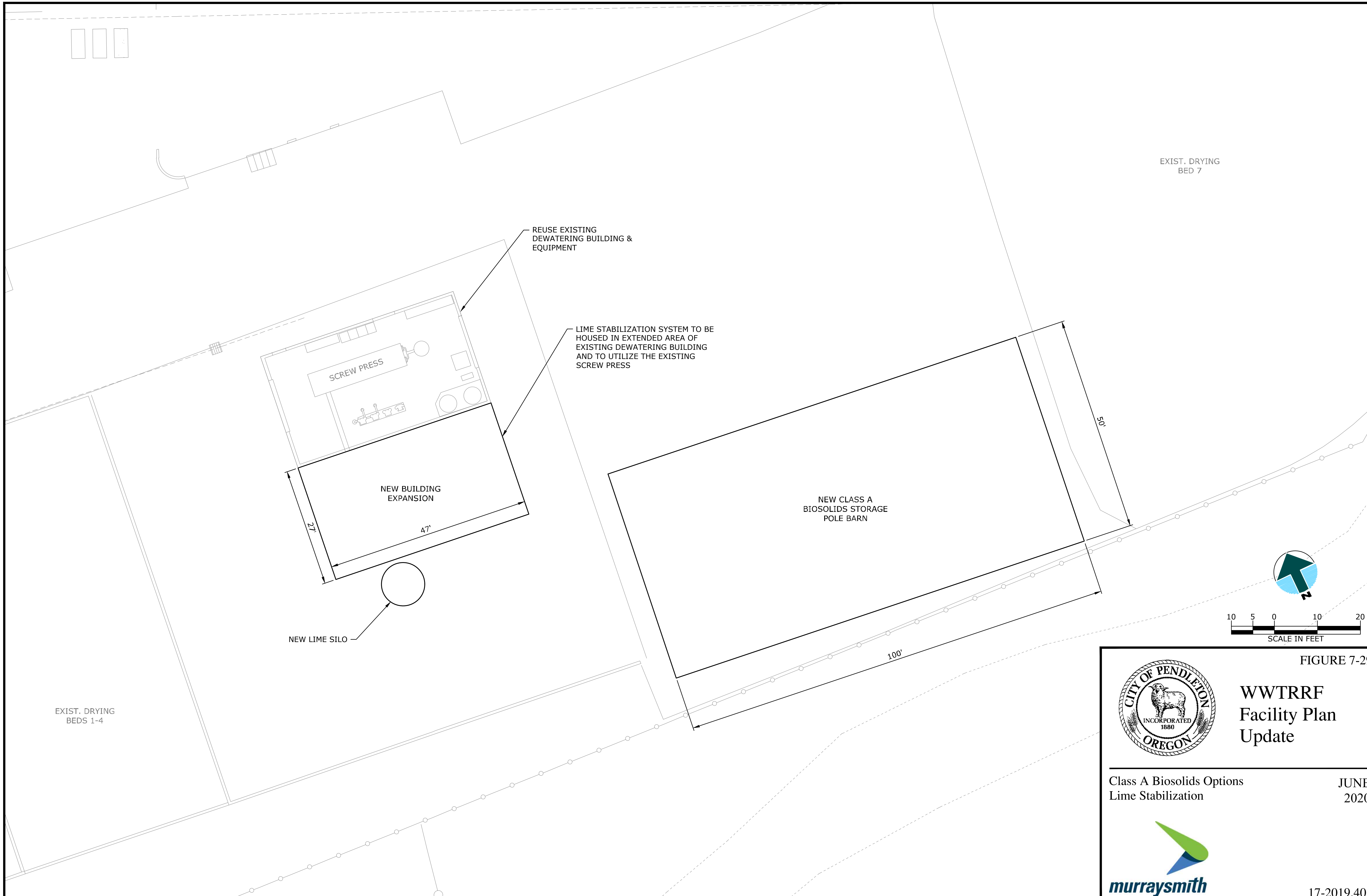

FIGURE 7-29

CITY OF PENDLETON
INCORPORATED 1880
OREGON

WWTRRF
Facility Plan
Update

Class A Biosolids Options
Lime Stabilization

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1 FLOOR PLAN

NOTES

SEE FIG 7-33 FOR OVERALL SITE LOCATION OF NEW ADMIN ANNEX BUILDING

0 8 16
SCALE: 1/8" = 1'-0"

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NEW ADMIN ANNEX BUILDING
CONCEPTUAL FLOOR PLAN

FIGURE 7-32

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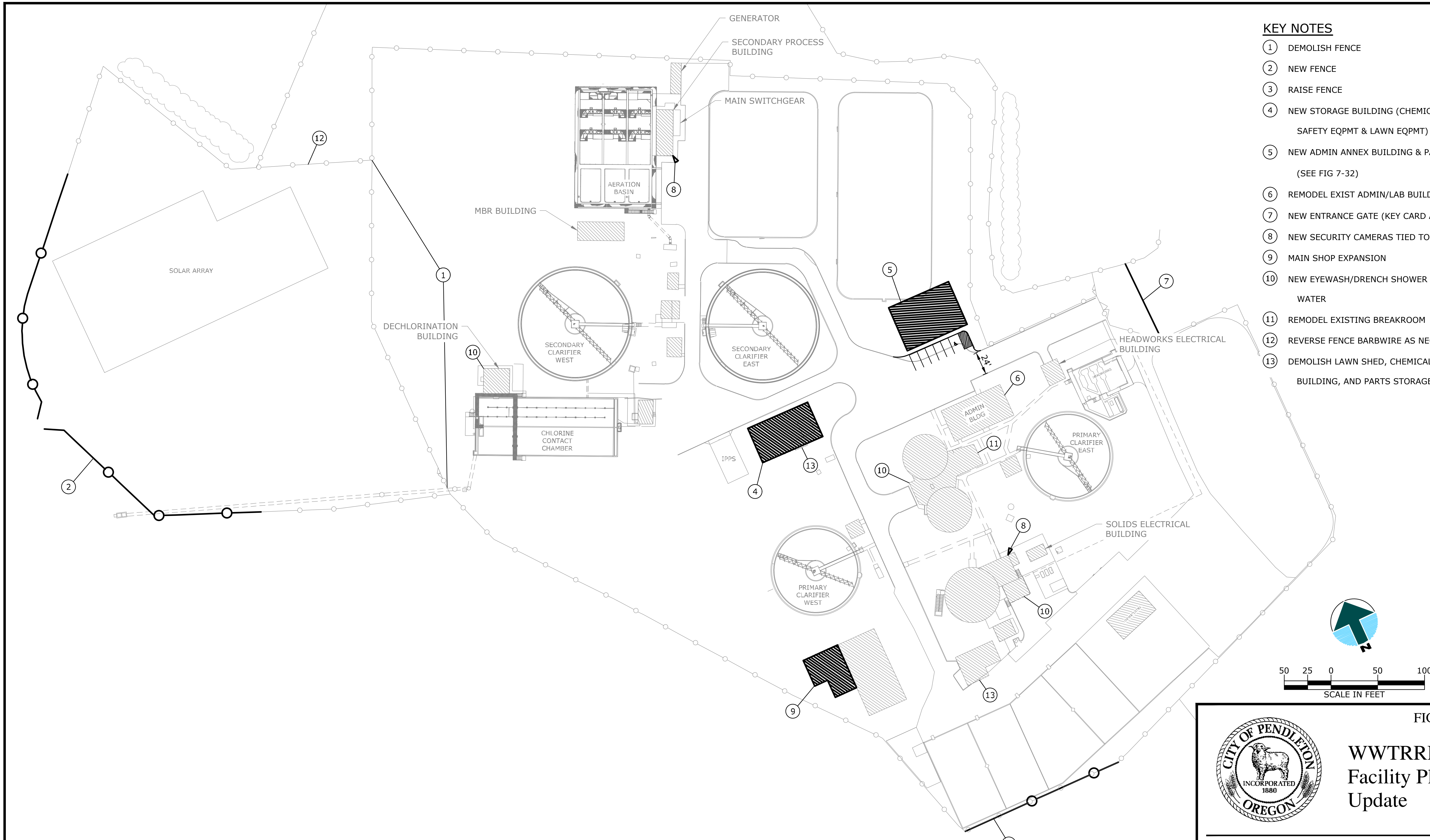

KEY NOTES

1. DEMOLISH FENCE
2. NEW FENCE
3. RAISE FENCE
4. NEW STORAGE BUILDING (CHEMICALS, PARTS, SAFETY EQPMT & LAWN EQPMT)
5. NEW ADMIN ANNEX BUILDING & PARKING SPACES (SEE FIG 7-32)
6. REMODEL EXIST ADMIN/LAB BUILDING
7. NEW ENTRANCE GATE (KEY CARD ACCESS)
8. NEW SECURITY CAMERAS TIED TO SCADA
9. MAIN SHOP EXPANSION
10. NEW EYEWASH/DRENCH SHOWER W/TEPID WATER
11. REMODEL EXISTING BREAKROOM
12. REVERSE FENCE BARBWIRE AS NECESSARY
13. DEMOLISH LAWN SHED, CHEMICAL STORAGE BUILDING, AND PARTS STORAGE BUILDING

FIGURE 7-33

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Architectural Evaluation, Access Control, and Protective Systems Site Plan

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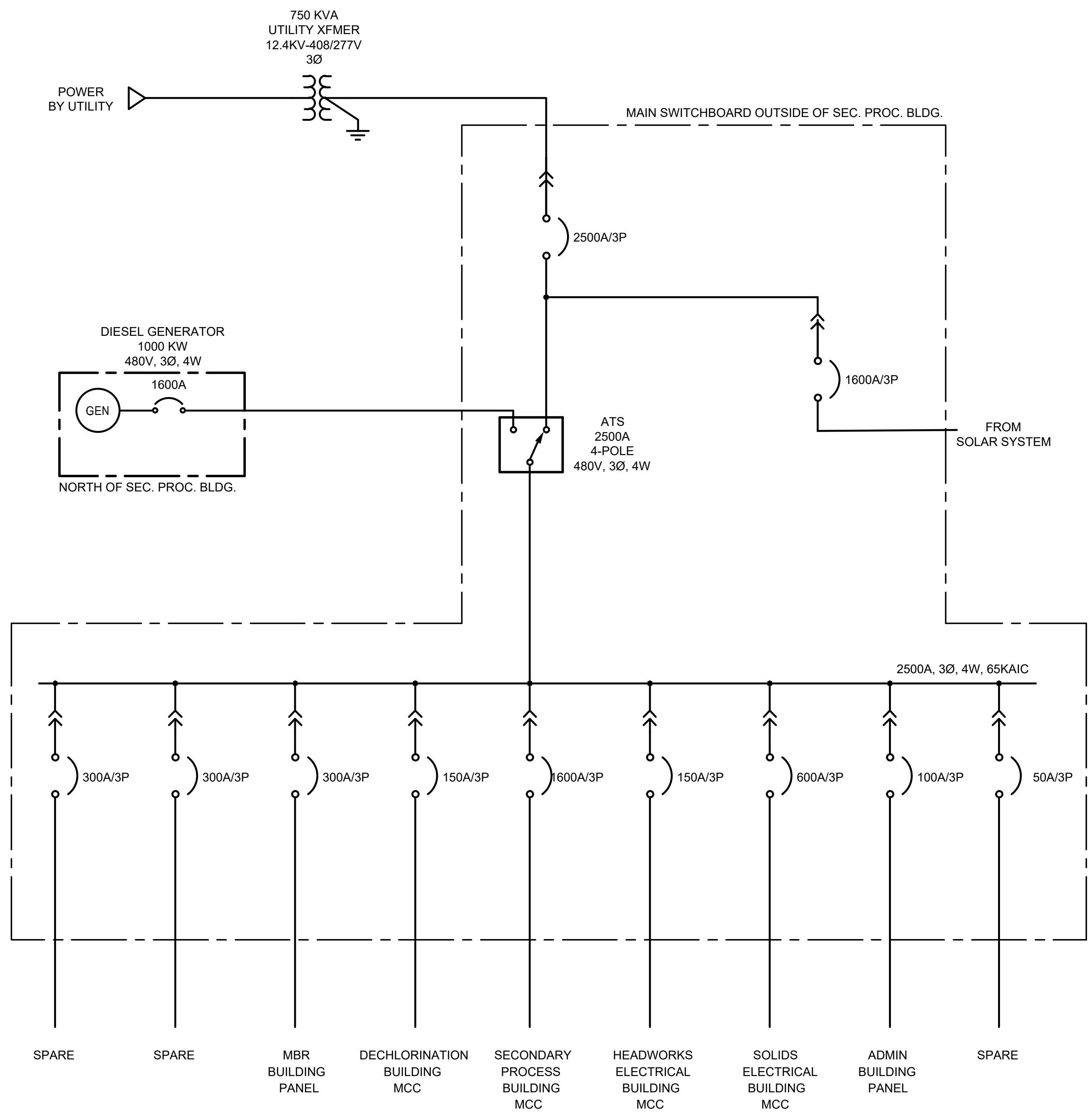

FIGURE 7-34

WWTRRF
Facility Plan
Update

Existing WWTRRF
One-Line Diagram

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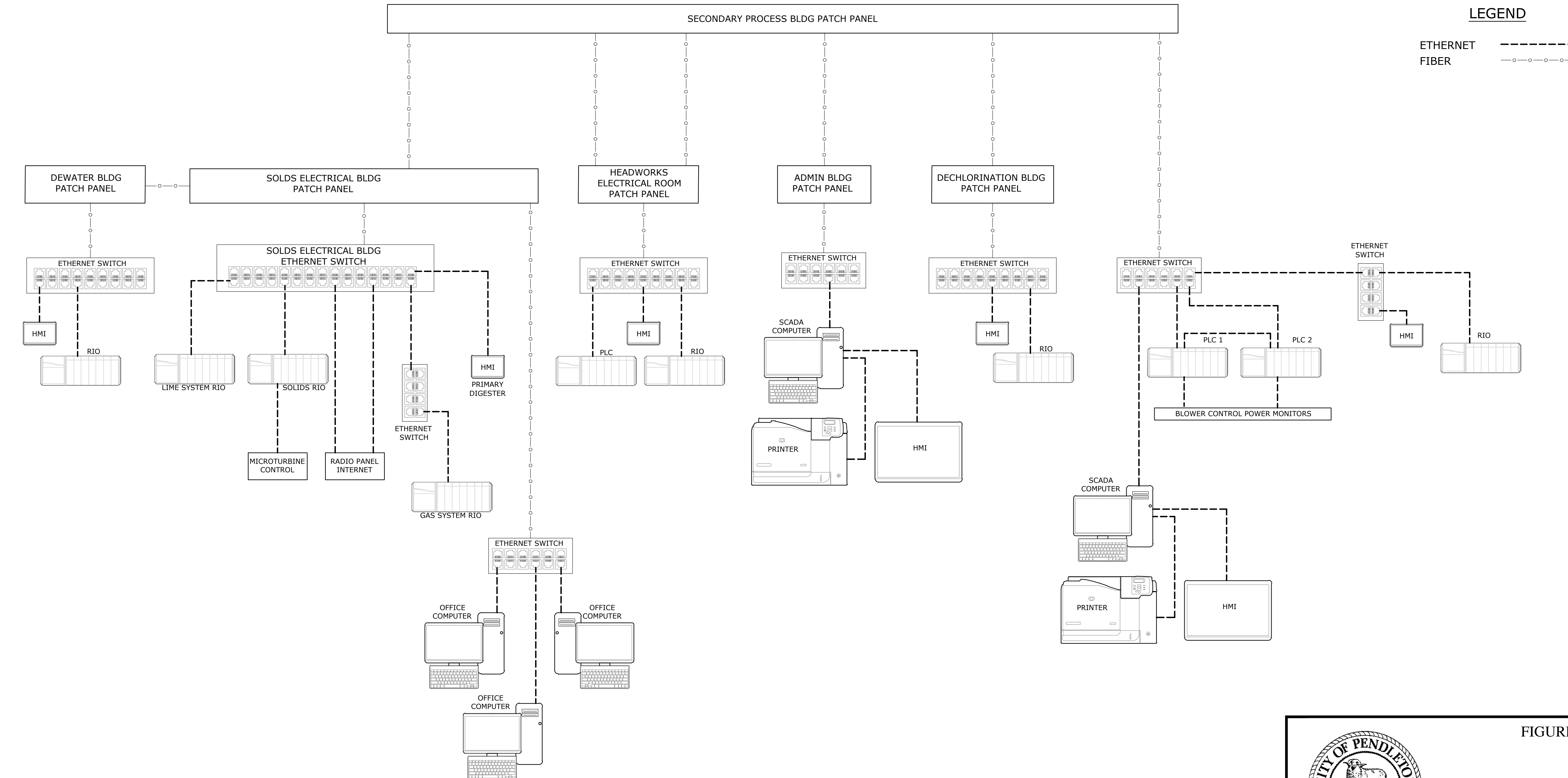

EXISTING SCADA NETWORK DIAGRAM

FIGURE 7-35

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Existing SCADA Network Diagram

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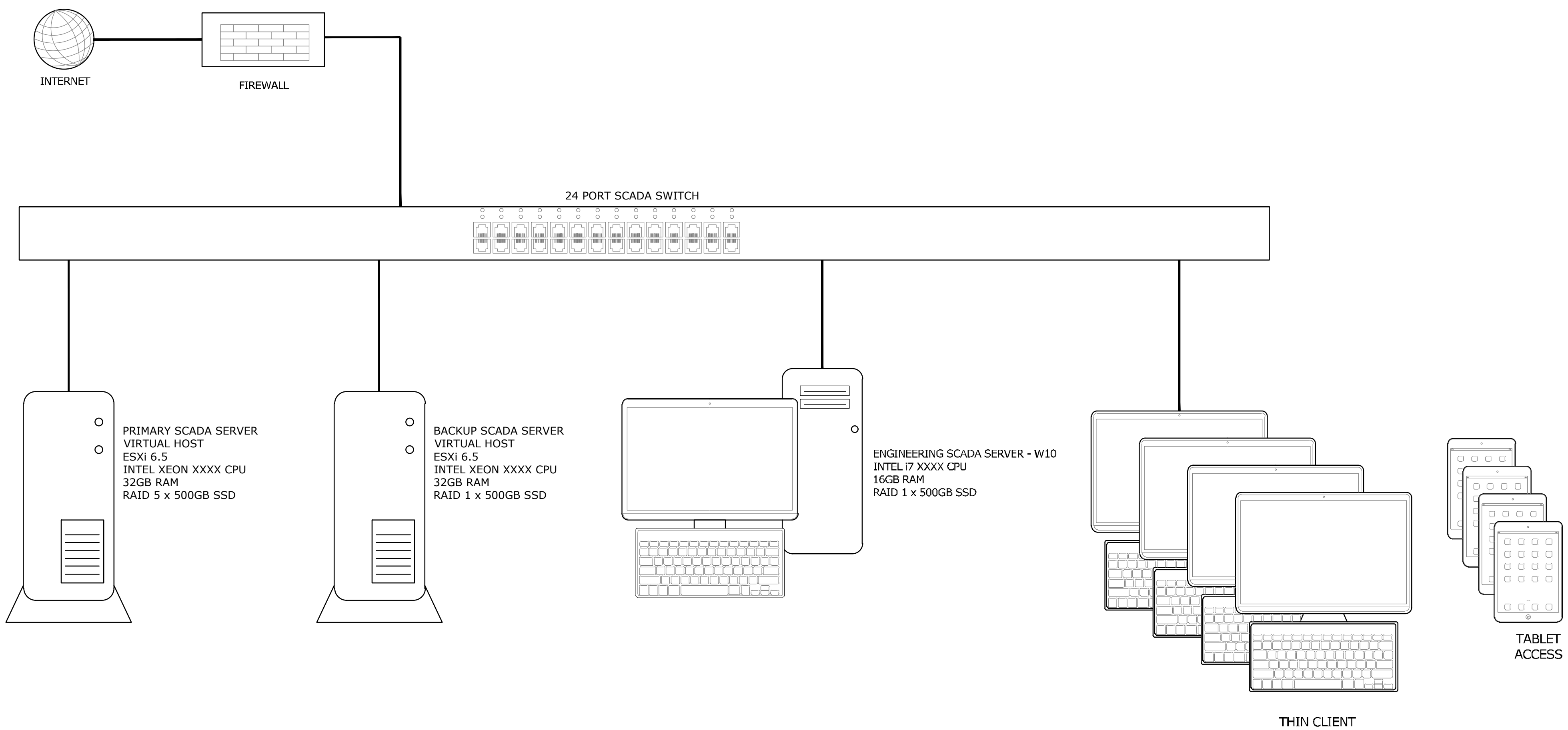

PROPOSED NETWORK TOPOLOGY

FIGURE 7-36

WWTRRF
Facility Plan
Update

Proposed Network
Topology

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Section **8**

Section 8

Combined Alternatives Evaluation

8.1 Introduction

The purpose of the Combined Alternatives Evaluation is to consolidate the various unit process options and recommendations into comprehensive alternatives meeting the City of Pendleton's (City's) goals and objectives and complying with regulatory requirements over the 20-year planning horizon of this Facility Plan Update.

Presented in this section are combinations of alternatives evaluated in the Unit Process Option Evaluations section which identified recommended upgrades to unit processes including the Liquid Stream, Solid Stream, Class A Biosolids, Architectural and Building Improvements, Civil and Security Improvements as well as Electrical Instrumentation and Controls (E&IC) Improvements. Also included in the alternatives are major condition assessment items identified in the Existing Wastewater Treatment and Resource Recovery Facility (WWTRRF) Evaluation and carried into the unit process options evaluation.

Elements previously evaluated, but not included in the combined alternatives are the smaller operations and maintenance (O&M) upgrades identified in the WWTRRF Condition Assessment Technical Memorandum. The smaller O&M upgrades will be included in the Recommended Plan and budgeted on an annual basis over the 20-year planning horizon.

The differentiating elements of the combined alternatives are related primarily to the Liquids Stream Upgrades driven by long-term temperature compliance for the WWTRRF direct discharge to the Umatilla River. The upgrade requirements in the solids stream are largely consistent across each alternative, though proposed process changes in the liquids stream necessitate accommodations in the solids stream to maintain compatibility between unit processes.

8.2 Combined Alternatives

Five combined alternatives are included in the evaluation, which are summarized as follows:

Alternative A – Conventional Activated Sludge (CAS) Expansion: Continue current conventional activated sludge process with upgrades to address deficiencies identified in the Condition Assessment and Class C recycled water production to address long-term temperature compliance concerns.

Alternative B – CAS/Membrane Bioreactor (MBR) Expansion: Partial conversion of the aeration basin to polymeric MBR to produce Class A recycled water to address long-term temperature compliance concerns with upgrades to address deficiencies identified in the Condition Assessment.

Alternative C1 – Polymeric MBR Conversion: A 3-train conversion of the aeration basin to polymeric MBR with diurnal storage in the secondary clarifiers and Class A recycled water production to address long-term temperature compliance with upgrades to address deficiencies identified in the Condition Assessment.

Alternative C2 – Ceramic MBR Conversion: A 2-train conversion of the aeration basin to ceramic MBR with diurnal storage in the secondary clarifiers and Class A recycled water production to address long-term temperature compliance with upgrades to address deficiencies identified in the Condition Assessment.

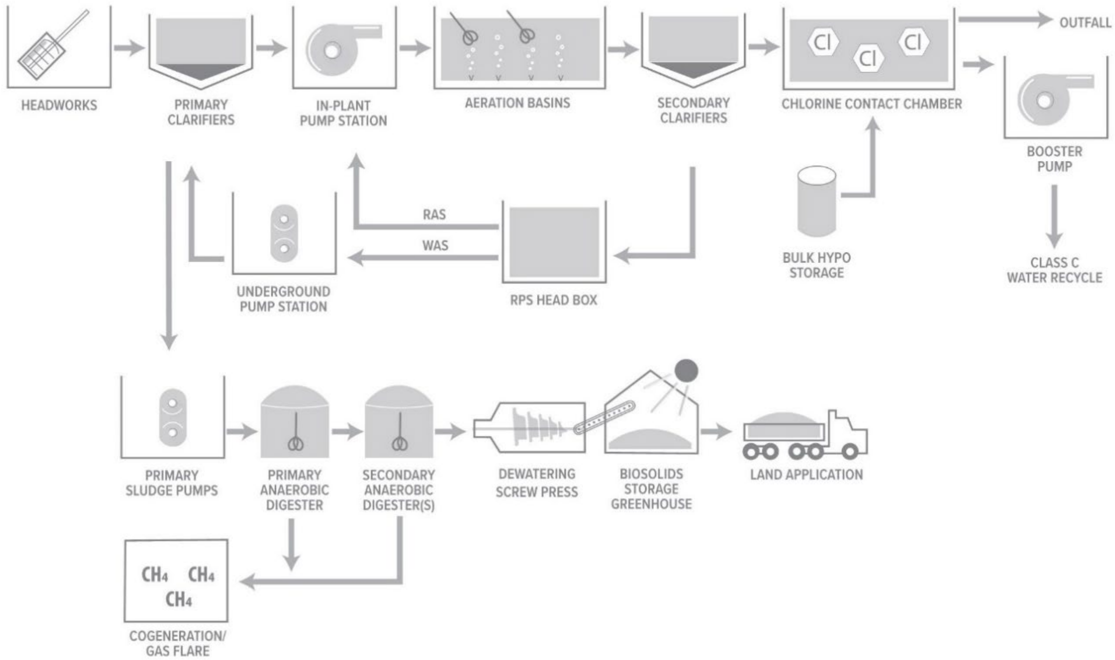
Alternative D – CAS/Tertiary Filtration: Addition of tertiary filtration to the chlorine contact chamber south train to produce Class A recycled water to address long-term temperature compliance concerns with upgrades to address deficiencies identified in the Condition Assessment.

8.2.1 Alternative A – Conventional Activated Sludge Expansion

This alternative considers the costs associated with upgrading the existing unit processes to address deficiencies discussed in greater detail in TM 5.1 – Liquid Stream Unit Process Options and TM 5.2 – Solid Stream Unit Process Options. The primary areas to be upgraded include structural and mechanical repairs to aging facilities; replacement of aged mechanical equipment; critical equipment redundancy; freeze protection; conversion to liquid sodium hypochlorite disinfection; and optimization of return activated sludge (RAS) handling, digester gas systems, and sludge drying. A Class C recycled water system will be installed to address long-term temperature compliance concerns.

Figure 8-1 shows a schematic of the proposed unit process upgrades. **Figure 8-2** shows the proposed upgrades on the WWTRRF Site Plan.

Figure 8-1
Alternative A: CAS Expansion Process Schematic Diagram



8.2.1.1 Alternative A – Liquids Stream Upgrades

8.2.1.1.1 Headworks and Dewatering Building Heat

Upgrades to the Headworks and Dewatering buildings to improve heating and prevent water lines from freezing during the winter months consists of skid-mounted makeup air units with a hot water coil for heat exchange, ducts, and blowers as necessary. The units would be installed on the building exterior, due to classified space restrictions, and connected to the hot water loop as the heat source. The skid-mounted units are projected to operate within the capacity of the existing hot water loop under normal conditions.

8.2.1.1.2 Primary Clarifiers

Repairs are required in both primary clarifiers to continue functioning through the end of the planning horizon. The required repairs are to correct deficiencies in the concrete structure and surfaces of the clarifiers, as well as the launders of both clarifiers. The scraper mechanism on Primary Clarifier West is also in need of sandblasting and recoating.

8.2.1.1.3 RPS and IPPS

RAS flow from the secondary clarifiers to the aeration basin would be modified to transfer RAS from the headbox of the RPS to the industrial pretreatment program (IPPS) via gravity. The combined flow would be transferred to the headbox of the aeration basin using the existing force main. This upgrade eliminates the need for the RPS pumps and the headbox would be sealed to isolate the wet well.

8.2.1.1.4 Aeration Basin Blowers

To achieve sufficient turndown of the aeration basin blowers during the winter months, an independent Supervisory Control and Data Acquisition (SCADA) system setting would be created for the existing Aerzen hybrid blower to utilize the lower range of operation available through the Variable Frequency Drive (VFD). In addition, a second Aerzen hybrid blower would be installed as a redundant unit.

8.2.1.1.5 Secondary Clarifiers

Repairs are required in the concrete structure and surfaces of both secondary clarifiers to continue functioning through the end of the planning horizon. The required repairs are to correct deficiencies in the concrete structure and surfaces of the clarifiers, as well as the launders of both clarifiers. Secondary Clarifier West requires a new drive unit in addition to sandblasting and recoating of the scraper mechanism. Secondary Clarifier East, however, requires a new scraper mechanism as well as new weirs.

8.2.1.1.6 Disinfection

The existing chlorine gas disinfection system would be converted to utilize liquid sodium hypochlorite from bulk storage. This upgrade requires an 8,000-gallon tank that would be insulated and located outside adjacent to the existing chlorine building. The existing building would house the injection pumps.

8.2.1.1.7 Chlorine Contact Chamber

Structural repairs required in the Chlorine Contact Chamber (CCC) include repairing large vertical cracks and expansion joints, spalled and broken areas around equipment anchors, generally spalling and degraded concrete, as well as constructing concrete baffle walls in the CCC for each train.

8.2.1.1.8 Final Effluent Measurement

The CCC effluent channel would be extended and a Parshall flume would be installed in a vault that connects to the outfall pipe. A 9-inch (minimum) Parshall flume would be installed with an ultrasonic level sensor connected to SCADA to record discharge flow rates.

8.2.1.1.9 Class C Recycled Water Irrigation

A Class C recycled water irrigation system is proposed to divert effluent discharge from the Umatilla River during the summer months. Effluent would be pumped for irrigation use offsite. The system includes a booster pump station, and a pipeline to the irrigation site(s). Thermal loading on the Umatilla River would be reduced, as necessary, by diverting the recycled water from the outfall. Current prospective irrigation sites include the I-84 median and the airport industrial area.

8.2.1.2 Alternative A – Solids Stream Upgrades

8.2.1.2.1 Primary Sludge Pumps

The pump houses would be upgraded to improve access to the pumps by retrofitting them to accommodate roll-up doors and overhead lifting mechanisms required to move the pumps from their pedestal to the door landing. The existing pumps would be replaced with new progressive cavity pumps and the associated piping would be reconfigured so that control valves are located outside of the pump house. In addition, flow meters would be installed and connected to the WWTRRF SCADA system.

8.2.1.2.2 Primary Digester Complex

Required upgrades include storage improvements, redundancy for critical systems, and ferric chloride injection. A redundant primary digester mixing pump would be installed to ensure normal function of the primary digester. A permanent injection port would be installed in the pipe gallery to improve the process of ferric chloride dosing.

8.2.1.2.3 Secondary Digester Complex

A complete overhaul of the pipe gallery would be completed to include replacement of all pipes and valves, the boiler (with booster pump), and the heat exchanger. In addition, the upgrades include an external mixing system, recirculation pump redundancy, ferric chloride injection, and SCADA connectivity.

8.2.1.2.4 Digester Gas Storage

A digester gas holding cover would be installed on the South Secondary Digester. Gas from the primary digester would be routed through a new underground line where it would be stored with gas generated in the secondary digester. The combined digester gas would be routed to the gas handling room through underground piping before being conditioned and then supplied to the microturbines or the flare, when necessary.

8.2.1.2.5 Digester Gas Moisture Reduction

The gas conditioning skid would be fully enclosed with insulated wall panels and a roll-up door would be included for access to equipment. An electric unit heater is proposed to keep the space heated.

8.2.1.2.6 Digester Gas Flare

The existing digester gas flare would be removed, and a new flare would be installed in its place. The two pipes running between the flare and the digesters would be replaced, and a new flow meter would be installed to monitor digester gas usage at the flare.

8.2.1.2.7 Dewatering Building

Upgrades would be completed in the vicinity of the Dewatering Building to improve stormwater drainage from the paved area, demolish the old drying bed wall for more space for equipment, and install a permanent wall to the south of the building where dewatered cake is collected prior to being moved to drying or storage.

8.2.1.2.8 Sludge Drying Beds

Upgrades to Sludge Drying Beds 1-4 include rehabilitation of the walls, pipes, and valves. The new walls will be installed to accommodate a future greenhouse with retractable roofs that will enhance drying while providing covered storage in the winter. A temporary coverall building is proposed to cover Sludge Drying Beds 1-4 for winter storage. The sludge piping and valves will be relocated to the north end of the drying beds for safer access by WWTRRF personnel.

Upgrades to Sludge Drying Bed 7 include replacement of the sloped, asphalt walls with vertical, concrete walls that would enable operators to more efficiently manage solids. Also, two center walls would be added so the bed could be divided into three cells.

8.2.1.2.9 Biosolids Storage Greenhouse

The biosolids storage greenhouse includes construction of 5 bays installed over the current location of drying beds 1 through 4. The greenhouse will be subdivided into five bays using knee walls to prevent contamination of finishing batches. A conveyor to transport dewatered cake from the existing screw press to the green house for drying will also be installed. A new tractor with a front bucket and snowblower attachment are also included for manual turning of the dewatered cake. The goal of the new greenhouse is to produce Class A biosolids.

8.2.1.3 Alternative A – Architectural, Access Control, and Protective Systems Upgrades

8.2.1.3.1 Admin/Lab and Admin Annex Building

The existing Admin/Lab Building would be remodeled to address deficiencies identified in the code review. A new Admin Annex Building would be constructed on the north side of the entrance road to accommodate functions lost in the existing Admin/Lab Building and Secondary Digester Complex remodels.

8.2.1.3.2 New Storage Building

A new storage building is proposed to house all the miscellaneous parts, chemicals, lawn equipment, and safety equipment stored throughout the WWTRRF site. The proposed location for this building is to the east of the IPPS adjacent to the driveway.

8.2.1.3.3 Main Shop Expansion

The Main Shop would be expanded to the west to add three bays to store equipment displaced from demolishing the parts storage/welding shop building. A new Welding Shop would be constructed on the southern side of this expansion.

8.2.1.3.4 Site Access Control

The fencing around the WWTRRF would be replaced, as necessary, with a new security fence that is uniform in style and continuous around the entire perimeter. Additionally, an automated gate would be installed at the entrance to allow operators to control access remotely. New security cameras would be installed on the Aeration Basin and Primary Digester Complex to allow operators to monitor these areas of the site remotely.

8.2.1.3.5 Protective Systems

Emergency eye wash stations and showers would be installed in areas where personnel may be exposed to materials or chemicals that meet applicable OSHA regulations.

8.2.1.4 Alternative A – Electrical, Instrumentation, and Controls Upgrades

8.2.1.4.1 Electrical

Routine maintenance should be performed on the WWTRRF MCC's. Also, demolition of the Lawn Equipment Shed and Chemical Storage Building should be considered. This would eliminate the breaker panel connected to an extension cord.

8.2.1.4.2 SCADA

The existing SCADA System would be upgraded to include modern, fully redundant server and networking hardware. Additionally, the software platform would be upgraded to modern platforms and architecture. This will allow for added reliability, security, and versatility. Operations staff will be able to remotely monitor and operate SCADA-connected systems via tablet technology.

8.2.1.5 Alternative A – Cost Summary

The capital cost for Alternative A is estimated at $16.48 million as summarized in **Table 8-1**.

Table 8-1
Alternative A: Capital Cost Summary

Item Description	Cost
Headworks and Dewatering Building Heat	$80,000
Primary Clarifiers	$143,000
RPS and IPPS	$ 60,000
Aeration Basin Blower Upgrades	$69,000
Secondary Clarifiers	$758,000
Disinfection Conversion	$42,000
Chlorine Contact Chamber	$186,000
Final Effluent Flow Measurement	$45,000
Class C Recycle Water	$1,642,000
Primary Sludge Pumps	$138,000
Primary Digester Complex	$68,000
Secondary Digester Complex	$513,000
Digester Gas Storage	$520,000
Digester Gas Moisture Reduction	$46,000
Digester Gas Flare	$286,000
Dewatering Upgrades	$627,000
Biosolids Storage Greenhouse	$1,156,000
Admin/Lab Remodel	$392,000
Admin Annex Building	$679,000
New Storage Building	$377,000
Main Shop Expansion	$142,000
Site Access Control and Protective Systems	$68,000
Electrical Improvements	$25,000
SCADA Upgrades	$245,000
Subtotal	**$8,307,000**
Mobilization (8%)	$665,000
General Conditions (8%)	$665,000
Contractor O&P (12%)	$997,000
Subtotal	**$10,634,000**
Engineering, Legal, & Administration (25%)	$2,659,000
Contingency (30%)	$3,190,000
Total CIP	**$16,483,000**

The total 20-year life cycle cost for Alternative A is estimated at $22.11 million as summarized in Table 8-2.

Table 8-2
Alternative A: Life Cycle Cost Summary

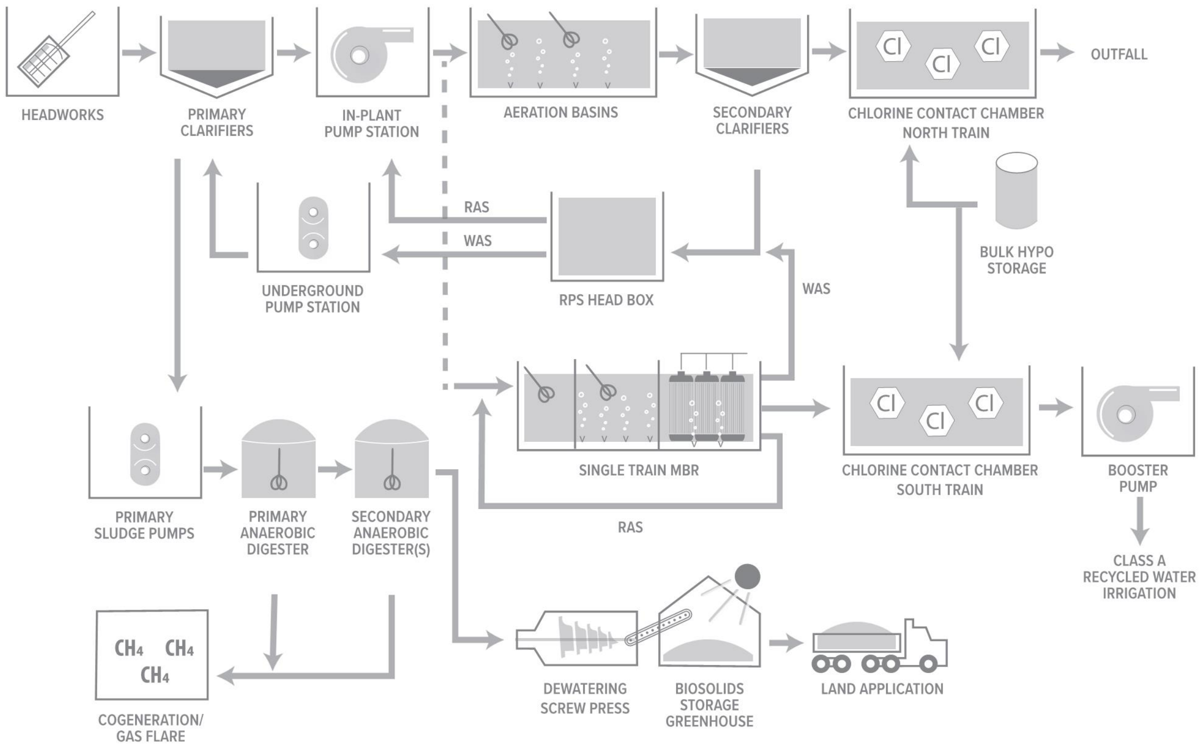
Cost Type	Cost
Capital Cost	$16.48 M
20-yr NPV of Additional Labor	$2.64 M
20-yr NPV of O&M – Chemical	$1.15 M
20-yr NPV of O&M – Energy	$1.47 M
20-yr NPV of O&M – Major Replacement	$ 0.37 M
20-yr Life Cycle Total	$22.11 M

8.2.2 Alternative B – CAS/Membrane Bioreactor Expansion

This alternative is fundamentally similar to Alternative A as it also considers the costs associated with upgrading the existing unit processes to address deficiencies previously discussed. Alternative B, however, utilizes a single-train MBR to produce Class A recycled water for offsite irrigation to address long-term temperature compliance concerns. The two remaining trains of the aeration basin would continue to be utilized as a conventional secondary process. In addition to the single-train MBR conversion, booster pump station, sodium hypochlorite injection (to maintain residual during transmission), and pipeline to the irrigation site(s) would be added for the Class A recycled water stream.

Figure 8-3 shows a schematic of the proposed unit process upgrades. **Figure 8-4** shows the proposed upgrades on the WWTRRF Site Plan.

Figure 8-3
Alternative B: CAS/MBR Expansion Process Schematic Diagram



8.2.2.1 Alternative B – Liquids Stream Upgrades

The liquids stream upgrades proposed for Alternative B would be the same as those previously discussed under Alternative A, with the exceptions of a single-train MBR conversion to produce Class A recycled water.

Liquid stream upgrades previously discussed under Alternative A that are proposed under this alternative include:

- Headworks and Dewatering Building Heat: Install skid-mounted makeup air units with a heat exchanger to improve heating and prevent water lines from freezing;
- Primary Clarifiers: Repair the launders and concrete of both clarifiers;
- RPS and IPPS: Replace the existing RPS pumps using a gravity line for the RAS;
- Aeration Basin Blowers: Create an independent SCADA system for the existing Aerzen hybrid blower and install a second Aerzen hybrid blower as a redundant unit;

- Secondary Clarifiers: Repair the launders and concrete of both clarifiers as well as replace some of the equipment;

- Disinfection: Convert the existing chlorine gas disinfection system to utilize bulk storage sodium hypochlorite for the conventional discharge stream and reuse side stream;

- Chlorine Contact Chamber: Repair cracks and broken areas of the CCC, as well as construct baffle walls in both trains; and

- Final Effluent Measurement: Install a Parshall flume in the outfall pipeline with level sensors connected to SCADA.

8.2.2.1.1 Single-Train MBR Conversion & Class A Recycled Water Irrigation

One train of the Aeration Basin would be converted to a single-train MBR as a side stream system in order to divert up to 2.0 MGD from discharge into the Umatilla River. The MBR effluent would be used as Class A recycled water for irrigation offsite. The side stream system would consist of the single-train MBR, a secondary clarifier bypass pipe, disinfection in the southern CCC train using sodium hypochlorite, a booster pump station, and a pipeline to the irrigation site(s). Thermal loading on the Umatilla River would be reduced, as necessary, by diverting the side stream from the outfall. Current prospective irrigation sites include the I-84 median and the airport industrial area. Figure 8-5 shows the proposed upgrades to the MBR Building.

8.2.2.2 Alternative B – Solids Stream Upgrades

The solids stream upgrades proposed for Alternative B would be the same as those previously discussed under Alternative A and include:

- Primary Sludge Pumps: Rehabilitate the existing pump houses, replace the existing pumps with progressive cavity pumps, and connect the system to SCADA;

- Primary Digester Complex: Install a redundant primary digester mixing pump and ferric chloride injection system;

- Secondary Digester Complex: Overhaul the pipe gallery and provide an external mixing system, recirculation pump, ferric chloride injection system, and SCADA connectivity;

- Digester Gas Storage: Install a digester gas holding cover and new underground lines to route digester gas to storage locations;

- Digester Gas Moisture Reduction: Enclose the gas conditioning skid and add a unit heater;

- Digester Gas Flare: Replace the existing digester gas flare and install a new flow meter;

- Dewatering Building: Improve stormwater drainage and the dewatered cake storage area;

- Sludge Drying Beds: Upgrade walls, pipes, and valves and install temporary coverall for biosolids storage; and

- Biosolids Storage Greenhouse: Install solar greenhouse dryers in place of existing drying beds to achieve greater than 90 percent solids.

8.2.2.3 Alternative B – Architectural, Access Control, and Protective Systems Upgrades

The architectural, access control, and protective systems upgrades proposed for Alternative B would be the same as those previously discussed under Alternative A. These upgrades include:

- Admin/Lab and Admin Annex Building: Remodel the existing admin/lab building and construct a new admin annex building;

- New Storage Building: Construct a new storage building to house chemicals and equipment;

- Main Shop: Expand to add three bays and a new welding shop;

- Site Access Control: Replace portions of the existing fencing and install an automatic gate and security cameras; and

- Protective Systems: Install emergency eyewash stations and showers.

8.2.2.4 Alternative B – Electrical, Instrumentation, and Controls Upgrades

The electrical, instrumentation, and controls upgrades proposed for Alternative B would be the same as those previously discussed under Alternative A. These upgrades include:

- Electrical: Routine maintenance should be performed on the WWTRRF MCC's. Also, demolition of the Lawn Equipment Shed and Chemical Storage Building should be considered. This would eliminate the breaker panel connected to an extension cord; and

- SCADA: The existing SCADA System would be upgraded to include modern, fully redundant server and networking hardware. Additionally, the software platform would be upgraded to modern platforms and architecture. This would allow for added reliability, security, and, versatility. Operations staff will be able to remotely monitor and operate SCADA-connected systems via tablet technology.

8.2.2.5 Alternative B – Cost Summary

The capital cost for Alternative B is estimated at $19.30 million as summarized in **Table 8-3**.

Table 8-3
Alternative B: Capital Cost Summary

Item Description		Cost
Headworks and Dewatering Building Heat		$80,000
Primary Clarifiers		$143,000
RPS and IPPS		$60,000
Aeration Basin Blower Upgrade		$69,000
Secondary Clarifiers		$758,000
Disinfection Conversion		$42,000
Chlorine Contact Chamber		$186,000
Final Effluent Flow Measurement		$45,000
MBR Single Train		$1,369,000
Class A Recycled Water		$1,692,000
Primary Sludge Pumps		$138,000
Primary Digester Complex		$68,000
Secondary Digester Complex		$513,000
Digester Gas Storage		$520,000
Digester Gas Moisture Reduction		$46,000
Digester Gas Flare		$286,000
Dewatering Upgrades		$627,000
Biosolids Storage Greenhouse		$1,156,000
Admin/Lab Remodel		$392,000
Admin Annex Building		$679,000
New Storage Building		$377,000
Main Shop Expansion		$142,000
Site Access Control and Protective Systems		$68,000
Electrical Improvements		$25,000
SCADA Upgrades		$245,000
	Subtotal	**$9,726,000**
Mobilization (8%)		$778,000
General Conditions (8%)		$778,000
Contractor O&P (12%)		$1,167,000
	Subtotal	**$12,449,000**
Engineering, Legal, & Administration (25%)		$3,112,000
Contingency (30%)		$3,735,000
	Total CIP	**$19,296,000**

The total life cycle cost for Alternative B is estimated at $26.54 million as summarized in **Table 8-4**.

Table 8-4
Alternative B: Life Cycle Cost Summary

Cost Type	Cost
Capital Cost	$19.30 M
20-yr NPV of Additional Labor	$3.16 M
20-yr NPV of O&M – Chemical	$1.30 M
20-yr NPV of O&M – Energy	$1.84 M
20-yr NPV of O&M – Major Replacement	$0.94 M
20-yr Life Cycle Total	**$26.54 M**

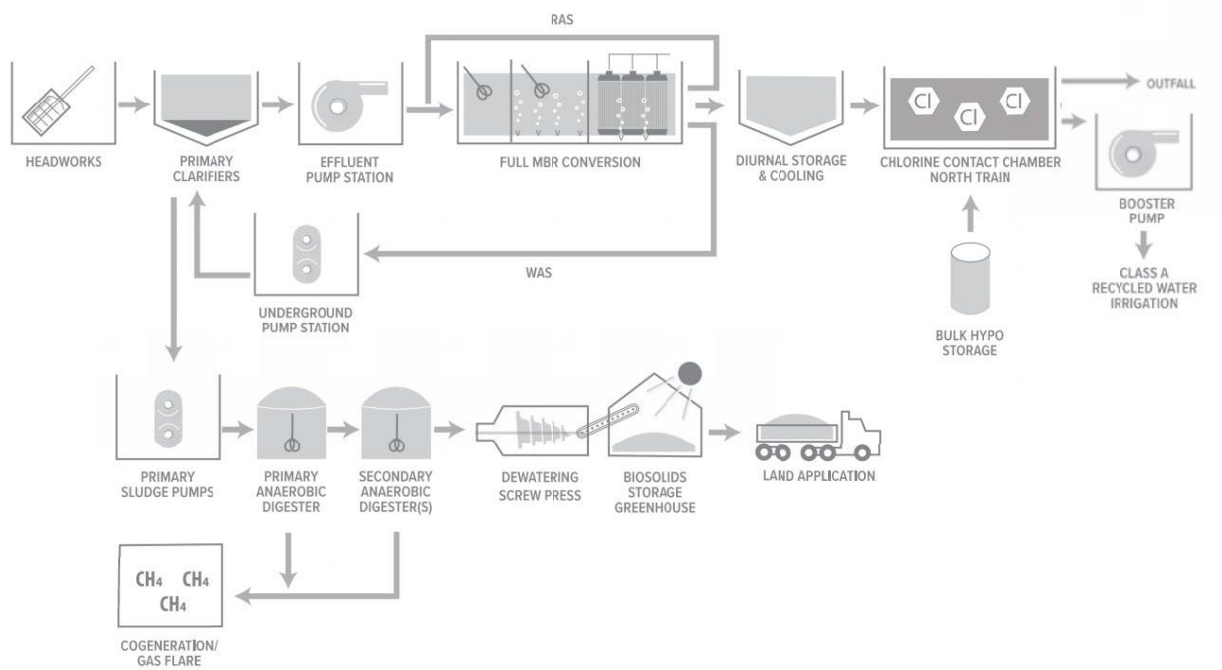
8.2.3 Alternative C – Full MBR Conversion

This alternative is also fundamentally similar to Alternative A as it considers the costs associated with upgrading the existing unit processes to address deficiencies previously discussed. Alternative C, however, utilizes a full MBR secondary process with liquid hypochlorite disinfection that allows the Secondary Clarifiers to be converted to diurnal storage basins to address long-term temperature compliance concerns. In addition to diurnal cooling, Class A recycled water reuse is included to address long term temperature compliance concerns.

As a result of the conversion, the gravity pipeline between the RPS and IPPS would not be required, and the RPS can be utilized for the diurnal storage system to offset costs. In addition, mechanical repairs and upgrades associated with the current function of the Secondary Clarifiers would not be required and will further offset costs.

Figure 8-6 shows a schematic of the proposed unit process upgrades. **Figure 8-7** shows the proposed upgrades on the WWTRRF Site Plan.

Figure 8-6
Alternative C: MBR Expansion Process Schematic Diagram



8.2.3.1 Alternative C1 – Liquids Stream Upgrades with Polymeric MBR Conversion

The liquids stream upgrades proposed for Alternative C1 would be the same as those previously discussed under Alternative A, with the exceptions of upgrades associated with the MBR conversion, RPS and IPPS, secondary clarifiers, disinfection unit process, and the chlorine contact chamber. **Figure 8-8** shows the proposed upgrades to the secondary process. **Figure 8-9** shows the proposed upgrades to the MBR Building.

Liquid stream upgrades previously discussed under Alternative A that are proposed under this alternative include:

- Headworks and Dewatering Building Heat: Install skid-mounted makeup air units with a heat exchanger to improve heating and prevent water lines from freezing;
- Primary Clarifiers: Repair the launders and concrete of both clarifiers;
- Aeration Basin Blowers: Create an independent SCADA system for the existing Aerzen hybrid blower and install a second Aerzen hybrid blower as a redundant unit;
- Disinfection: Convert the existing chlorine gas disinfection system to utilize bulk storage sodium hypochlorite for the discharge stream.

- Chlorine Contact Chamber: Repair cracks and broken areas of the CCC, as well as construct baffle walls in both trains;

- Final Effluent Measurement: Install a Parshall flume in the outfall pipeline with level sensors connected to SCADA; and

- Class A Recycled Water: Additional dosing of residual chlorine in the offline CCC train using sodium hypochlorite, a booster pump station, and a pipeline to the irrigation site(s).

8.2.3.1.1 RPS and IPPS

RAS flow would be limited to the MBR under Alternative C1, and the RPS would no longer handle activated sludge. Accordingly, the RAS gravity line described in Alternative A would not be required and, the force main from the IPPS to the headbox of the MBR would convey primary clarifier effluent only. The RPS would be repurposed to draw thermally stratified, treated effluent from the bottom of the converted secondary clarifiers for discharge through the outfall. WAS would be transferred directly from the MBR to the Underground Pump Station.

8.2.3.1.2 Secondary Clarifiers

The Secondary Clarifiers would be converted to diurnal storage basins to cool effluent in the summer months when thermal loading on the Umatilla River is high. The basins would be allowed to thermally stratify and the RPS would transfer treated effluent, drawn from the cooler bottom. During normal operations when cooling is not necessary, the basins would be allowed to flow by gravity through the CCC and to the existing outfall, reducing energy consumption for this alternative. The structural upgrades to the Secondary Clarifiers of Alternative A would be completed for Alternative C1. No repairs of the weirs, launders, scraper mechanisms, or drive units would be required.

8.2.3.1.3 3-Train MBR Conversion

Conversion of the Aeration Basin to MBR would displace the need for clarifiers in the secondary process, allowing both secondary clarifiers and the CCC to be utilized for diurnal storage and cooling of treated effluent. The full Aeration Basin (3 trains) would be converted to a MBR using conventional, polymeric membranes under Alternative C1. The O&M characteristics of polymeric membranes dictate that three trains are required in order to meet redundancy criteria, though no more than two trains are anticipated to be operational at any given time.

8.2.3.2 Alternative C2 – Liquids Stream Upgrades with Ceramic MBR Conversion

The liquids stream upgrades proposed under Alternative C2 would be the same as those previously discussed under Alternative C1; however, the membranes installed would be ceramic instead of the polymeric. The alternate material of construction optimizes the O&M requirements for the membranes and allows for a train to be put into and taken out of service more quickly. As a result, two trains (instead of three) meet the redundancy requirement for the secondary process. **Figure 8-10** shows the proposed upgrades to the secondary process.

8.2.3.3 Alternatives C1 & C2 – Solids Stream Upgrades

The solids stream upgrades proposed for Alternatives C1 & C2 would be the same as those previously discussed under Alternative A and include:

- <u>Primary Sludge Pumps:</u> Rehabilitate the existing pump houses, replace the existing pumps with progressive cavity pumps, and connect the system to SCADA;
- <u>Primary Digester Complex:</u> Install a redundant primary digester mixing pump and ferric chloride injection system;
- <u>Secondary Digester Complex:</u> Overhaul the pipe gallery and provide an external mixing system, recirculation pump, ferric chloride injection system, and SCADA connectivity;
- <u>Digester Gas Storage:</u> Install a digester gas holding cover and new underground lines to route digester gas to storage locations;
- <u>Digester Gas Moisture Reduction:</u> Enclose the gas conditioning skid and add a unit heater;
- <u>Digester Gas Flare:</u> Replace the existing digester gas flare and install a new flow meter;
- <u>Dewatering Building</u>: Improve stormwater drainage and the dewatered cake storage area;
- <u>Sludge Drying Beds:</u> Upgrade walls, pipes, and valves and install temporary coverall for biosolids storage; and
- <u>Biosolids Storage Greenhouse:</u> Install solar greenhouse dryers in place of existing drying beds to achieve greater than 90 percent solids.

8.2.3.4 Alternatives C1 & C2 – Architectural, Access Control, and Protective Systems Upgrades

The architectural, access control, and protective systems upgrades proposed for Alternatives C1 & C2 would be the same as for Alternative A. These upgrades include:

- <u>Admin/Lab and Admin Annex Building:</u> Remodel the existing admin/lab building and construct a new admin annex building;
- <u>New Storage Building</u>: Construct a new storage building to house chemicals and equipment;
- <u>Main Shop</u>: Expand to add three bays and add a new welding shop;

- Site Access Control: Replace portions of the existing fencing and install an automatic gate and security cameras; and

- Protective Systems: Install emergency eyewash stations and showers.

8.2.3.5 Alternatives C1 & C2 – Electrical, Instrumentation, and Controls Upgrades

The electrical, instrumentation, and controls upgrades proposed for Alternatives C1 & C2 would be the same as for Alternative A. These upgrades include:

- Electrical: Routine maintenance should be performed on the WWTRRF MCC's. Also, demolition of the Lawn Equipment Shed and Chemical Storage Building should be considered. This would eliminate the breaker panel connected to an extension cord; and

- SCADA: The existing SCADA System would be upgraded to include modern, fully redundant server and networking hardware. Additionally, the software platform would be upgraded to modern platforms and architecture. This would allow for added reliability, security, and, versatility. Operations staff will be able to remotely monitor and operate SCADA-connected systems via tablet technology.

8.2.3.6 Alternatives C1 & C2 – Cost Summary

The capital cost for Alternative C1 is estimated at $20.45 million as summarized in **Table 8-5**.

Table 8-5
Alternative C1: Capital Cost Summary

Item Description	Cost
Headworks and Dewatering Building Heat	$80,000
Primary Clarifiers	$143,000
Aeration Basin Blower Upgrade	$69,000
Secondary Clarifiers	$308,000
Disinfection Conversion	$42,000
Chlorine Contact Chamber	$186,000
Final Effluent Flow Measurement	$45,000
MBR & Diurnal Storage	$2,509,000
Class A Recycle Water	$1,642,000
Primary Sludge Pumps	$138,000
Primary Digester Complex	$68,000
Secondary Digester Complex	$513,000
Digester Gas Storage	$520,000
Digester Gas Moisture Reduction	$46,000
Digester Gas Flare	$286,000
Dewatering Upgrades	$627,000

Item Description		Cost
Biosolids Storage Greenhouse		$1,156,000
Admin/Lab Remodel		$392,000
Admin Annex Building		$679,000
New Storage Building		$377,000
Main Shop Expansion		$142,000
Site Access Control and Protective Systems		$68,000
Electrical Improvements		$25,000
SCADA Upgrades		$245,000
	Subtotal	**$10,306,000**
Mobilization (8%)		$824,000
General Conditions (8%)		$824,000
Contractor O&P (12%)		$1,237,000
	Subtotal	**$13,191,000**
Engineering, Legal, & Administration (25%)		$3,298,000
Contingency (30%)		$3,957,000
	Total CIP	**$20,446,000**

The total life cycle cost for Alternative C1 is estimated at $28.97 million as summarized in **Table 8-6**.

Table 8-6
Alternative C1: Life Cycle Cost Summary

Cost Type	Cost
Capital Cost	$20.45 M
20-yr NPV of Additional Labor	$2.94 M
20-yr NPV of O&M – Chemical	$1.46 M
20-yr NPV of O&M – Energy	$2.21 M
20-yr NPV of O&M – Major Replacement	$1.91 M
20-yr Life Cycle Total	**$28.97 M**

The capital cost for Alternative C2 is estimated at $26.21 million as summarized in **Table 8-7**.

Table 8-7
Alternative C2: Capital Cost Summary

Item Description	Cost
Headworks and Dewatering Building Heat	$80,000
Primary Clarifiers	$143,000
Aeration Basin Blower Upgrade	$69,000
Secondary Clarifiers	$308,000
Disinfection Conversion	$42,000

Item Description	Cost
Chlorine Contact Chamber	$186,000
Final Effluent Flow Measurement	$45,000
MBR & Diurnal Storage	$5,410,000
Class A Recycle Water	$1,642,000
Primary Sludge Pumps	$138,000
Primary Digester Complex	$68,000
Secondary Digester Complex	$513,000
Digester Gas Storage	$520,000
Digester Gas Moisture Reduction	$46,000
Digester Gas Flare	$286,000
Dewatering Upgrades	$627,000
Biosolids Storage Greenhouse	$1,156,000
Admin/Lab Remodel	$392,000
Admin Annex Building	$679,000
New Storage Building	$377,000
Main Shop Expansion	$142,000
Site Access Control and Protective Systems	$68,000
Electrical Improvements	$25,000
SCADA Upgrades	$245,000
Subtotal	**$13,207,000**
Mobilization (8%)	$1,057,000
General Conditions (8%)	$1,056,000
Contractor O&P (12%)	$1,585,000
Subtotal	**$16,906,000**
Engineering, Legal, & Administration (25%)	$4,227,000
Contingency (30%)	$5,072,000
Total CIP	**$26,205,000**

The total life cycle cost for Alternative C2 is estimated at $33.74 million as summarized in **Table 8-8**.

Table 8-8
Alternative C2: Life Cycle Cost Summary

Cost Type	Cost
Capital Cost	$26.21 M
20-yr NPV of Additional Labor	$3.00 M
20-yr NPV of O&M – Chemical	$1.46 M
20-yr NPV of O&M – Energy	$2.21 M
20-yr NPV of O&M – Major Replacement	$0.86 M
20-yr Life Cycle Total	**$33.74 M**

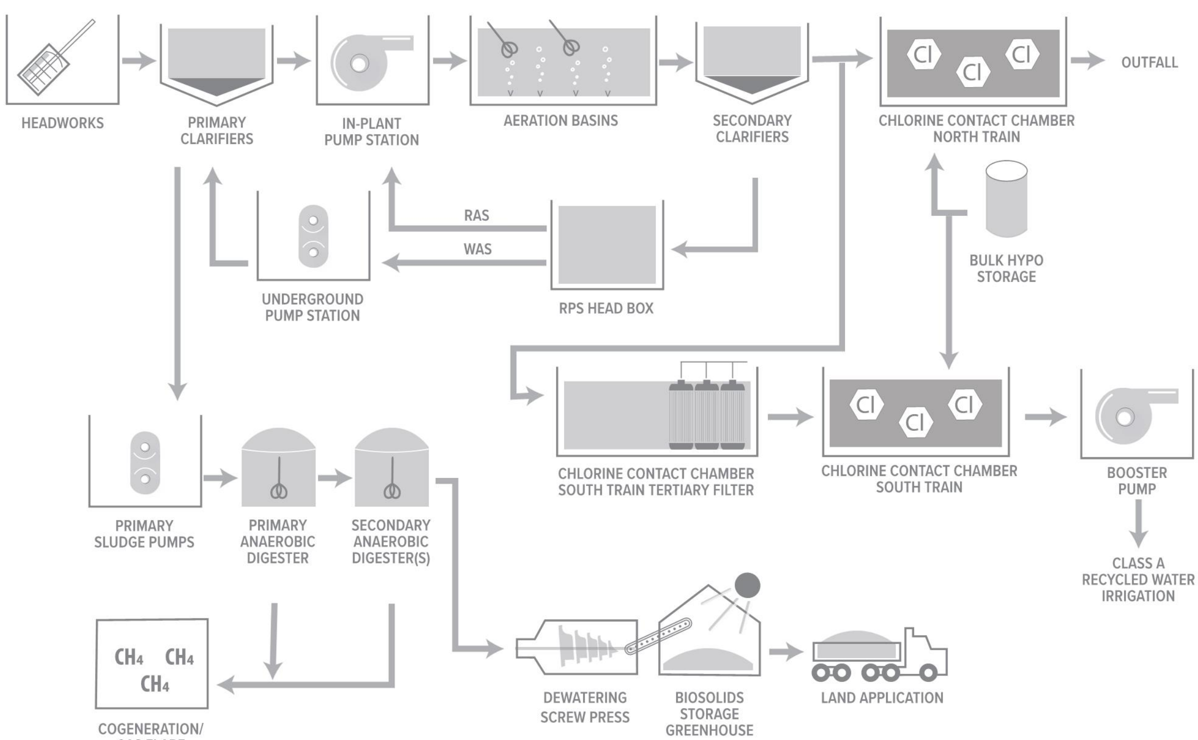
8.2.4 Alternative D – CAS/Tertiary Filtration

This alternative is fundamentally similar to Alternative B as it also considers the costs associated with upgrading the existing unit processes to address deficiencies previously discussed. Alternative D, however, utilizes ultrafiltration methods of tertiary treatment to produce Class A recycled water for offsite irrigation to address long-term temperature compliance concerns. Alternative D requires conversion of a portion of the chlorine contact chamber's south train but does not require any reconfiguration of the aeration basin, as is necessary in Alternative B.

The ultrafiltration process is an ideal method for tertiary treatment because there are no chemicals required for filtration, it produces a constant product quality, equipment has a small footprint, and it is capable of exceeding regulatory standards of water quality with 90-100 percent pathogen removal. Post-filtration, a booster pump station, sodium hypochlorite injection (to maintain residual during transmission), and pipeline to the irrigation site(s) would be added for the Class A recycled water stream.

Figure 8-11 shows a schematic of the proposed unit process upgrades. **Figure 8-12** shows the proposed upgrades on the WWTRRF Site Plan.

Figure 8-11
Alternative D: CAS/Tertiary Filtration



8.2.4.1 Alternative D – Liquids Stream Upgrades

The liquids stream upgrades proposed for Alternative D would be the same as those previously discussed under Alternative A with the exception of a side stream tertiary filtration system to produce Class A recycled water.

Liquid stream upgrades previously discussed under Alternative A that are proposed under this alternative include:

- Headworks and Dewatering Building Heat: Install skid-mounted makeup air units with a heat exchanger to improve heating and prevent water lines from freezing;
- Primary Clarifiers: Repair the launders and concrete of both clarifiers;
- RPS and IPPS: Replace the existing RPS pumps using a gravity line for the RAS;
- Aeration Basin Blowers: Create an independent SCADA system for the existing Aerzen hybrid blower and install a second Aerzen hybrid blower as a redundant unit;
- Secondary Clarifiers: Repair the launders and concrete of both clarifiers as well as replace some of the equipment;
- Disinfection: Convert the existing chlorine gas disinfection system to utilize bulk storage sodium hypochlorite;
- Chlorine Contact Chamber: Repair cracks and broken areas of the CCC, as well as construct baffle walls in both trains;
- Final Effluent Measurement: Install a Parshall flume in the outfall pipeline with level sensors connected to SCADA, and
- Class A Recycled Water: Additional dosing of residual chlorine in the offline CCC train using sodium hypochlorite, a booster pump station, and a pipeline to the irrigation site(s).

8.2.4.1.1 Chlorine Contact Chamber South Train Tertiary Filter

A portion of the south train of the chlorine contact chamber would be converted for a side-stream tertiary filtration system in order to divert up to 2.0 MGD from discharge into the Umatilla River. The filtered effluent would be used as Class A recycled water for irrigation offsite. The side stream system would consist of the tertiary membrane filtration process, liquid sodium hypochlorite disinfection, a booster pump station, and a pipeline to the irrigation site(s). Thermal loading on the Umatilla River will be reduced, as necessary, by diverting the side stream from the outfall. Current prospective irrigation sites include the I-84 median and the airport industrial area.

Two tertiary ceramic membrane filtration (TMF) basins are required to treat the full side stream volume in peak summer months. Reinforced concrete walls would be constructed to partition the existing south train of the chlorine contact chamber into two TMF basins and one fully redundant chlorine contact chamber. **Figure 8-13** shows the new TMF building layout.

8.2.4.1.2 Disinfection

Disinfection for the conventional discharge stream and the Class A recycled water side stream would be converted to bulk storage sodium hypochlorite as described in Alternative A. The northern CCC train would disinfect the conventional stream and the southern train would disinfect the TMF side stream.

8.2.4.2 Alternative D – Solids Stream Upgrades

The solids stream upgrades proposed for Alternative D would be the same as for Alternative A and include:

- Primary Sludge Pumps: Rehabilitate the existing pump houses, replace the existing pumps with progressive cavity pumps, and connect the system to SCADA;
- Primary Digester Complex: Install a redundant primary digester mixing pump and ferric chloride injection system;
- Secondary Digester Complex: Overhaul the pipe gallery and provide an external mixing system, recirculation pump, ferric chloride injection system, and SCADA connectivity;
- Digester Gas Storage: Install a digester gas holding cover and new underground lines to route digester gas to storage locations;
- Digester Gas Moisture Reduction: Enclose the gas conditioning skid and add a unit heater;
- Digester Gas Flare: Replace the existing digester gas flare and install a new flow meter;
- Dewatering Building: Improve stormwater drainage and the dewatered cake storage area;
- Sludge Drying Beds: Upgrade walls, pipes, and valves and install temporary coverall for biosolids storage; and
- Biosolids Storage Greenhouse: Install solar greenhouse dryers in place of existing drying beds to achieve >90% solids.

8.2.4.3 Alternative D – Architectural, Access Control, and Protective Systems Upgrades

The architectural, access control, and protective systems upgrades proposed for Alternative D would be the same as for Alternative A. These upgrades are summarized below:

- Admin/Lab and Admin Annex Building: Remodel the existing admin/lab building and construct a new admin annex building;

- New Storage Building: Construct a new storage building to house chemicals and equipment;

- Main Shop: Expand to add three bays and a new welding shop;

- Site Access Control: Replace portions of the existing fencing and install an automatic gate and security cameras; and

- Protective Systems: Install emergency eyewash stations and showers.

8.2.4.4 Alternative D – Electrical, Instrumentation, and Controls Upgrades

The electrical, instrumentation, and controls upgrades proposed for Alternative D would be the same as for Alternative A. These upgrades are summarized below:

- Electrical: Routine maintenance should be performed on the WWTRRF MCC's. Also, demolition of the Lawn Equipment Shed and Chemical Storage Building should be considered. This would eliminate the breaker panel connected to an extension cord; and

- SCADA: The existing SCADA System would be upgraded to include modern, fully redundant server and networking hardware. Additionally, the software platform would be upgraded to modern platforms and architecture. This would allow for added reliability, security, and, versatility. Operations staff will be able to remotely monitor and operate SCADA-connected systems via tablet technology.

8.2.4.5 Alternative D – Cost Summary

The capital cost for Alternative D is estimated at $19.80 million as summarized in **Table 8-9**.

Table 8-9
Alternative D: Capital Cost Summary

Item Description	Cost
Headworks and Dewatering Building Heat	$80,000
Primary Clarifiers	$143,000
RPS and IPPS	$60,000
Aeration Basin Blower Upgrade	$69,000
Secondary Clarifiers	$758,000
Disinfection Conversion	$42,000
Chlorine Contact Chamber	$186,000
Final Effluent Flow Measurement	$45,000
Tertiary Filter	$1,674,000

Item Description		Cost
Class A Recycle Water		$1,642,000
Primary Sludge Pumps		$138,000
Primary Digester Complex		$68,000
Secondary Digester Complex		$513,000
Digester Gas Storage		$520,000
Digester Gas Moisture Reduction		$46,000
Digester Gas Flare		$286,000
Dewatering Upgrades		$627,000
Biosolids Storage Greenhouse		$1,156,000
Admin/Lab Remodel		$392,000
Admin Annex Building		$679,000
New Storage Building		$377,000
Main Shop Expansion		$142,000
Site Access Control and Protective Systems		$68,000
Electrical Improvements		$25,000
SCADA Upgrades		$245,000
	Subtotal	**$9,981,000**
Mobilization (8%)		$798,000
General Conditions (8%)		$798,000
Contractor O&P (12%)		$1,198,000
	Subtotal	**$12,775,000**
Engineering, Legal, & Administration (25%)		$3,194,000
Contingency (30%)		$3,833,000
	Total CIP	**$19,802,000**

The total cost for Alternative D is estimated at $27.17 million as summarized in **Table 8-10**.

Table 8-10
Alternative D: Life Cycle Cost Summary

Cost Type	Cost
Capital Cost	$19.80 M
20-yr NPV of Additional Labor	$3.33 M
20-yr NPV of O&M – Chemical	$1.46 M
20-yr NPV of O&M – Energy	$1.92 M
20-yr NPV of O&M – Major Replacement	$0.66 M
20-yr Life Cycle Total	**$27.17 M**

8.3 Evaluation of Combined Alternatives

As outlined in the **Section 3 – Basis of Planning**, selection of the recommended alternative to be carried forward for implementation is based on an evaluation of economic and non-economic criteria including capital cost, 20-year lifecycle cost, regulatory compliance and constructability. The total score for each alternative is calculated based on the score and weighting for each criterion using the following equation:

$$Total = \sum_{Criteria} (Score * Weighting)$$

The Economic criteria and weightings used in the combined alternatives evaluation include:

Capital Cost	30%
20-year Life Cycle Cost	20%
Total Economic Weighting	50%

The Non-economic criteria and weightings used in the combined alternatives evaluation include:

Regulatory Compliance:	30%
Constructability:	20%
Total Non-Economic Weighting	50%

The following sections summarize the overall evaluation of combined alternatives and the recommended alternative for implementation.

8.3.1 Economic Cost Summary for Combined Alternatives

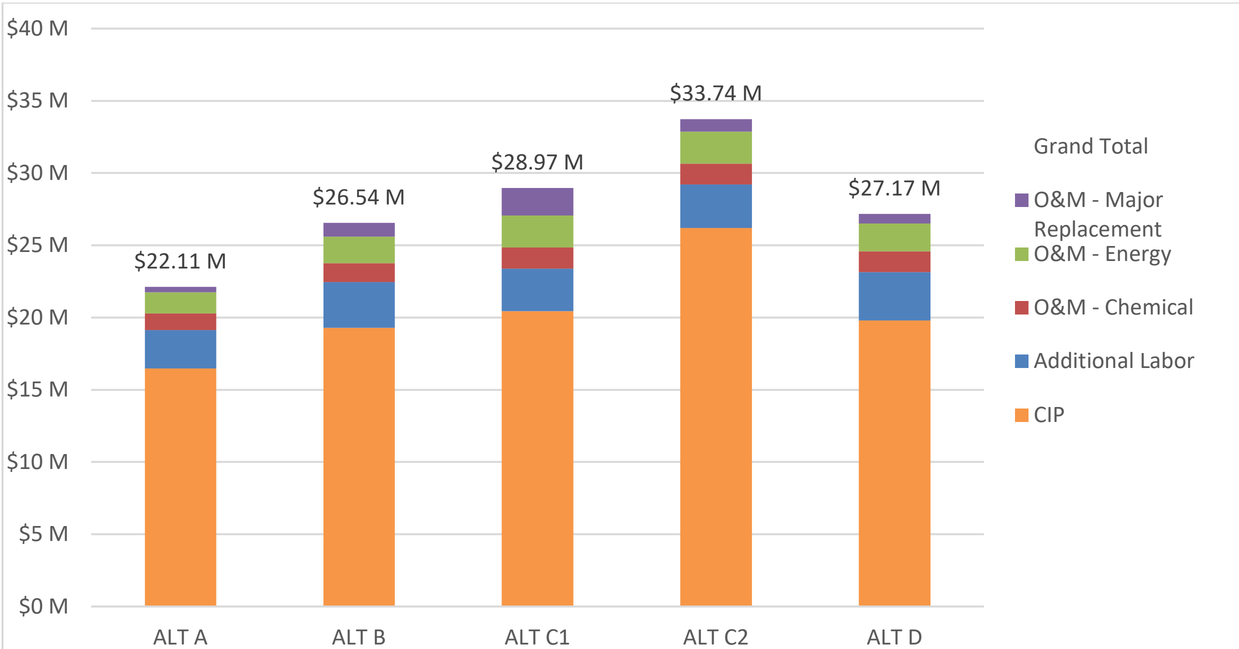
Table 8-11 below summarizes the capital and lifecycle costs for the five combined alternatives. As summarized previously, capital cost and lifecycle cost represent 30 percent and 20 percent weighting in the overall evaluation, respectively.

Table 8-11
Combined Alternative Capital and Lifecycle Costs

Cost Type	Alt A	Alt B	Alt C1	Alt C2	Alt D
Capital Cost	**$16.48 M**	**$19.30 M**	**$20.45 M**	**$26.21 M**	**$19.80 M**
20-yr NPV of Additional Labor	$2.64 M	$3.16 M	$2.94 M	$3.00 M	$3.33 M
20-yr NPV of O&M – Chemical	$1.15 M	$1.30 M	$1.46 M	$1.46 M	$1.46 M
20-yr NPV of O&M – Energy	$1.47 M	$1.84 M	$2.21 M	$2.21 M	$1.92 M
20-yr NPV of O&M – Major Replacement	$0.37 M	$0.94 M	$1.91 M	$0.86 M	$0.67 M
20-year Lifecycle Cost	**$22.11 M**	**$26.54 M**	**$28.97 M**	**$33.74 M**	**$27.17 M**

A summary of capital and 20-year lifecycle costs for each alternative is presented in **Figure 8-14.**

Figure 8-14
Alternatives A - D: Overall Cost Summary Chart



8.3.2 Non-economic Scoring for Combined Alternatives

Non-economic evaluations included a review of long-term regulatory compliance and constructability for each of the combined alternatives. Discussion of these criteria with regard to each of the five combined alternatives is summarized on the following sub-sections.

8.3.2.1 Regulatory Compliance

Due to the uncertainty and potential impacts associated with long term temperature compliance in the face the loss of the Natural Conditions Criteria (NCC) on which the Umatilla Temperature TMLD was a basis, the long-term recommendation for the Pendleton WWTP discharge is to pursue a water recycled program to reduce Umatilla River discharge rather than opportunities to reduce the temperature of WWTP effluent discharged to the river.

Under this scenario, Umatilla River discharge would be continued up to the excess thermal load limits included in the City's NPDES Permit but flows in excess of that limit would be diverted to a water recycling program.

Given the approach providing the most certainty for long-term regulatory compliance is to reduce the Umatilla River discharge by implementing a water recycling program, the primary difference between the alternatives then is related to the level of recycled water quality needed to provide adequate demand for the water to be diverted from the river. The primary consideration in this discussion is whether Class A or B Recycled Water requiring coagulation, flocculation and filtration is required or if Class C or D Recycled Water not requiring the additional treatment steps is needed for the successful implementation of a water recycling program in the City of Pendleton.

Alternative A is an expansion of the existing WWTP treatment process that could be designed to consistently produce Class C Recycled Water. Alternatives B, C1, C2 and D would all consistently produced Class A Recycled Water. While there are many more allowable uses for Class A Recycled Water, such as irrigation of parks and other open public spaces, those demands are relatively small for the City of Pendleton and would require installation of an expensive and invasive recycled water pipe system where there is already potable water available from the City's water distribution system.

Therefore, the apparent best options for recycled water irrigation would be recycled water irrigation on areas like the I-84 highway median and then up near the airport industrial park on grass or pastureland where the City could purchase property or secure a long-term lease. This property could also be considered for land application of Class B Biosolids produced by the WWTRRF. These options could all be irrigated with Class C Recycled Water. Therefore, from a regulatory compliance perspective, Alternative A scores slightly higher than the other alternatives because the production of Class A Recycled Water would not be necessary for the recycled water demands anticipated for Pendleton WWTRRF recycled water.

8.3.2.2 Constructability

From a constructability perspective, the level of impact on current WWTP operations, invasiveness of the planned improvements and ability to phase construction to reduce the impact on community ratepayers were considered.

Alternative A represents a continuation of the current WWTP operations, is relatively easy to implement, can be phased as necessary based on funding availability. The rehabilitation elements will require some work in existing unit processes, which can be mitigated by the high level of redundancy provided in the WWTP (e.g. redundant primary and secondary clarifiers).

Alternative B to convert one aeration basin train to an MBR would require an invasive retrofit and other modifications to the existing aeration basin, but the remaining construction would primarily be outside the current WWTP unit processes.

Alternatives C1 and C2 would require full conversion of the existing aeration basin to an MBR, which would have the greatest impact on the existing WWTP operations and is highly invasive.

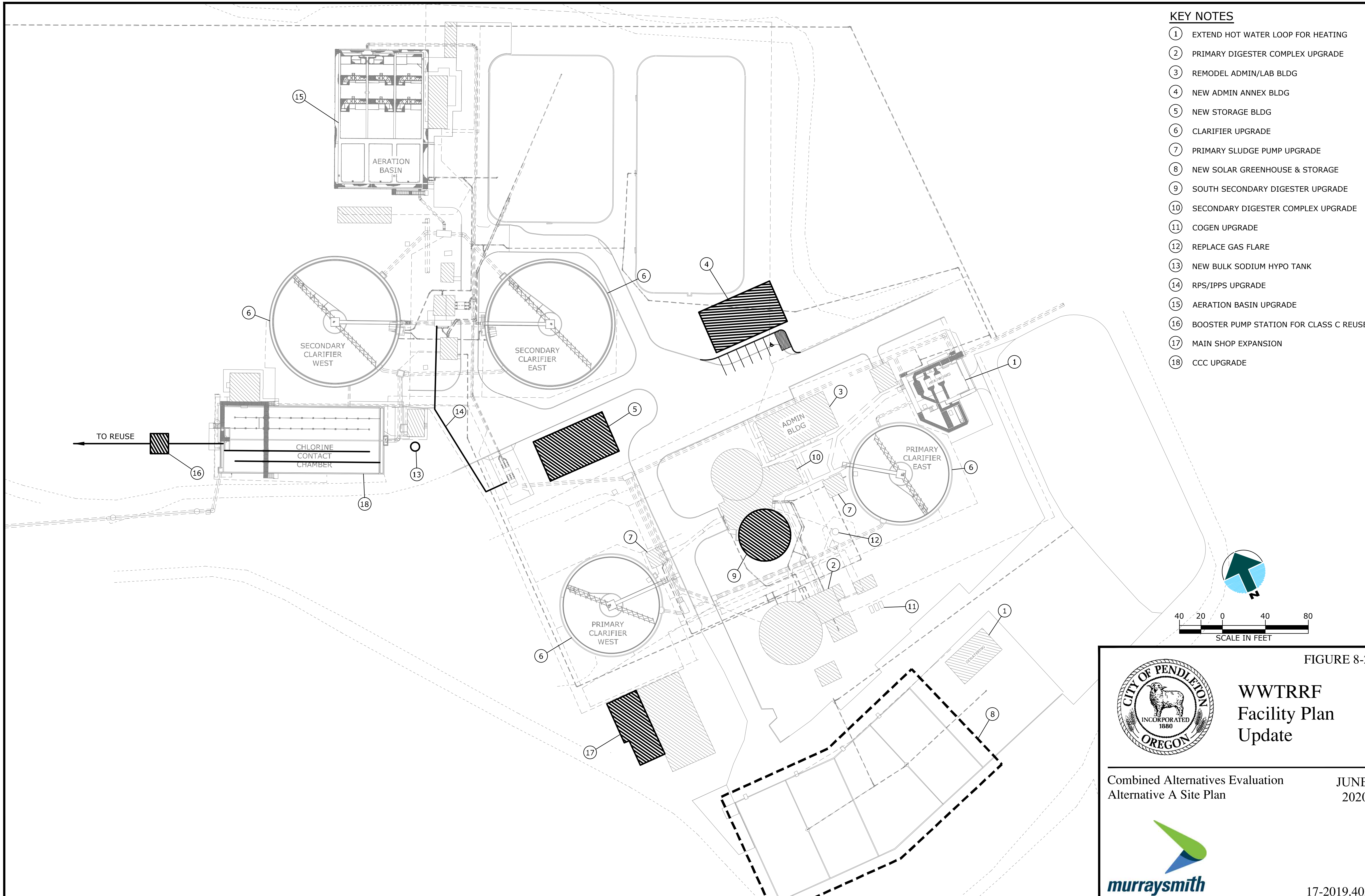
Alternative D represents the least impact on current WWTP operations through the construction of a separate tertiary filter train, allowing current WWTP operations to continue with minimal impact during construction.

8.3.3 Recommended Alternative for Implementation

The combined alternative scoring summary based on the previous discussion is presented in **Table 8-12** below. Based on the evaluation, Alternative A has the highest scoring and is recommended for implementation over the 20-year planning horizon.

Table 8-12
Combined Alternative Scoring

	Weight	Alt A	Alt B	Alt C1	Alt C2	Alt D
Capital Cost	30%	4.0	3.5	3.0	2.5	3.0
20-year Life-Cycle Cost	20%	4.0	3.0	2.5	3.0	3.0
Regulatory Compliance	30%	4.0	3.0	3.0	3.0	3.0
Constructability	20%	3.5	3.0	2.5	2.5	4.0
Total	**100%**	**3.9**	**3.2**	**2.8**	**2.8**	**3.2**



KEY NOTES

1. EXTEND HOT WATER LOOP FOR HEATING
2. PRIMARY DIGESTER COMPLEX UPGRADE
3. REMODEL ADMIN/LAB BLDG
4. NEW ADMIN ANNEX BLDG
5. NEW STORAGE BLDG
6. CLARIFIER UPGRADE
7. PRIMARY SLUDGE PUMP UPGRADE
8. NEW SOLAR GREENHOUSE & STORAGE
9. SOUTH SECONDARY DIGESTER UPGRADE
10. SECONDARY DIGESTER COMPLEX UPGRADE
11. COGEN UPGRADE
12. REPLACE GAS FLARE
13. NEW BULK SODIUM HYPO TANK
14. RPS/IPPS UPGRADE
15. AERATION BASIN UPGRADE
16. BOOSTER PUMP STATION FOR CLASS C REUSE
17. MAIN SHOP EXPANSION
18. CCC UPGRADE

FIGURE 8-2

WWTRRF
Facility Plan
Update

Combined Alternatives Evaluation
Alternative A Site Plan

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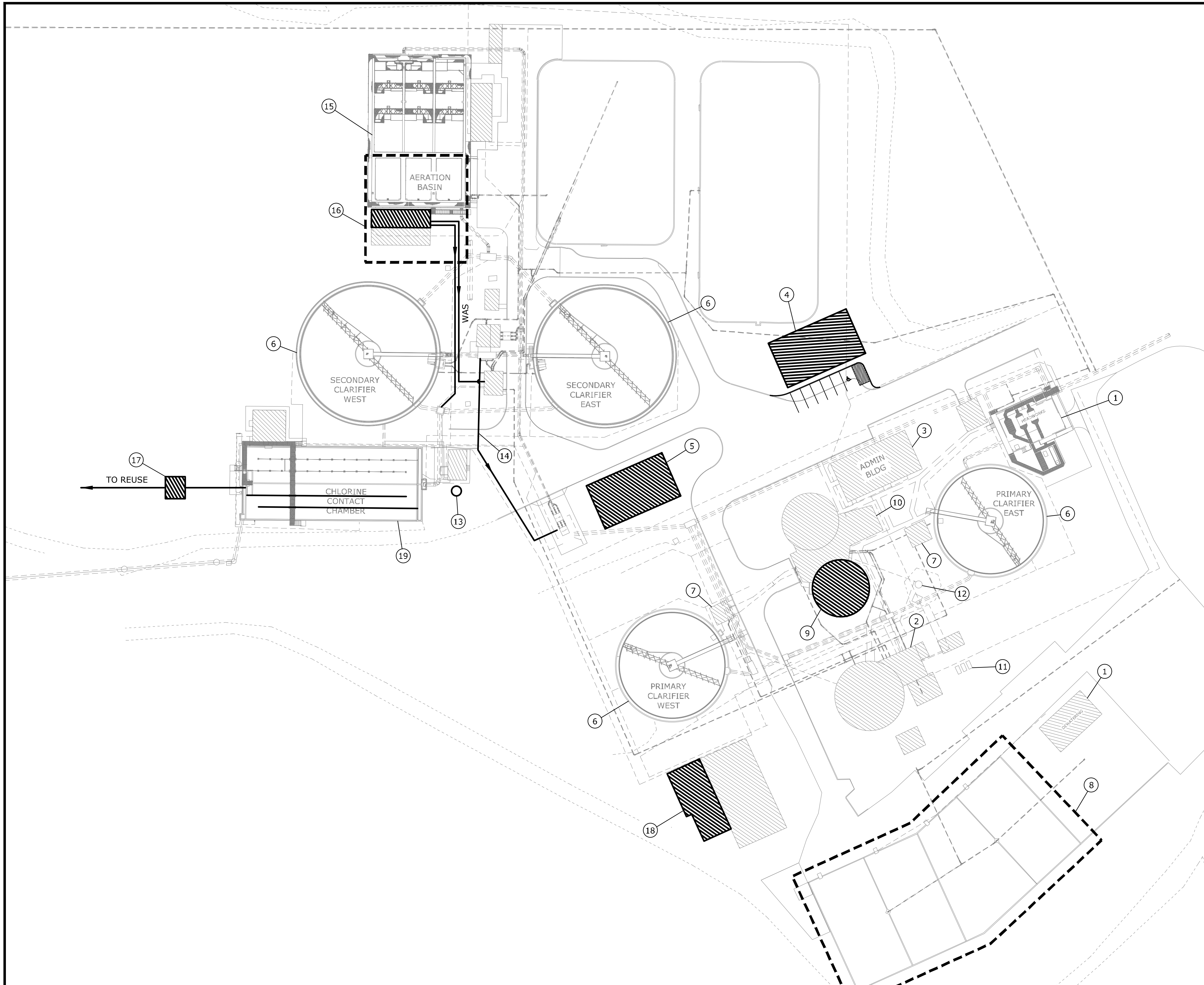

KEY NOTES

1. EXTEND HOT WATER LOOP FOR HEATING
2. PRIMARY DIGESTER COMPLEX UPGRADE
3. REMODEL ADMIN/LAB BLDG
4. NEW ADMIN ANNEX BLDG
5. NEW STORAGE BLDG
6. CLARIFIER UPGRADE
7. PRIMARY SLUDGE PUMP UPGRADE
8. NEW SOLAR GREENHOUSE & STORAGE
9. SOUTH SECONDARY DIGESTER UPGRADE
10. SECONDARY DIGESTER COMPLEX UPGRADE
11. COGEN UPGRADE
12. REPLACE GAS FLARE
13. NEW BULK SODIUM HYPO TANK
14. RPS/IPPS UPGRADE
15. AERATION BASIN UPGRADE (SINGLE-TRAIN MBR)
16. MBR BUILDING EXPANSION (SEE FIG 8-5)
17. BOOSTER PUMP STATION FOR CLASS A REUSE
18. MAIN SHOP EXPANSION
19. CCC UPGRADE

40 20 0 40 80
SCALE IN FEET

FIGURE 8-4

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Combined Alternatives Evaluation
Alternative B Site Plan

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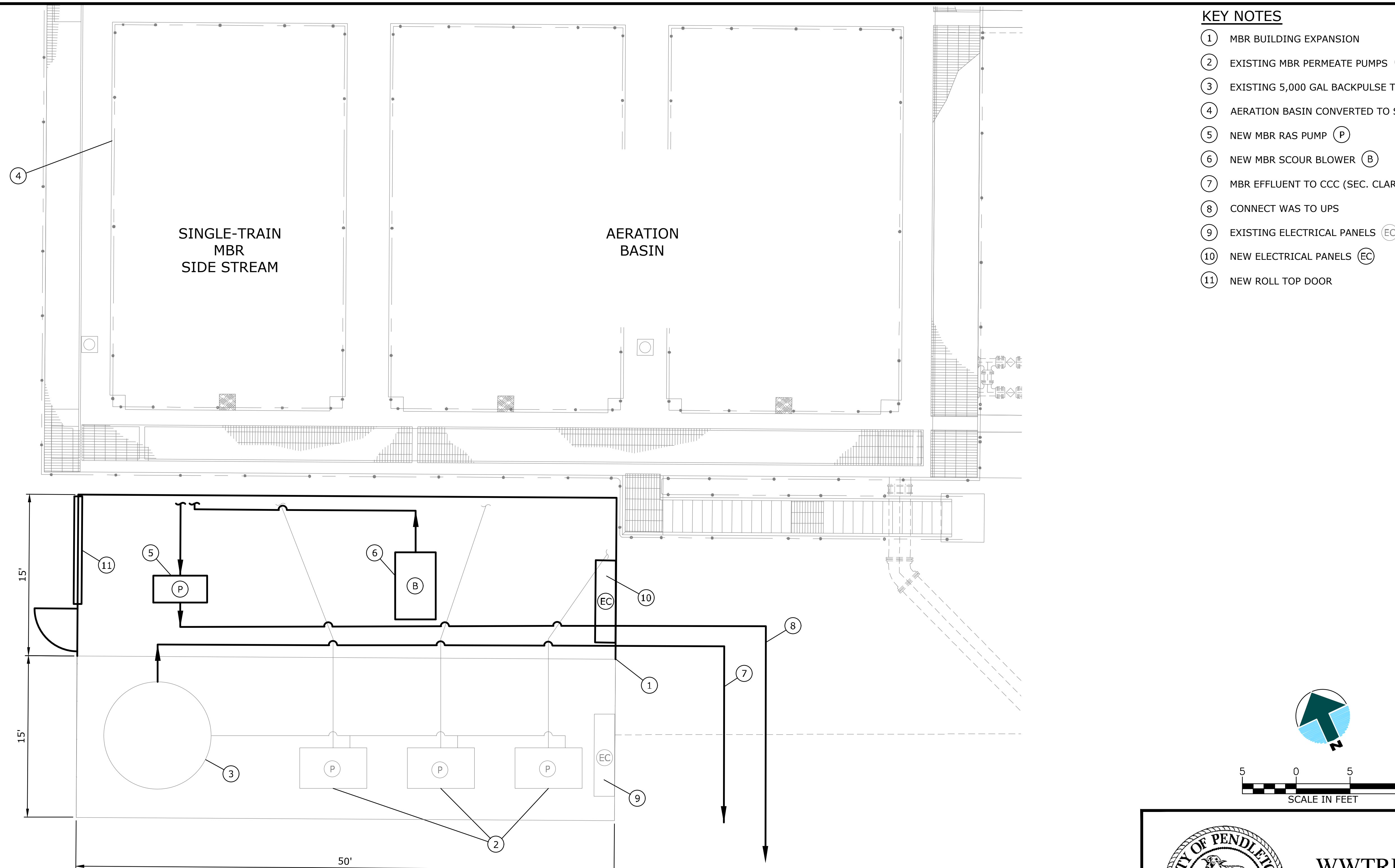

KEY NOTES

1. MBR BUILDING EXPANSION
2. EXISTING MBR PERMEATE PUMPS (P)
3. EXISTING 5,000 GAL BACKPULSE TANK
4. AERATION BASIN CONVERTED TO SINGLE-TRAIN MBR
5. NEW MBR RAS PUMP (P)
6. NEW MBR SCOUR BLOWER (B)
7. MBR EFFLUENT TO CCC (SEC. CLARIFIER BYPASS)
8. CONNECT WAS TO UPS
9. EXISTING ELECTRICAL PANELS (EC)
10. NEW ELECTRICAL PANELS (EC)
11. NEW ROLL TOP DOOR

FIGURE 8-5

WWTRRF Facility Plan Update

Combined Alternatives Evaluation
Alternative B
MBR Building Expansion Layout

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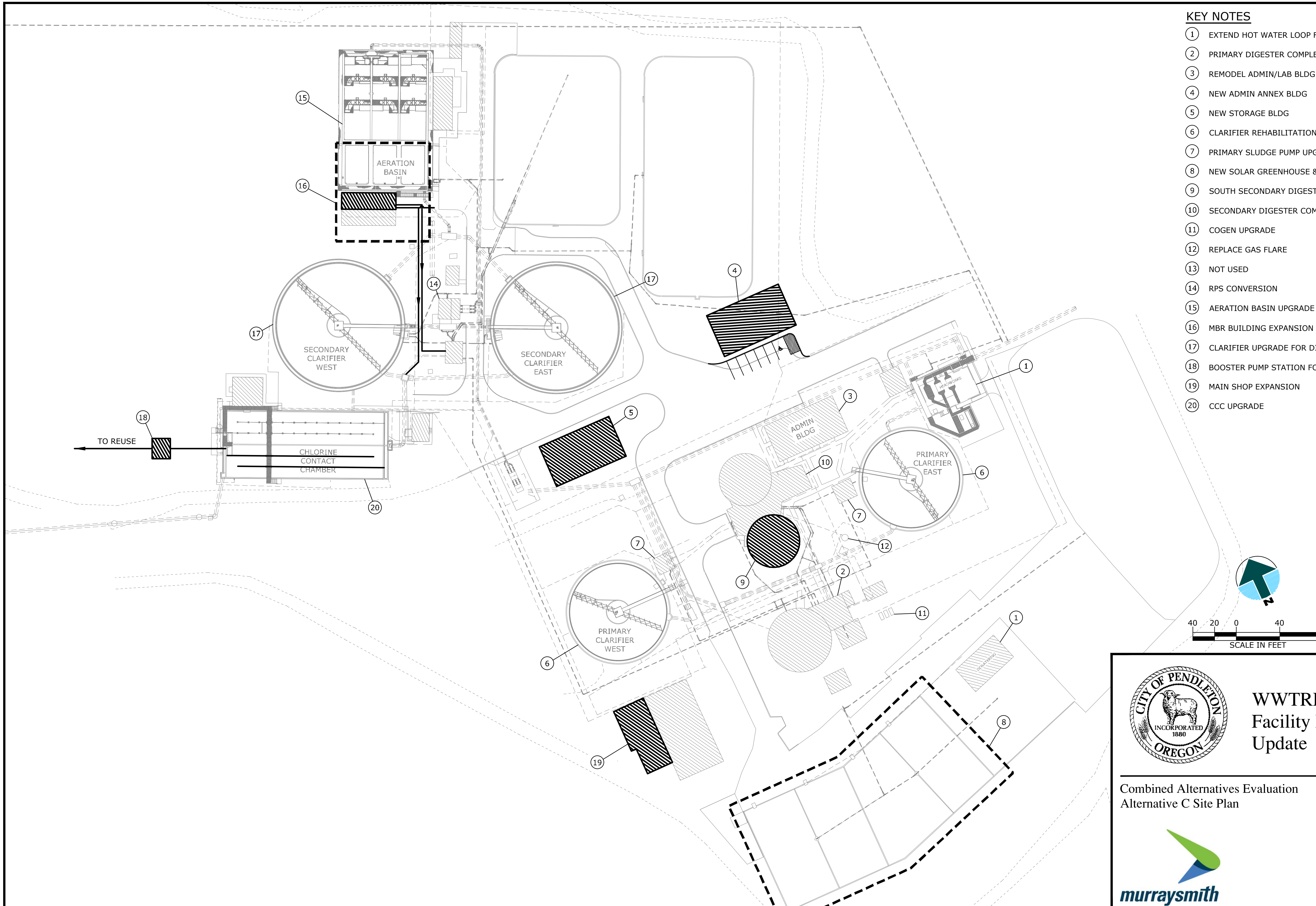

KEY NOTES

1. EXTEND HOT WATER LOOP FOR HEATING
2. PRIMARY DIGESTER COMPLEX UPGRADE
3. REMODEL ADMIN/LAB BLDG
4. NEW ADMIN ANNEX BLDG
5. NEW STORAGE BLDG
6. CLARIFIER REHABILITATION
7. PRIMARY SLUDGE PUMP UPGRADE
8. NEW SOLAR GREENHOUSE & STORAGE
9. SOUTH SECONDARY DIGESTER UPGRADE
10. SECONDARY DIGESTER COMPLEX UPGRADE
11. COGEN UPGRADE
12. REPLACE GAS FLARE
13. NOT USED
14. RPS CONVERSION
15. AERATION BASIN UPGRADE (FULL MBR)
16. MBR BUILDING EXPANSION (SEE FIG 8-9)
17. CLARIFIER UPGRADE FOR DIURNAL STORAGE
18. BOOSTER PUMP STATION FOR CLASS A REUSE
19. MAIN SHOP EXPANSION
20. CCC UPGRADE

FIGURE 8-7

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Combined Alternatives Evaluation
Alternative C Site Plan

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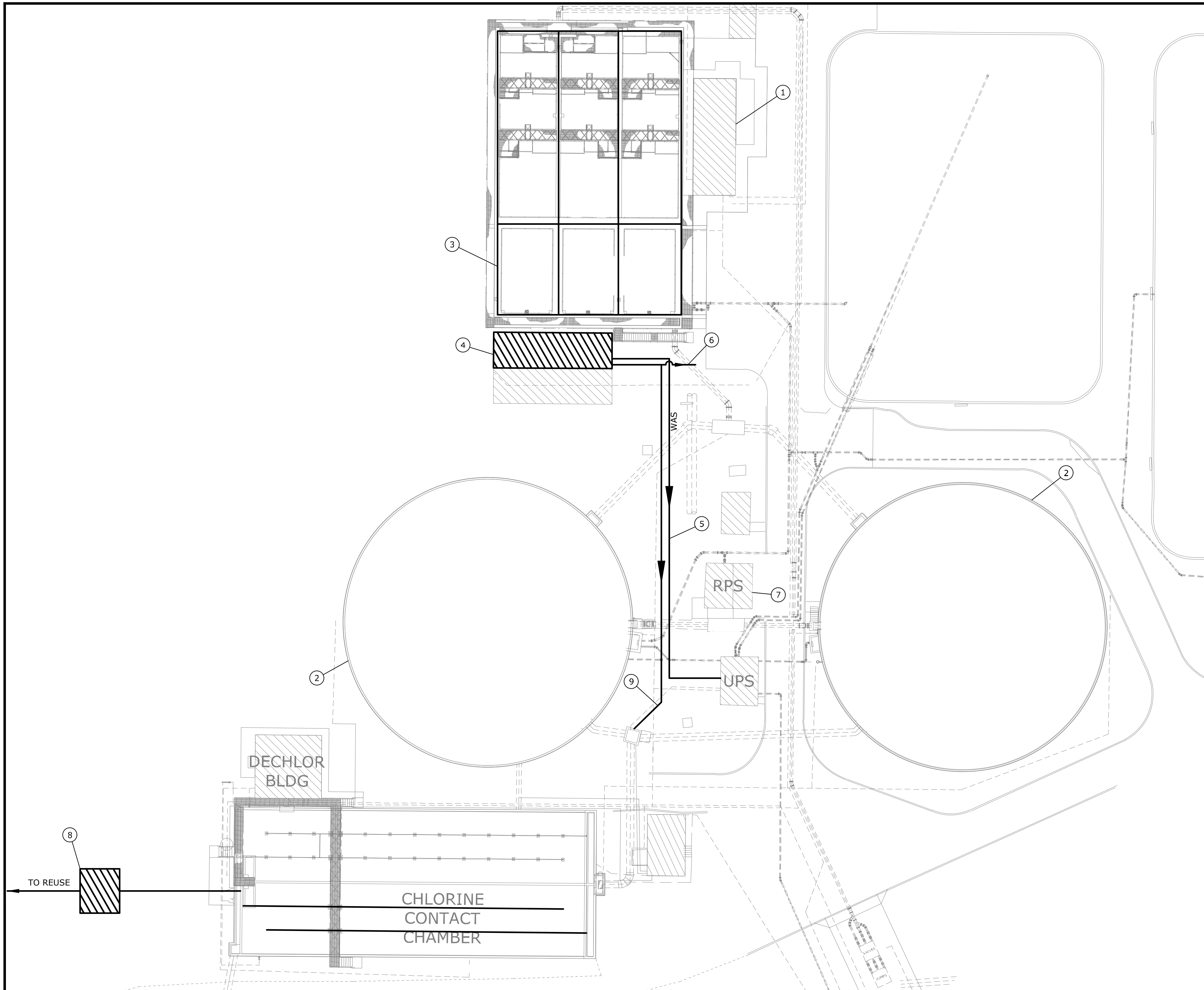

KEY NOTES

1. BLOWER UPGRADE
2. SECONDARY CLARIFIER CONVERSION
3. AERATION BASIN CONVERSION (POLYMERIC)
4. EXPAND MBR BUILDING
5. CONNECT WAS TO UPS
6. CONNECT MBR EFFLUENT TO CLARIFIERS FOR STORAGE AND COOLING
7. RPS UPGRADE
8. BOOSTER PUMP STATION FOR CLASS A REUSE
9. MBR EFFLUENT TO CCC (SEC. CLARIFIER BYPASS)

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20 10 0 20 40
SCALE IN FEET

FIGURE 8-8

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Combined Alternatives Evaluation
Alternative C1

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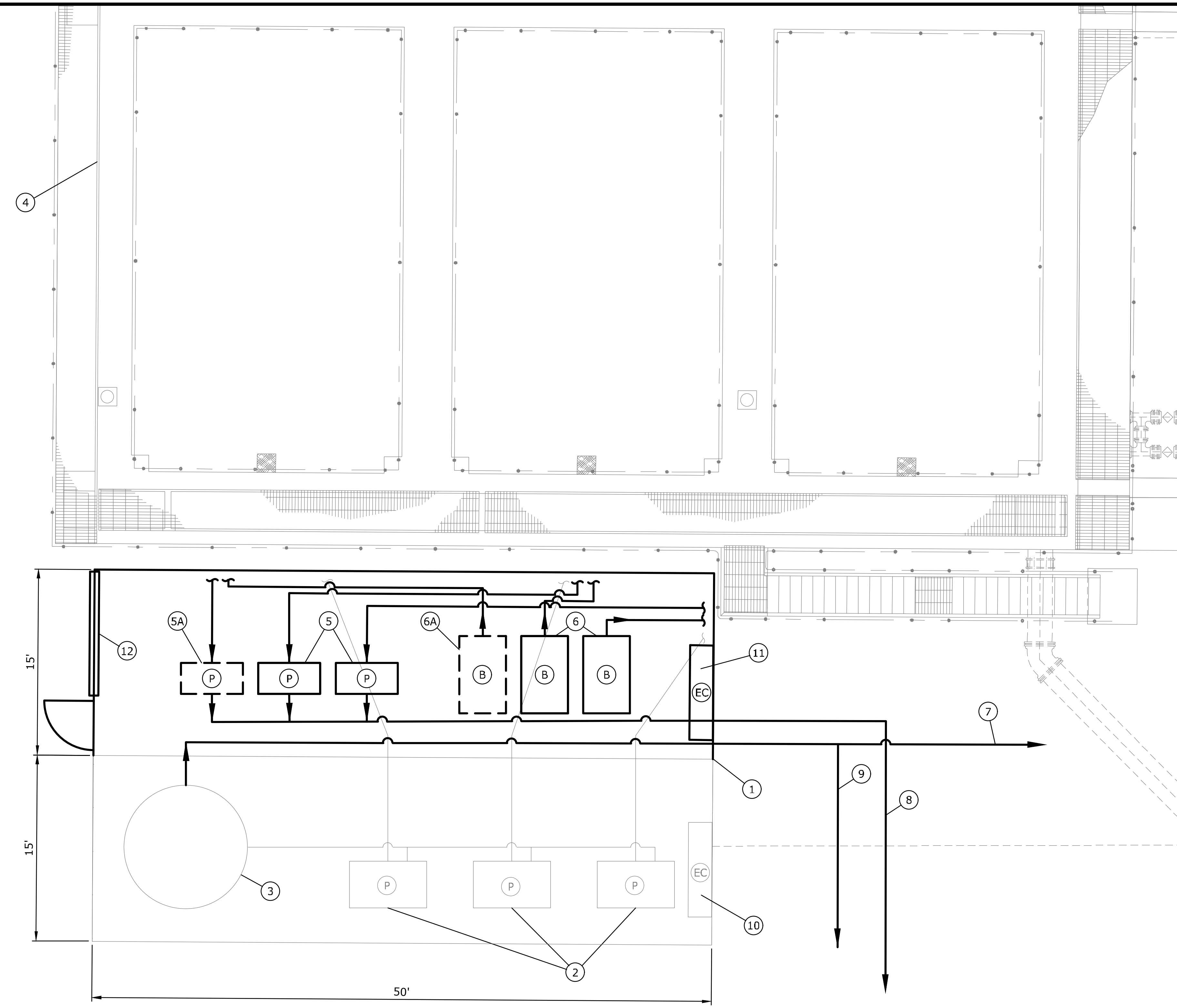

KEY NOTES

1. MBR BUILDING EXPANSION
2. EXISTING MBR PERMEATE PUMPS (P)
3. EXISTING 5,000 GAL BACKPULSE TANK
4. AERATION BASIN CONVERTED FOR FULL MBR
5. NEW MBR RAS PUMPS (P)
5A. THIRD RAS PUMP FOR THREE-TRAIN MBR (P)
6. NEW MBR SCOUR BLOWERS (B)
6A. THIRD SCOUR BLOWER FOR THREE-TRAIN MBR (B)
7. CONNECT MBR EFFLUENT TO CLARIFIERS FOR STORAGE AND COOLING
8. CONNECT WAS TO UPS
9. MBR EFFLUENT TO CCC (SEC. CLARIFIER BYPASS)
10. EXISTING ELECTRICAL PANELS (EC)
11. NEW ELECTRICAL PANELS (EC)
12. NEW ROLL TOP DOOR

FIGURE 8-9

CITY OF PENDLETON OREGON INCORPORATED 1880

WWTRRF Facility Plan Update

Combined Alternatives Evaluation
Alternative C
MBR Building Expansion Layout

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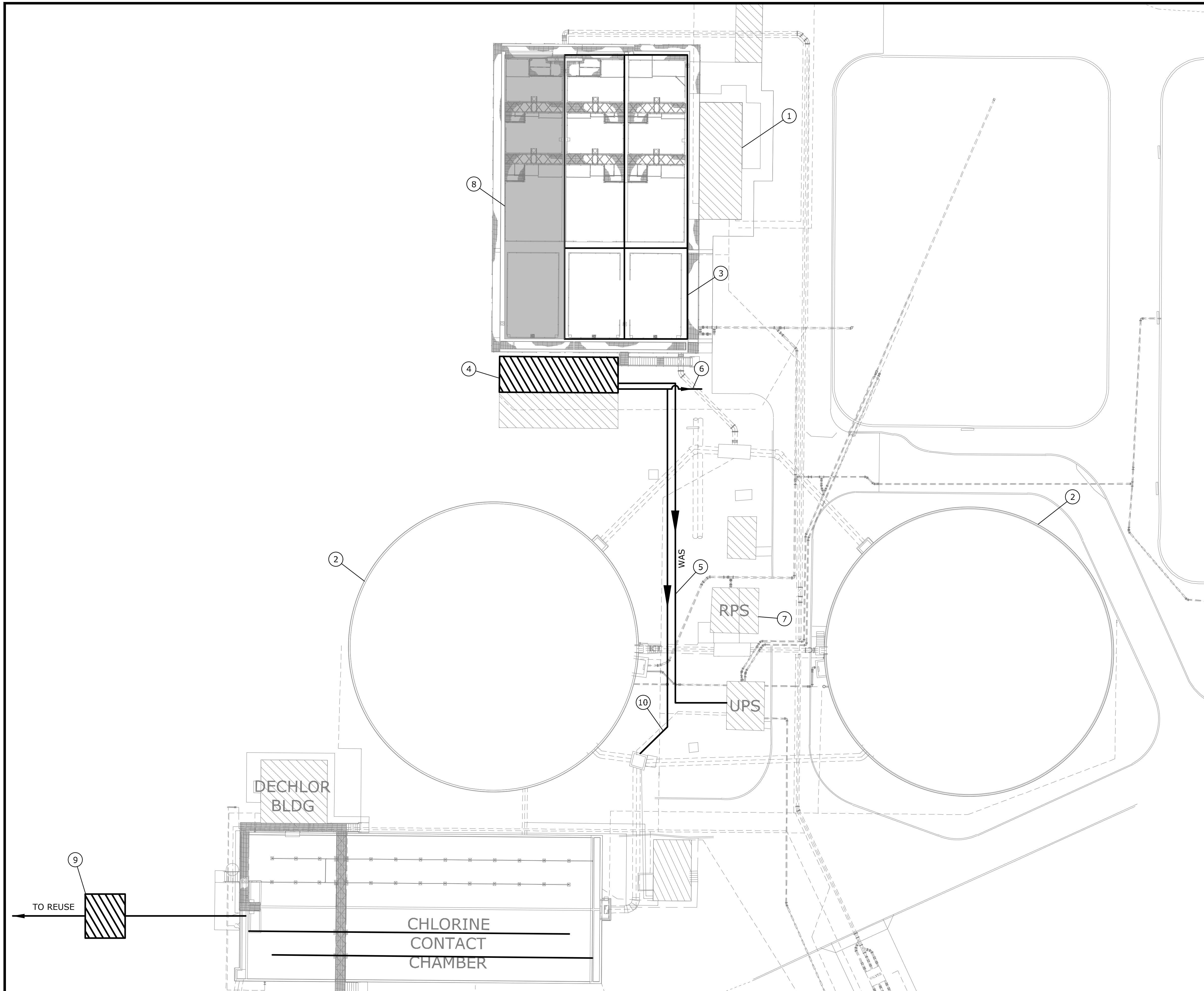

KEY NOTES

1. BLOWER UPGRADE
2. SECONDARY CLARIFIER CONVERSION
3. AERATION BASIN CONVERSION (CERAMIC)
4. EXPAND MBR BUILDING
5. CONNECT WAS TO UPS
6. CONNECT MBR EFFLUENT TO CLARIFIERS FOR STORAGE AND COOLING
7. RPS UPGRADE
8. OFFLINE TRAIN
9. BOOSTER PUMP STATION FOR CLASS A REUSE
10. MBR EFFLUENT TO CCC (SEC. CLARIFIER BYPASS)

N

20 10 0 20 40

SCALE IN FEET

FIGURE 8-10

CITY OF PENDLETON OREGON INCORPORATED 1880

WWTRRF
Facility Plan
Update

Combined Alternatives Evaluation
Alternative C2

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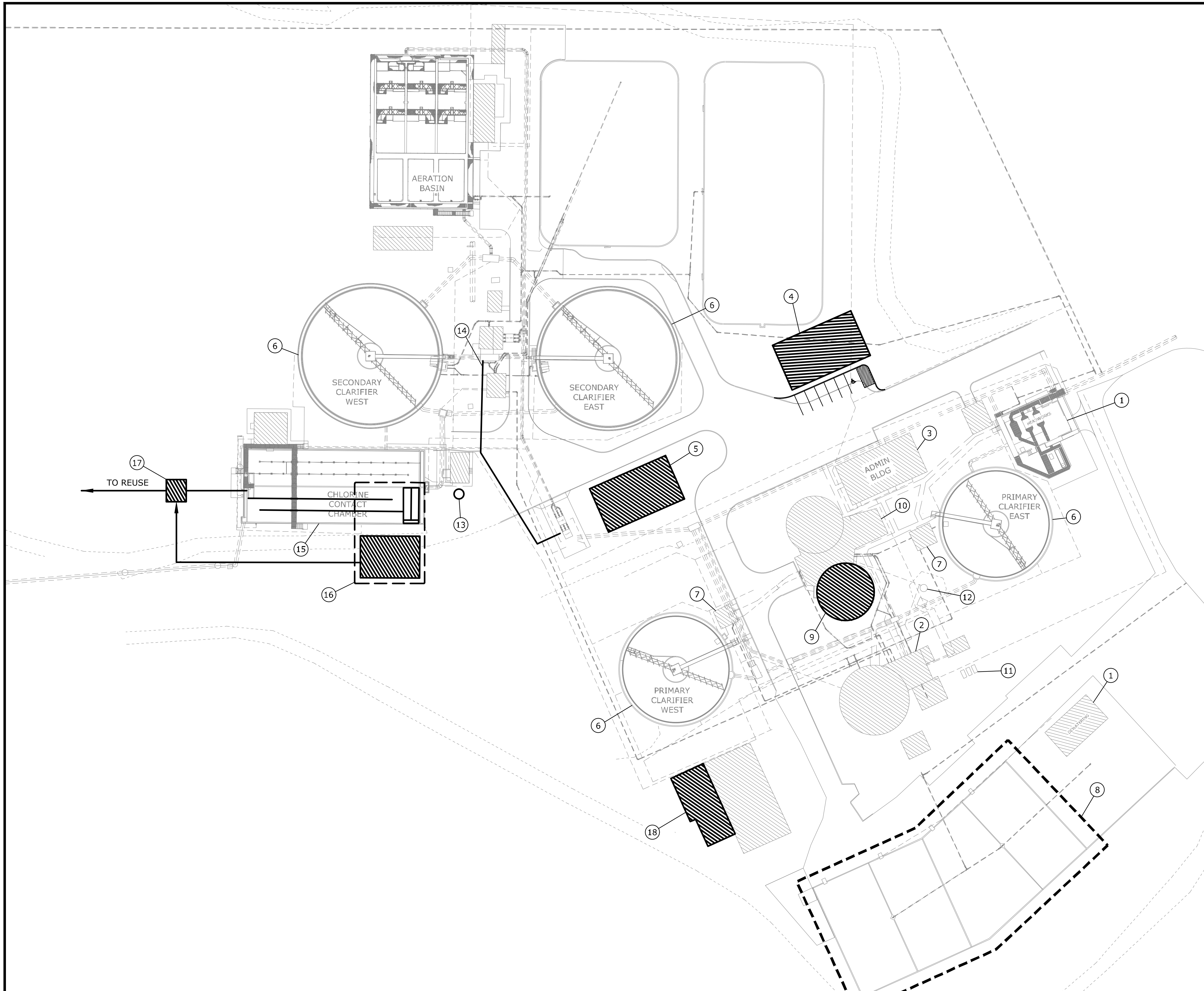

KEY NOTES

1. EXTEND HOT WATER LOOP FOR HEATING
2. PRIMARY DIGESTER COMPLEX UPGRADE
3. REMODEL ADMIN/LAB BLDG
4. NEW ADMIN ANNEX BLDG
5. NEW STORAGE BLDG
6. CLARIFIER UPGRADE
7. PRIMARY SLUDGE PUMP UPGRADE
8. NEW SOLAR GREENHOUSE & STORAGE
9. SOUTH SECONDARY DIGESTER UPGRADE
10. SECONDARY DIGESTER COMPLEX UPGRADE
11. COGEN UPGRADE
12. REPLACE GAS FLARE
13. NEW BULK SODIUM HYPO TANK
14. RPS/IPPS UPGRADE
15. CHLORINE CONTACT CHAMBER UPGRADE
16. NEW TERTIARY MEMBRANE FILTRATION UPGRADES (SEE FIG 8-13)
17. BOOSTER PUMP STATION FOR CLASS A REUSE
18. MAIN SHOP EXPANSION

FIGURE 8-12

CITY OF PENDLETON INCORPORATED 1880 OREGON

WWTRRF Facility Plan Update

Combined Alternatives Evaluation
Alternative D Site Plan

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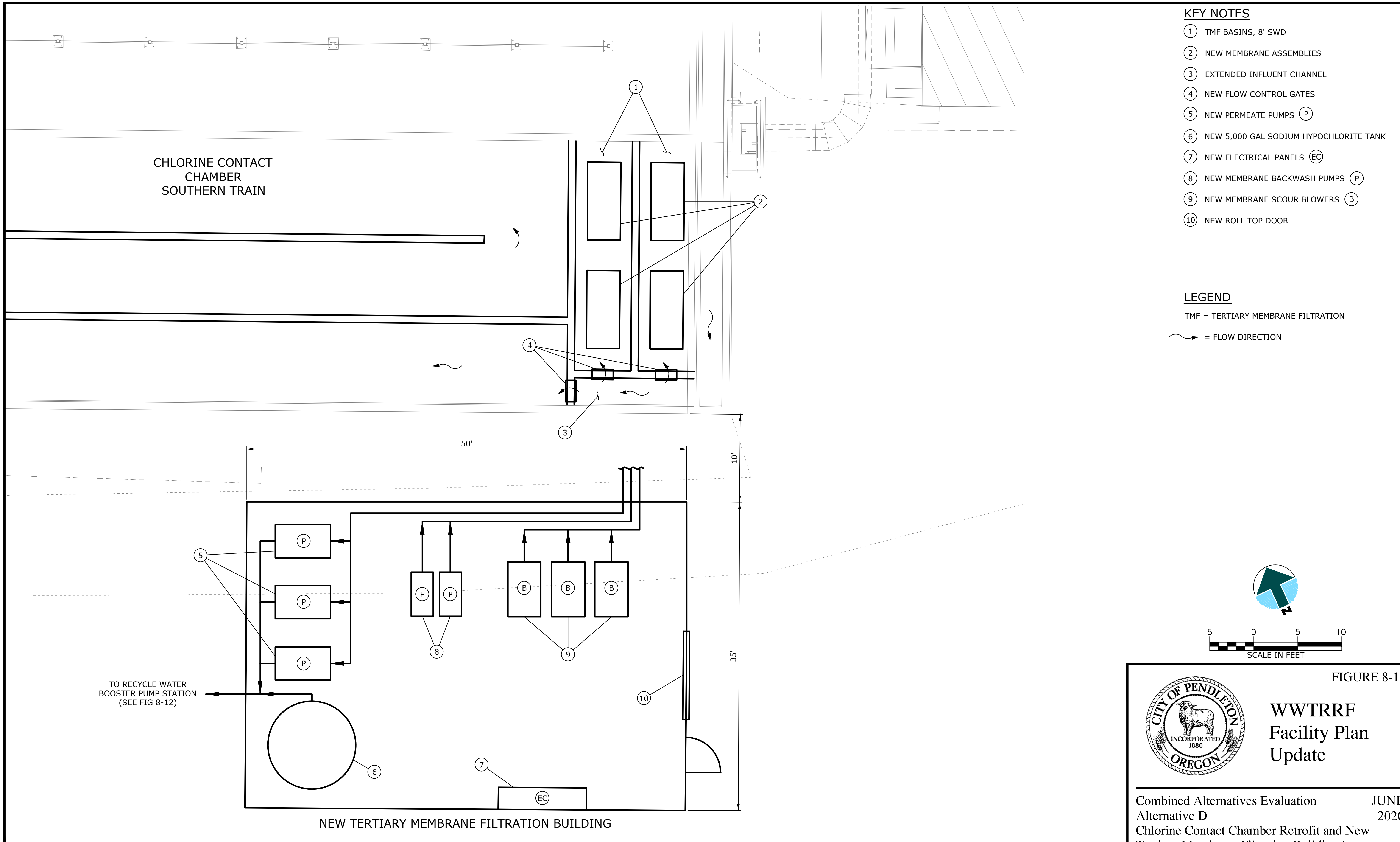

FIGURE 8-13

WWTRRF Facility Plan Update

Combined Alternatives Evaluation
Alternative D
Chlorine Contact Chamber Retrofit and New Tertiary Membrane Filtration Building Layout

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Section 9

Section 9

Recommended Plan and Phased Implementation Plan

9.1 Introduction

This section provides an overview for implementation and phasing of the capital upgrades recommended in **Section 8 – Combined Alternatives Evaluation**. The purpose of this chapter is to provide the overall 20-year Pendleton WWTRRF Capital improvement Plan (CIP) breaking out the Recommended Plan into phases for implementation. Key elements of this section include:

Project Phasing – Recommended upgrades are divided into four separate phases.

"Triggers" for Phase Upgrades – The timings for Phase 1A and 1B are triggered based on immediate needs, however, the required timing for implementation of Phases 2 and 3 as part of the overall WWTRRF CIP are uncertain at this time. Therefore, these two phases will be completed in the 20-year planning horizon based on future triggers. For example, loss of the City's biosolids land application sites due to development of the airport industrial park may trigger the Phase 3 biosolids upgrades.

O&M Upgrades – A list of smaller O&M related upgrades was identified during the WWTRRF field condition assessment. These smaller projects are incorporated into the CIP as separate budget line items.

The following phased implementation plan includes the following sections:

- Recommended Plan Overview summarizing proposed WWTRRF Liquids Stream, Solids Stream, Architectural, Electrical, Instrumentation and Controls and other recommended upgrades.
- Phased Implementation Plan summarizing the separate phases for implementation of the recommended WWTRRF upgrades.
- Overview of implementation "triggers" and assumed timing for Phases 2 and 3 used to develop the overall CIP.

9.2 Recommended Plan and Phasing

As summarized in previous evaluations, Alternative A is recommended as the best long-term option for the City. This alternative considers the costs associated with upgrading the existing unit processes to address deficiencies discussed in greater detail in in previous sections. The primary areas to be upgraded include structural and mechanical repairs to aging facilities; replacement of aged mechanical equipment; critical equipment redundancy; conversion to liquid sodium hypochlorite disinfection; and optimization of RAS handling, digester gas systems, and sludge drying. A Class C recycled water system will be installed to address long-term temperature compliance. **Figure 9-1** shows the overall Recommended Plan overlaid on the WWTRRF site plan.

9.2.1 Recommended Plan Phasing

Implementation of the Recommended Plan is broken into four phases to be completed over the 20-year planning period. The phases are summarized as follows:

- **Phase 1A** (2020-2022) includes repairs to failing solids stream unit processes and upgrades required to meet near-term regulatory requirements. Site access control measures, protective systems, expansion of the main shop, and electrical improvements are also included in this phase.

- **Phase 1B** (2025-2027) includes repairs to failing liquids stream unit processes, a new storage building, and SCADA improvements.

- **Phase 2** (2030-2032) includes dewatering upgrades and installation of a biosolids storage greenhouse for Class A biosolids production capabilities. A new admin annex building and primary sludge pumps are also included in this phase.

- **Phase 3** (2038-2040) includes unit process upgrades required for production of Class C recycled water, digester gas storage, and architectural improvements to the existing admin/lab building.

The proposed phases are separated based on the triggers associated with each. The triggers for each phase, outlined in Section 9.2.3, may deviate from the proposed phasing. For example, there may be project specific triggers that cause a CIP line item to occur sooner or later than the overall phase.

9.2.2 Phased Implementation Plan

Table 9-1 below summarizes the Phased Implementation Plan with improvements tied to phases and associated project costs.

Table 9–1
Phased Implementation Plan Summary

WWTRRF CIP	Phase 1A (2020-2022)	Phase 1B (2025-2027)	Phase 2 (2030-2032)	Phase 3 (2038-2040)
O&M Upgrades[1]	$220,000 per year			
Headworks and Dewatering Building Heat	$ -	$ -	$ -	$ 160,000
Primary Clarifiers	$ -	$ 284,000	$ -	$ -
RPS and IPPS	$ 120,000	$ -	$ -	$ -
New Smaller Blower w/ VFD	$ 136,000	$ -	$ -	$ -
Secondary Clarifiers	$ -	$ 1,504,000	$ -	$ -
Disinfection Conversion	$ 84,000	$ -	$ -	$ -
Chlorine Contact Chamber	$ -	$ 368,000	$ -	$ -
Final Effluent Flow Measurement	$ -	$ -	$ -	$ 88,000
Class C Recycled Water	$ -	$ -	$ -	$ 3,256,000
Primary Sludge Pumps	$ -	$ -	$ 272,000	$ -
Primary Digester Complex	$ 136,000	$ -	$ -	$ -
Secondary Digester Complex	$ 1,016,000	$ -	$ -	$ -
Digester Gas Storage	$ -	$ -	$ -	$ 1,032,000
Digester Gas Moisture Reduction	$ -	$ -	$ -	$ 92,000
Digester Gas Flare	$ -	$ -	$ -	$ 568,000
Dewatering Upgrades	$ -	$ -	$ 1,243,000	$ -
Biosolids Storage Greenhouse	$ -	$ -	$ 2,292,000	$ -
Admin/Lab Remodel	$ -	$ -	$ -	$ 776,000
Admin Annex Building	$ -	$ -	$ 1,348,000	$ -
New Storage Building	$ -	$ 748,000	$ -	$ -
Main Shop Expansion	$ 280,000	$ -	$ -	$ -
Site Access Control and Protective Systems	$ 136,000	$ -	$ -	$ -
Electrical Improvements	$ 48,000	$ -	$ -	$ -
SCADA Upgrades	$ -	$ 488,000	$ -	$ -
Totals	**$ 1,956,000**	**$ 3,392,000**	**$ 5,155,000**	**$ 5,972,000**

1. O&M upgrades include $220,000 per year. See Table 9-2 for a complete CIP summary.

9.2.3 "Triggers" for Recommended Plan Phases

Phases 1A and 1B will be implemented early in the 20-year planning horizon to address triggers that stem from immediate needs at the WWTRRF. Phases 2 and 3 will be triggered by a change in treatment requirements or other factors that are currently uncertain. While the estimated timing for these phases has been provided in order to develop the 20-year WWTRRF CIP, the actual triggers for each phase, or portions thereof, would be as follows:

- O&M Upgrades (2020-2040): The recommended plan includes a separate budget line item that incorporates smaller annual O&M related projects.

- **Phase 1A (2020-2022) and 1B (2025-2027) Immediate Needs:** These upgrades are triggered by failing equipment and immediate operational needs. For example, secondary digester complex upgrades in Phase 1A are triggered by near-term operating requirements for redundancy and improved chemical dosing. Less immediate upgrades have been included in Phase 1B that could be triggered earlier than planned, depending on O&M needs.

- **Phase 2 (2030-2032) Biosolids Greenhouse and Dewatering Upgrades:** The dewatering upgrades and greenhouse for Class A biosolids would be triggered by loss of local Class B biosolids land application sites and changes in biosolids management regulatory requirements. The City has lost 1,426 acres of their existing 1,700 acres of approved land application sites due to development or other restrictions at the Eastern Oregon Regional Airport and the Airport Industrial Park. They will acquire sites as needed to continue to land apply Class B biosolids since DEQ will allow additional site authorizations without requiring a permit modification. The City will upgrade to Class A biosolids production if future regulations limit Class B application.

- **Phase 2 (2030-2032) Building Upgrades and Renovations:** Construction of the new Administration Annex Building will be triggered by loss of the County lab and the need to provide a location for local testing of water quality for private wells and other private lab services re-established locally using the WWTRRF laboratory.

- **Phase 3 (2038-2040) WWTRRF Recycled Water Expansion:** Upgrades to produce Class C Recycled Water and implement a water recycling program would be triggered by an update of the Umatilla River Temperature TMDL eliminating the NCC criteria and potentially resulting in a much lower excess thermal load limit than currently anticipated. It is anticipated the Umatilla Temperature TMDL will be updated in the next 8 years, after which new temperature limits would be included in the City's next NPDES permit renewal.

9.3 Preliminary Financial Plan

The Preliminary Financial Plan includes the funding requirements for each phase and year for the Recommended Plan, an overview of the current wastewater utility usage fees/rates, and preliminary funding options. **Table 9-2** at the end of this section details the yearly costs by project and phase.

9.3.1 Current WW Rates and System Development Charges

The current wastewater user rates for service connections are described below in **Table 9-3**. No wastewater system development charges (SDC's) are implemented at this time. City Council adopted SDC methodology in 2017 for collection system improvements; however, no rate analysis has yet been conducted for the WWTRRF. Wastewater rates and SDC updates will be performed after the completion of the Collection System Master Plan Update in 2020.

Table 9–3
Pendleton Wastewater User Rates

Sewer Base Rates		In City		Out of City
Residential		$43.25		$64.90
Transient				
1st Unit		$43.25		$64.90
Each and every unit		$22.20		$33.20
Commercial (Light)				
Minimum charge (1,100 cubic feet)		$43.25		$64.90
Per additional 100 cubic feet		$ 2.40		$ 3.70
Commercial (Heavy)				
Flow (per 100 cubic feet)		$ 1.25		$ 2.10
B.O.D. (per lb)		$ 1.10		$ 1.75
Suspended Solids (per lb)		$ 1.25		$ 2.10
RV Spaces (Each Unit)		$10.95		$16.55
Wholesale				
Base Rate		$47.55		
Usage		$ 2.65		
Hotel		$24.45		
RV Space		$12.05		
Septic Waste Disposal				
First 500 gallons		$63.10		
Each additional 500 gallons		$63.10		
Service Connections	**No Pavement**	**With Sidewalk No Pavement**	**With Pavement**	**With Sidewalk and Pavement**
Service Size				
¾"	$1,236.55	$1,866.75	$2,260.55	$2,890.65
1"	$1,378.35	$2,008.45	$2,402.35	$3,032.45
1 ½"	$2,008.45	$2,638.60	$3,032.45	$3,662.55
2"	$2,764.65	$3,394.80	$3,788.60	$4,418.70
Over 2"	(See note 1)			
Cross Connection (underground sprinklers)				
Permit Fee			$44.50	
First Inspection and/or test of backflow			$29.70	

Notes:

1. Actual cost of field labor, materials, plus 40 percent (for overhead). A full deposit based on an estimated cost is required before installation.

9.3.2 Preliminary Funding Options

Potential funding sources for completing the Recommended Plan may include some combination of the following:

- Local savings from near-term rate increases to help fund future construction;
- Develop Wastewater SDCs;
- Revenue Bonds;
- General Obligation Bonds;
- State and Federal Loan Programs:
    1. Clean Water State Revolving Fund;
    2. Water Infrastructure Finance and Innovation Act (WIFIA);
    3. Business Oregon – Infrastructure Finance, Water Wastewater Fund; and
- Energy Trust of Oregon Rebates and Incentives.

For the various loan programs, the City would be required to repay loans through user rates, wastewater SDCs, property taxes, or a combination of these revenue options determined by the City. The City is required to comply with the terms and conditions of grants in order to be eligible for grant funding, however, the money provided by the grants does not need to be repaid.

9.3.2.1 Local Savings from Near-Term Rate Increases

By increasing wastewater rates in the near-term, a significant amount of revenue can be saved to help fund future construction. These immediate changes are helpful for the City to generate funds without interest rates or to pay off previously acquired loans. In order raise enough funds for the Recommended Plan while also minimizing the economic burden on the community, a formal Rate Study should be conducted to determine the appropriate wastewater rate increases.

9.3.2.2 Revenue Bonds

Revenue Bonds are supported by revenue specifically generated from wastewater system usage. The implementation of a system development charge or general increase of user rates is the mechanism relied upon to establish the credit of the issuing municipality. Since revenue bonds are dependent upon the income of the specific project, it is a higher risk than general obligation bonds and therefore typically a higher rate of interest.

9.3.2.3 General Obligation Bonds

General obligation bonds are loans repaid through a variety of tax sources. Property taxes are a common form of credit for this type of bond.

9.3.2.4 State and Federal Grant/Loan Programs

Several State and Federal grant and loan programs exist to assist communities with infrastructure improvement projects. These include:

- Clean Water State Revolving Fund;
- Business Oregon – Infrastructure Finance: Water Wastewater Fund; and
- Water Infrastructure Finance Innovation Act.

9.3.2.4.1 Clean Water State Revolving Fund

Established in 1987, the CWSRF is a financial assistance program that uses federal and state funds to provide low-interest loans for planning, design, and construction of municipal wastewater facilities that have NPDES Permits for surface water discharges to Waters of the United States. Loans from the Clean Water State Revolving fund have repayment periods of up to 30 years. States may even provide up to a fixed percentage of funds as grants, principal forgiveness, or negative interest rate loans. Loans include an annual fee of 0.5 percent of the outstanding balance.

The CWSRF also has specific amount of program funds for financing green infrastructure, water efficiency improvements, energy efficiency improvements, or environmentally innovative activities.

More information on the DEQ CWSRF loan program is available at:

> Oregon Department of Environmental Quality
> 700 NE Multnomah, Suite 600
> Portland, OR 97232-4100
>
> Primary Contact: Tiffany Yelton Bram
> Phone: 503-229-5219
> Website:
> https://www.oregon.gov/deq/wq/cwsrf/Pages/ApplicationAssistance.aspx

9.3.2.4.2 Business Oregon – Infrastructure Finance, Water Wastewater Fund, Special Public Works Fund

Business Oregon provides financing opportunities for the design and construction of public infrastructure needed to comply with the Clean Water Act. The Fund is primarily a loan program, but some grant opportunities are available for specific financing needs. The maximum loan amount is $10.0 million per project with terms up to 25 years. The maximum grant is up to $20,000 per project for municipalities with populations of less than 15,000 people for the purpose of planning, engineering, and economic investigations related to an eligible construction project.

9.3.2.4.3 Water Infrastructure Finance and Innovation Act (WIFIA)

The WIFIA program is a pool of financing set up through the EPA to provides loans for water, wastewater and general infrastructure project. For local government entities of communities with less than 25,000 people the project costs must exceed $5 million. It is important to apply before June 1st to ensure the best chance for funding. WIFIA loans may have a length of up to 35 years. WIFIA loans can fund a maximum of 49 percent of the eligible project costs.

The Water Infrastructure Finance and Innovation Act (WIFIA) is a pool of financing set up through the EPA, which covers a range of water, wastewater, and general infrastructure projects. In 2018, the program set aside $5.5 billion in credit assistance for water and wastewater infrastructure investment. Fifteen percent of the funds are set aside for municipalities smaller than 25,000 people; however, if these funds are not allocated by June 1, they will be used for other applicable projects. In 2018 small projects accounted for less than 1 percent of the awarded funds. Because smaller projects are underrepresented out of total applications, it is likely they will be more favorable.

The borrower must have a form a dedicated source of revenue to repay the loan. This credit can be in the form of Revenue, General Obligation Bonds, or approved funding mechanism. Since Pendleton is an underrepresented applicant, the application process will have favorable award probabilities.

9.3.2.5 Energy Trust of Oregon (ETO)

The Energy Trust of Oregon provides incentive dollars or rebates for more energy efficient equipment installations. The capitol cost difference between the energy efficient case and the base case are considered eligible for the rebate if the associated energy savings have a payoff period of less than 15 years. Up to 50 percnet of the cost difference between the base case and the energy efficient case is eligible for rebate up to $500,000 dollars per project with a limit of $1,000,000 annually per site.

9.3.2.6 Summary of Loan and Grant Programs

Table 9-4 contains a summary of the City's eligibility for loan and grant programs based on the above listed funding programs.

Table 9-4
WW Funding Eligibility Overview

Program	Eligibility		
	Loan Type	***Interest Rates*** (Jan 1 – March 31, 2019)	***Repayment Period***
Oregon Department of Environmental Quality Clean Water State Revolving Fund (CWSRF)	*Planning:*	*1.06 %*	*5-years*
	Design/Construction:	*1.06% to 2.84%*	*5-years to 30-years*
	Fees: 0.5% of the unpaid balance annually		
	The CWSRF also provides communities a set-aside reserve for funding green projects.		
Business Oregon Infrastructure Finance: Water/Wastewater Fund	Maximum Loan Amount: $60,000 (technical assistance financing)		

Program	Eligibility
	Maximum Loan Amount: $10,000,000 (combination of direct and/or bond funded loans Grant Eligibility: Technical assistance financing is available to municipalities with populations of less than 15,000 people.
Special Public Works Fund (SPWF)	Maximum Loan Amount: $10,000,000 Maximum Loan Term: 25-years Planning Grants: $60,000 max Development Project Grants: not to exceed 85% per eligible job or $500,000 per project Eligible entities: Cities, Counties, Special Districts, Ports, Tribal Councils, Domestic water supply districts, water authorities, sanitary districts, sanitary authority, joint water and sanitary authority, county service districts, airport districts Allowable Project Costs: Project management expenses, engineering design, architectural work, surveying, and construction inspections, public facilities that are essential to support continuing and expanded economic development activity. Interest Rate: set by Business Oregon based on market conditions for bonds with similar terms and credit characteristics.
Environmental Protection Agency Water Infrastructure Finance Innovation Act (WIFIA)	Maximum final maturity date from substantial completion: 35 years Maximum time that repayment may be deferred after substantial completion of the project: 5 years Allowable Project Costs: Planning, engineering, and economic investigations related to an eligible construction project Percentage of Total Project Costs: WIFIA may finance up to 49% of the total project costs. WIFIA and CWSRF combined may finance up to 80% of total project costs. *NEPA, Davis-Bacon, American Iron and Steel, and all other federal cross-cutter provisions apply.
Energy Trust of Oregon Wastewater Incentives	Energy Trust will pay up to $0.32/annual kWh saved or 50% of eligible project costs, whichever is less. Maximum Rebate: $500,000 dollars per project with a limit of $1,000,000 annually per site.

9.3.3 Next Steps Related to Funding

The impact of the WWTRRF Recommended Plan on wastewater rates will depend on combination of decisions regarding the wastewater utility rates, SDCs, City levied taxes, and external funding agencies. Based on the City's wastewater utility rates, it is anticipated the project will be funded by loans. The CWSRF loan program has the lowest interest rates and most favorable terms and conditions. SDCs, Revenue and/or General Obligation Bonds will be necessary to repay and establish credit for the loan program(s).

The following next steps are recommended to finalize the financial plan for the WWTRRF Facilities Plan Recommended Upgrades:

1. Update Wastewater Collection System Master Plan to determine total funding needed;
2. Complete a Wastewater Utility Rate Study to consider setting new utility rates, SDCs;
3. Request a “One-Stop” Financing Roundtable with Business Oregon;
4. Prepare loan applications to submit to the above stated funding agencies; and
5. Pursue potential grants with the above stated funding agencies.

City of Pendleton

WWTRRF Facility Plan Update

Table 9-2

Capital Improvements Program Summary

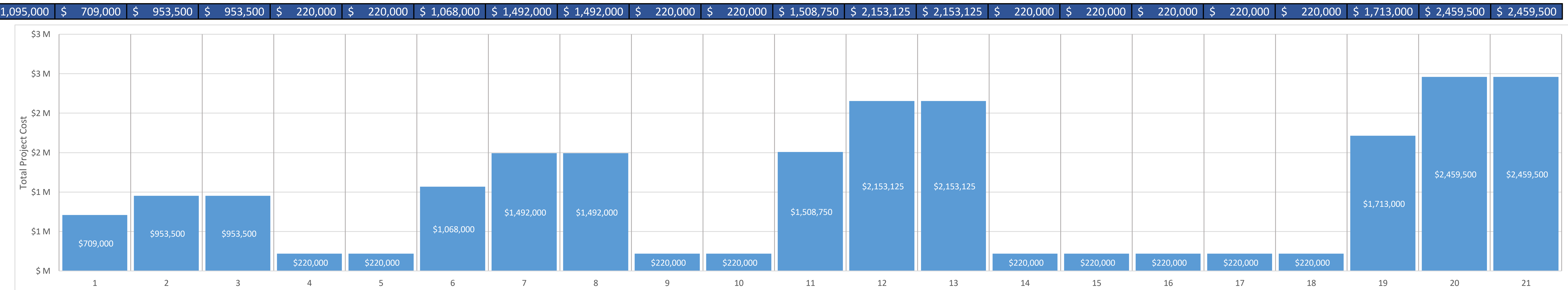
Description	O&M Upgrades	Phase 1 A Subtotal	Phase 1 B Subtotal	Phase 2 Subtotal	Phase 3 Subtotal	Total CIP Cost Estimate
Annual Condition Assessment O&M Upgrades	$ 4,620,000					$ 4,620,000
Headworks and Dewatering Building Heat		$ -	$ -	$ -	$ 160,000	$ 160,000
Primary Clarifiers		$ -	$ 284,000	$ -	$ -	$ 284,000
RPS and IPPS		$ 120,000	$ -	$ -	$ -	$ 120,000
New Smaller Blower w/ VFD		$ 136,000	$ -	$ -	$ -	$ 136,000
Secondary Clarifiers		$ -	$ 1,504,000	$ -	$ -	$ 1,504,000
Disinfection Conversion		$ 84,000	$ -	$ -	$ -	$ 84,000
Chlorine Contact Chamber		$ -	$ 368,000	$ -	$ -	$ 368,000
Final Effluent Flow Measurement		$ -	$ -	$ -	$ 88,000	$ 88,000
Class C Recycled Water		$ -	$ -	$ -	$ 3,256,000	$ 3,256,000
Primary Sludge Pumps		$ -	$ -	$ 272,000	$ -	$ 272,000
Primary Digester Complex		$ 136,000	$ -	$ -	$ -	$ 136,000
Secondary Digester Complex		$ 1,016,000	$ -	$ -	$ -	$ 1,016,000
Digester Gas Storage		$ -	$ -	$ -	$ 1,032,000	$ 1,032,000
Digester Gas Moisture Reduction		$ -	$ -	$ -	$ 92,000	$ 92,000
Digester Gas Flare		$ -	$ -	$ -	$ 568,000	$ 568,000
Dewatering Upgrades		$ -	$ -	$ 1,243,000	$ -	$ 1,243,000
Biosolids Storage Greenhouse		$ -	$ -	$ 2,292,000	$ -	$ 2,292,000
Admin/Lab Remodel		$ -	$ -	$ -	$ 776,000	$ 776,000
Admin Annex Building		$ -	$ -	$ 1,348,000	$ -	$ 1,348,000
New Storage Building		$ -	$ 748,000	$ -	$ -	$ 748,000
Main Shop Expansion		$ 280,000	$ -	$ -	$ -	$ 280,000
Site Access Control and Protective Systems		$ 136,000	$ -	$ -	$ -	$ 136,000
Electrical Improvements		$ 48,000	$ -	$ -	$ -	$ 48,000
SCADA Upgrades		$ -	$ 488,000	$ -	$ -	$ 488,000
Totals	$ 4,620,000	$ 1,956,000	$ 3,392,000	$ 5,155,000	$ 5,972,000	$ 21,095,000

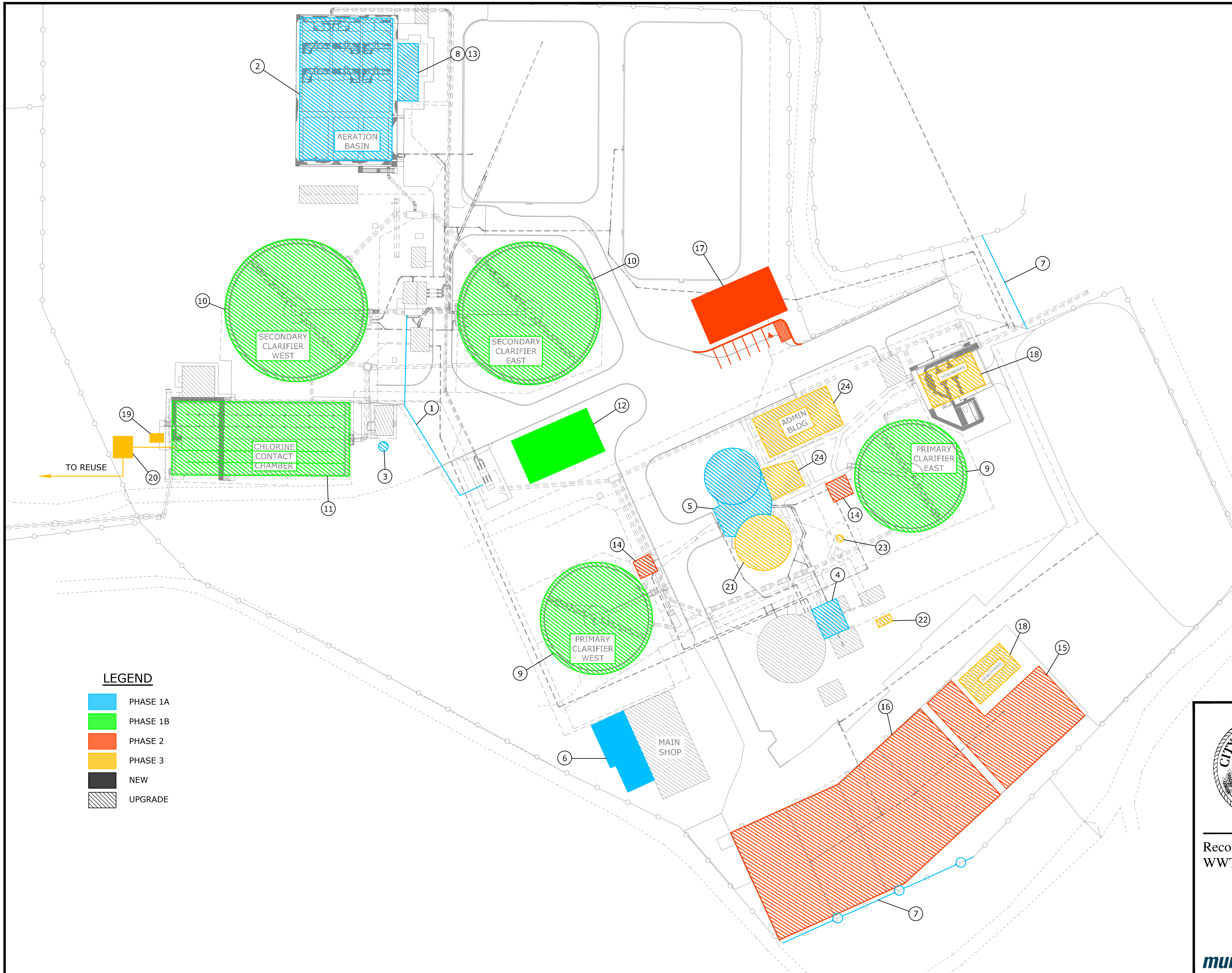
Description	Phase 1 A 2020	Phase 1 A 2021	Phase 1 A 2022	2023	2024	Phase 1 B 2025	Phase 1 B 2026	Phase 1 B 2027	2028	2029
Annual Condition Assessment O&M Upgrades	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000
Headworks and Dewatering Building Heat	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Clarifiers	$ -	$ -	$ -	$ -	$ -	$ 71,000	$ 106,500	$ 106,500	$ -	$ -
RPS and IPPS	$ 30,000	$ 45,000	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New Smaller Blower w/ VFD	$ 34,000	$ 51,000	$ 51,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Clarifiers	$ -	$ -	$ -	$ -	$ -	$ 376,000	$ 564,000	$ 564,000	$ -	$ -
Disinfection Conversion	$ 21,000	$ 31,500	$ 31,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Chlorine Contact Chamber	$ -	$ -	$ -	$ -	$ -	$ 92,000	$ 138,000	$ 138,000	$ -	$ -
Final Effluent Flow Measurement	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Class C Recycled Water	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Sludge Pumps	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Digester Complex	$ 34,000	$ 51,000	$ 51,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Digester Complex	$ 254,000	$ 381,000	$ 381,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Gas Storage	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Gas Moisture Reduction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Gas Flare	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dewatering Upgrades	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Biosolids Storage Greenhouse	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Admin/Lab Remodel	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Admin Annex Building	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New Storage Building	$ -	$ -	$ -	$ -	$ -	$ 187,000	$ 280,500	$ 280,500	$ -	$ -
Main Shop Expansion	$ 70,000	$ 105,000	$ 105,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Site Access Control and Protective Systems	$ 34,000	$ 51,000	$ 51,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Electrical Improvements	$ 12,000	$ 18,000	$ 18,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SCADA Upgrades	$ -	$ -	$ -	$ -	$ -	$ 122,000	$ 183,000	$ 183,000	$ -	$ -
Totals	$ 709,000	$ 953,500	$ 953,500	$ 220,000	$ 220,000	$ 1,068,000	$ 1,492,000	$ 1,492,000	$ 220,000	$ 220,000

Description	Phase 2 2030	Phase 2 2031	Phase 2 2032	2033	2034	2035	2036	2037	Phase 3 2038	Phase 3 2039	Phase 3 2040
Annual Condition Assessment O&M Upgrades	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000
Headworks and Dewatering Building Heat	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 40,000	$ 60,000	$ 60,000
Primary Clarifiers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
RPS and IPPS	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New Smaller Blower w/ VFD	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Clarifiers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Disinfection Conversion	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Chlorine Contact Chamber	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Final Effluent Flow Measurement	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 22,000	$ 33,000	$ 33,000
Class C Recycled Water	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 814,000	$ 1,221,000	$ 1,221,000
Primary Sludge Pumps	$ 68,000	$ 102,000	$ 102,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Primary Digester Complex	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Secondary Digester Complex	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Digester Gas Storage	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 258,000	$ 387,000	$ 387,000
Digester Gas Moisture Reduction	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 23,000	$ 34,500	$ 34,500
Digester Gas Flare	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 142,000	$ 213,000	$ 213,000
Dewatering Upgrades	$ 310,750	$ 466,125	$ 466,125	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Biosolids Storage Greenhouse	$ 573,000	$ 859,500	$ 859,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Admin/Lab Remodel	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 194,000	$ 291,000	$ 291,000
Admin Annex Building	$ 337,000	$ 505,500	$ 505,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New Storage Building	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Main Shop Expansion	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Site Access Control and Protective Systems	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Electrical Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
SCADA Upgrades	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Totals	$ 1,508,750	$ 2,153,125	$ 2,153,125	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 220,000	$ 1,713,000	$ 2,459,500	$ 2,459,500

<u>*Notes:*</u>

- *All costs in 2019 dollars*
- *For planning purposes, future costs should be increased for cost escalation (inflation) based on Engineering News Record - Construction Cost Index or other index preferred by the City.*
- *Cost estimates represent a Class 5 budget estimate in 2019 dollars, as established by the American Association of Cost Engineers (AACE), with a level of accuracy range between -30 to +50 percent.*





PHASE 1A

1. RPS AND IPPS
2. NEW SMALLER BLOWER W/ VFD
3. DISINFECTION CONVERSION
4. PRIMARY DIGESTER COMPLEX
5. SECONDARY DIGESTER COMPLEX
6. MAIN SHOP EXPANSION
7. SITE ACCESS CONTROL AND PROTECTIVE SYSTEMS
8. ELECTRICAL IMPROVEMENTS

PHASE 1B

9. PRIMARY CLARIFIERS
10. SECONDARY CLARIFIERS
11. CHLORINE CONTACT CHAMBER
12. NEW STORAGE BUILDING
13. SCADA UPGRADES

PHASE 2

14. PRIMARY SLUDGE PUMPS
15. DEWATERING UPGRADES
16. BIOSOLIDS STORAGE GREENHOUSE
17. ADMIN ANNEX BUILDING

PHASE 3

18. HEADWORKS AND DEWATERING BUILDING HEAT
19. FINAL EFFLUENT FLOW MEASUREMENT
20. CLASS C RECYCLED WATER
21. DIGESTER GAS STORAGE
22. DIGESTER GAS MOISTURE REDUCTION
23. DIGESTER GAS FLARE
24. ADMIN/LAB REMODEL

40 20 0 40 80
SCALE IN FEET

FIGURE 9-1

WWTRRF Facility Plan Update

Recommended Plan
WWTRRF Site Plan

JUNE 2020

17-2019.403

murraysmith

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