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The Dalles Wastewater Treatment Plant Facility Plan Update

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Prepared for

City of The Dalles
313 Court Street
The Dalles, Oregon 97058

K/J Project No. 1576016*00

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Executive Summary

ES 1.1 Introduction and Background

The City of The Dalles (City) completed a Wastewater Facility Master Plan Update (Master Plan) in March of 2013 which evaluated the existing wastewater treatment plant (WWTP) infrastructure and presented a 20-year Capital Improvement Plan (CIP). That CIP provided the City the guidance and direction needed to continue to meet their National Pollutant Discharge Elimination System (NPDES) permit requirements and treatment reliability standards as the service area continues to grow. With this growth, domestic and industrial waste streams to the plant are also anticipated to increase.

Currently, the plant provides secondary treatment and ultraviolet (UV) disinfection followed by discharge to the Columbia River. Current dry weather flows range from 2.3-4.15 million gallons per day (MGD) with a current Peak Instantaneous Flow (PIF) of 7.7 MGD. As the facility expands, PIF flows are projected to be 10.8 MGD in 2022, 11.9 MGD in 2030, and 13.2 MGD at buildout.

The CIP presented in the Master Plan was comprised of three phases of construction. The initial construction phase was intended to address the influent pumping firm capacity shortfalls and provide necessary improvements to the headworks screening and grit system to accommodate the 2030 projected PIF, with the capability for expansion to build-out flows. Additionally, the existing Digester #2 was expected to be converted to an active digester, likely by replacing the floating cover with a fixed roof and adding gas handling equipment, heating, and mixing. The project was also expected to incorporate site aesthetics to visually shield it from the surrounding areas through the use of walls, screens, and planting areas along three sides of the facility.

Since the development of this first improvement project envisioned above, the City elected to include a conceptual design phase (Phase 1A) which includes evaluation of potential alternative project configurations, and phasing to maximize project value. The result of this Phase 1A has been a modified configuration of the 2015 construction project as well as the subsequent improvement phases recommended by the Facility Plan.

This Facility Plan Update was developed to document these modifications. This Update is not intended to replace the significant efforts in previous planning studies, but updates certain sections of the approved March 2013 Facility Plan to address the modifications to the improvement plan phases.

The Wastewater Treatment Plant Facility Plan Update includes the following Sections:

- Introduction and Background
- Updated Wastewater Characteristics
- Unit Process Evaluations and CIP Alternatives
- Project Alternatives
- Updated Recommended Plan Estimated Costs

ES 1.2 Updated Wastewater Characteristics

The estimated wastewater flow and load from the Master Plan (Carollo 2013) included flow and load projections through the year 2030. By the time construction of the first improvement phase is complete, more than three years will have passed since the Master Plan was published. In order to ensure that design criteria for the proposed wastewater treatment facility will meet the City's needs through a true 20-year design period, the flow and load projections have been extended through 2037. These flow and load values, Tables ES.1 and ES.2, respectively, are the basis for plant upgrades.

Table ES.1: Wastewater Flow Summary and 2037 Projection

	2013 Master Plan Values				
	PF	**2011**	**2022**	**2030**	**2037**
Population[(1)]	-	15,084	16,088	16,819	17,481
BWF	1.00	1.99	3	3.5	4.0
AAF (MGD)	-	2.3	3.5	4	4.4
ADWF (MGD)	1.02	2.04	3.1	3.6	4.1
AWWF (MGD)	1.28	2.56	3.9	4.5	5.1
MMDWF (MGD)	1.23	2.46	3.7	4.3	4.9
MMWWF (MGD)	1.70	3.38	5	5.7	6.8
PDAF (MGD)	3.93	6.1	8.5	9.3	10.0
PIF (MGD)	7.27	7.7	10.8	11.9	13.2

Abbreviations:

AAF = annual average flow
ADWF = average dry weather flow
AWWF = average wet weather flow
BOD = biochemical oxygen demand
BWF = base wastewater flow
MGD = million gallons per day
MMDWF = maximum month dry weather flow
MMWWF = maximum month wet weather flow
PDAF = peak daily average flow
PF = peaking factor
PIF = peak instantaneous flow

Notes:

1. Population presented has been realigned with US Census and City accepted population projections. See Section 2.2 for discussion.

Table ES.2: Wastewater Load Summary and 2037 Projection

BOD_5 (lb/day)	2011	2022	2030	2037
Average annual	4150	5100	5800	6500
Maximum month	5700	7000	8000	8900
Maximum week	8500	10400	11900	13300
Peak day	10600	13000	14800	16600
TSS (lb/day)				
Average annual	3200	3900	4400	5000
Maximum month	4300	5200	5900	6700
Maximum week	6200	7600	8500	9700
Peak day	6700	8200	9200	10500

Abbreviations:

lb/day = pounds per day
TSS = total suspended solids

ES 1.3 Unit Process Evaluations

Throughout the development of this Facility Plan Update and this Phase 1A project, the Project team worked with City staff to develop a better understanding of the existing system, the operations, and the WWTP's successes and its shortfalls. Through this collaboration, unit processes across the plant were investigated to determine where both short term and long term improvements were required and which improvements maximized the investment value. The progressive-design-build process, under which this project is being delivered, allowed and facilitated this effort, allowing both the Owner and Project team to work collaboratively to more comprehensively develop the project objectives and evaluate the available improvement solutions.

This process resulted in development of unit process alternatives to further investigate improvement options that could meet project design criteria while providing equivalent or superior performance and reliability to the City's overall CIP. Unit process evaluations focused on the Phase 1 improvements, but also incorporated the overall needs of the WWTP through the 20-year planning horizon. The objective of these evaluations was to develop a CIP that addresses the growth, permit, and performance needs of the WWTP while maximizing the City's investment.

Alternative evaluation recommendations and decision-making was developed through the use of a Choosing by Advantage (CBA) methodology. This CBA process is founded on the fundamental rule of decision-making; "Decisions must be made on the importance of advantages." Through this fundamental concept, each alternative's attributes were developed based on six fundamental Factors. The advantages of each alternative compared to the Factors were then identified with the most important advantage being scored positively (higher) while less advantageous alternative Factors were scored low. Weighting Factors, developed through discussions with City staff, were then used to calculate a numeric score representative of the total importance of each alternative's advantages.

Advantageous unit process alternatives were then assembled into complete mulit-phased CIP alternatives to develop an overall improvement plan for evaluation. A total of four CIP alternative plans were developed with overall CBAs completed for each. A summary of the Recommended Plan resulting from this process is the Alternative 3C option which is summarized as follows:

ES 1.3.1 Influent Pump Station and Headworks

Phase 1 improvements to address the firm capacity issues at the headworks will include installation of three new pumps within the existing influent pump station dry well. No modifications to the wet well or influent gravity pipeline are necessary. The three pumps will be sized to provide firm capacity to meet the 2030 PIF with capacity to meet 2037 PIF by replacing the pump impellers.

Screening and grit upgrades include repurposing the existing grit system footprint and constructing three parallel influent channels. Two new basket or rotary drum style screens can be installed with space provisions for a future third screen, if needed. Grit system improvements include a new vortex style grit system located adjacent to the existing building footprint which would include a new grit pump, cyclone, and classifier.

ES 1.3.2 Secondary Process

The Master Plan recommends construction of a new process basin located adjacent to the existing basin during Phase 3 of the Master Plan CIP. As part of this Facility Plan update, process modeling was used to examine the extent to which optimization of the existing treatment basin could extend the capacity within the existing basin footprint, delaying or eliminating the need for an additional process basin as recommended by the Master Plan. Influent characterization completed through weekly influent sampling was used in conjunction with historical operating data to develop and calibrate the process model.

The optimization process and subsequent modeling simulated splitting the basin into two trains, with each train modifying the existing complete-mix basin and configuring it into a plug-flow type basin. During summer months, the basin would operate in conventional activated sludge process but include an anoxic zone upstream of the aerobic zone in a Modified Ludzack-Ettinger process (MLE). During winter months, the basin would operate in step-feed contact stabilization process targeting BOD removal during the higher flow events.

The optimization of this process was found to be favorable, maintaining the effluent criteria quality within the 2037 planning horizon summarized below.

Table ES.3: Process Modeling Results

Target Effluent Criteria		
Parameter	**Summer Effluent Target**	**Winter Effluent Target**
Effluent $CBOD_5$ (mg/l)	<20	<30
Effluent TSS (mg/l)	<20	<30
Effluent Ammonia-N (mg/l)	<5	NA
Effluent pH	>6, <9	>6, <9
Effluent $CBOD_5$ (ppd)	<700	<1000
Effluent TSS (ppd)	<700	<1000

Notes / Abbreviations:

Summer: AAF and average annual BOD/TSS Loads
Winter: MMWWF and Max month BOD/TSS Loads
CBOD = carbonaceous biochemical oxygen demand
mg/l = milligrams per liter
ppd = pounds per day

While the secondary process upgrades were not projected until Phase 3 construction, the optimization of the basin is estimated to be significantly less expensive compared to building the proposed new treatment basin. Given the benefits of this optimization, the recommended plan replaces the Master Plan proposed improvement with the optimization project to maintain operations within the existing footprint.

ES 1.3.3 Solids Improvements

Thickened waste activated sludge from the process basin will be digested in a new 180,000 gallon anaerobic digester. The digester is sized to operate in series with the existing primary digester. The current sludge storage basin can continue to be used as a backup sludge storage vessel; however, no additional improvements to the float lid or mechanical systems are recommended.

ES 1.3.3.1 Alternate Recommended Plan (Solids Improvements)

While the primary filtration component is not included in the Baseline Recommended Plan, an Alternate Recommended Plan is provided and presented as Alternative 3D. This alternative builds on the Recommended Plan, but includes the larger digester to accommodate WWTP solids and additional volatile solids through FOG, food waste, or carbon diversion.

Carbon diversion, in this case through primary filtration, is a process in which influent is screened prior to the secondary process basin, redirecting carbon load to the digester rather than the process basin. This process concept is relatively new, but has been shown to reduce loading to the secondary processes resulting in decreased energy demands and increased process capacity. The redirected carbon into the digester also increases digestion, resulting in increased gas production. In addition to these benefits, renewable energy programs have been

interested in piloting these installations and providing seed money or incentive money to help offset initial costs.

This carbon diversion component can continue to be evaluated through the preliminary design phase. A number of filter manufacturers have shown interest in an onsite pilot opportunity to showcase the technology and this concept. This type of onsite demonstration test would allow further development of this installation option and expected costs and allow potential funding agencies an opportunity to see the assembly and initial results.

ES 1.3.4 Aesthetic Improvements

The WWTP is situated within the heart of the Historic Downtown Redevelopment District, an area seeing revitalization through strategic planning and redevelopment. As this revitalization occurs, the areas surrounding the plant are becoming destination draws, attracting the public towards the downtown district and subsequently towards the treatment plant. In order to ensure the plant does not inhibit or detract from this revitalization, the City is interested in reducing the perceived presence of the plant. This Facility Plan Update includes painting and vegetative concepts as well as screen concepts in which art themes or scenes are applied to screening fences. Three screening concepts have been included for consideration and will be further refined through discussions with City staff, City Council, and other identified stakeholders.

ES 1.4 Recommended Plan Estimated Costs

The cost to construct the Recommended Plan is summarized in Table ES.4. The estimate represents the Constructor's opinion of probable costs using current and best available information, industry standard material price escalation, and the current bidding climate. Detailed estimates were developed for each unit process. Where unit process recommendations were not modified from the Master Plan, for example, the Secondary Clarifier, the estimate costs were developed based on the scope of work described in the Master Plan. All costs presented for both the Recommended Plan and the 2013 Master Plan have been updated to reflect current construction costs. All cost estimates are presented in July 2015 dollars with a referenced Construction Cost Index (CCI) of 10,037.

The estimated total Phase 1 project cost is approximately $6.5 million and the estimated total treatment plant CIP is $15.2 million. The level of accuracy is -20%/+30% creating an expected Phase 1 project cost between $5.2 to $8.4 million dollars.

Table ES.4: Constructor's Estimate of Probable Construction Costs

Item Description		Total
Influent Pump Station		$ 503,105
Screening and Grit		$ 1,197,676
Digester		$ 1,806,395
Site Aesthetics		$ 150,000
	SUBTOTAL	**$ 3,657,175**
Table 5.1 Applied Markups		$ 2,255,885
Phase 1A Services		$ 132,274
Phase 1B Services (estimated)		$ 487,000
Phase 1 Total		**$ 6,532,000**
Phase 2		**$ 5,927,000**
Phase 3		**$ 1,482,000**
Future Phases		**$ 1,291,000**
Total CIP Cost		**$ 15,232,000**

ES 1.**5** Recommended Implementation Schedule

The preliminary project schedule for the implementation of Phase 1 of the Recommended Plan is as follows:

- Complete Design to 80 percent (%) – October through February 2016
- Contracts, Permits, & Notice to Proceed – February 2016 through April 2016
- Start Construction – May 2016
- Complete Construction (9 months) – January 2017.

ES 1.**6** Summary of the Facility Plan Update

The progressive design-build delivery approach facilitated the collaborative exploration and development of project enhancements, resulting in the development of the Recommended Plan. This Recommended Plan maximizes the City's existing assets, utilizing the remaining service life in the Influent Pump Station building, the existing grit and screening areas, and the process basin. This Plan address the required scope elements of the CIP needed to continue to meet their NPDES permit requirements and treatment reliability standards as the service area continues to grow while addressing previously known and newly identified plant insults.

The Plan addresses the shortcomings of the solids storage system, including construction of a digester that both eliminates the need for construction of the Master Plan recommended sludge storage basin while accommodating outside waste streams needed to support a future cogeneration installation and provides the ability to secure outside funding sources associated with renewable energies that could help offset the costs of digester volume expansions.

A phase by phase comparison of the Master Plan CIP and this Recommended Plan is provided in Table ES 5. As shown, initial Phase 1 costs in this Recommended Plan are less than estimated Phase 1 costs proposed in the Master Plan. The $15.2 million total project costs include an optional $1.17 million dollar project to address poor hydraulics at the ultraviolet disinfection system included in the Future Phase. Should this be omitted, the overall CIP represents approximately $3.6M in savings.

Lastly, projects identified in Phases 3 and beyond should continue to be monitored to establish appropriate timing. Additional value engineering and cost refinement are recommended as these project scopes are better defined.

Table ES.5: Summary Comparison of Recommended Plan Costs

	2013 Master Plan[1]	2015 Facility Plan Update
Phase 1	$ 7,799,000[2]	$ 6,532,000[2]
Phase 2	$ 4,732,000	$ 5,927,000
Phase 3	$ 5,170,000	$ 1,482,000
Future Phase		$ 1,291,000[3]
Total	**$ 17,700,000**	**$ 15,232,000**

Notes:

1. Revised Master Plan costs to reflect current construction costs, July 2015 dollars, CCI = 10,037
2. Includes Phase 1A design services contract
3. $1.17M in optional hydraulic improvements at Ultraviolet/Effluent Pump Station (UV/EPS)