Willamette Water Supply System
Raw Water Facilities

Conditional Use
Willamette River Greenway Conditional Use
Flood Plain Permit
Site Design Review
Significant Resource Overlay Zone Map Refinement
Significant Resource Impact Report Review
Type C Tree Removal Plan and Tree Permit

Prepared for: Willamette Water Supply System Commission

Prepared by: Angelo Planning Group

Submitted to City of Wilsonville Planning Division
Originally Submitted: May 3, 2019
Revised and Submitted: July 25, 2019
Revised and Submitted: November 13, 2019

City of Wilsonville
Exhibit B1 DB19-0019 et al

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Application Team for Willamette Water Supply Program: Willamette Water Supply System Raw Water Facilities

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Application Summary Information for Willamette Water Supply Program: Willamette Water Supply System Raw Water Facilities

Address:	10350 SW Arrowhead Creek Lane, Wilsonville, OR, 97070
Tax lot IDs:	31W 23B 01700 (Lot 1700), 01800 (Lot 1800), and 01900 (Lot 1900)
Tax lot Acres:	4.95 acres (Lot 1700), 11.1 acres (Lot 1800), and 20.1 acres (Lot 1900)
Current Zoning:	Residential (R) (Lot 1700) Residential Agricultural Holding (RA-H) (Lot 1800) RA-H and Planned Development Industrial (PDI) (Lot 1900)
Comprehensive Plan:	Residential and Industrial
Applications Submitted for:	Type III Conditional Use, Willamette River Greenway Conditional Use, Site Design Review, Significant Resource Overlay Zone Map Refinement, Abbreviated Significant Resource Impact Report Review, and Tree Removal Permit Type II Flood Plain Permit

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Exhibit C: Willamette River Water Treatment Plant 2017 Master Plan Update (February 2018) [excerpts]

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Exhibit E: U.S. Army Corps of Engineers Permit and Oregon Department of State Lands Permit

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Exhibit W: Pre-Application Conference Notes from City of Wilsonville Staff

Exhibit X: Willamette Water Supply Program Facility On-Site Alternatives Analysis Memorandum (September 27, 2018)

ACRONYMS AND ABBREVIATIONS

AAN	American Association of Nurserymen
ADA	Americans with Disabilities Act
BFE	Base Flood Elevation
BPA	Bonneville Power Administration
CFR	Code of Federal Regulations
DBH	diameter at breast height
DEA	David Evans & Associates
DEQ	(Oregon) Department of Environmental Quality
DOGAMI	Department of Geology and Mineral Industries
DRB	Development Review Board
DSL	(Oregon) Department of State Lands
ESEE	Economic, Social, Environmental and Energy (Analysis)
FEMA	Federal Emergency Management Agency
FIA	Federal Insurance Administration
FIRM	Flood Insurance Rate Maps
GMP	Guaranteed Maximum Price
HVAC	heating, ventilation, and air conditioning
JPA	Joint Permit Application
JWC	Joint Water Commission
LED	light-emitting diode
LWI	Local Wetland Inventory
LZ	Lighting Zone
NMFS	National Marine Fisheries Services
NPDES	National Pollutant Discharge Elimination System
NRC	National Response Center
OAR	Oregon Administrative Rules
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OEESC	Oregon Energy Efficiency Specialty Code
OERS	Oregon Emergency Response System
ORS	Oregon Revised Statutes
PDI	Planned Development Industrial (City of Wilsonville zoning district)
PGE	Portland General Electric
RA-H	Residential Agricultural Holding (City of Wilsonville zoning district)
RWF	Raw Water Facilities
SFHA	Special Flood Hazard Area
SRIR	Significant Resource Impact Report
SROZ	Significant Resource Overlay Zone
TSP	Transportation System Plan
TVF&R	Tualatin Valley Fire & Rescue
TVWD	Tualatin Valley Water District
UGMFP	Urban Growth Management Functional Plan
USACE	U.S. Army Corps of Engineers
WIF	Willamette Intake Facilities

ACRONYMS AND ABBREVIATIONS

WRWTP	Willamette River Water Treatment Plant
WWSP	Willamette Water Supply Program
WWSS	Willamette Water Supply System
WWSS	Willamette Water Supply System Commission

1 GENERAL INFORMATION

1.1 PROJECT PROPOSAL

The Tualatin Valley Water District (TVWD) and the City of Hillsboro originally partnered to form the Willamette Water Supply Program (WWSP) and to build the Willamette Water Supply System (WWSS), illustrated in Figure 1.[1] In July 2019, the City of Beaverton joined this partnership. The governing authority and assets related to the WWSS have been transferred to the Willamette Water Supply System Commission (WWSSC), which continues to operate the WWSP for the purpose of building the WWSS for its member entities.

The WWSP is seeking land use approvals from the City of Wilsonville (City) in order to develop water intake and transmission facilities at the Willamette River Water Treatment Plant (WRWTP) site. The requested approvals are for the following: Conditional Use; Willamette River Greenway Conditional Use; Flood Plain Permit; Site Design Review; Significant Resource Overlay Zone Map Refinement; Abbreviated Significant Resource Impact Report Review; and Tree Removal Plan and Permit. The proposed facilities and improvements are described below in Section 1.2.2; they are collectively referred to as the Raw Water Facilities (RWF).

Pursuant to Wilsonville Development Code Section 4.009(.01), "applications involving specific sites may be filed only by the owner of the subject property, by a unit of government that is in the process of acquiring the property, or by an agent who has been authorized by the owner, in writing, to apply." TVWD and the City jointly own Lots 1800 and 1900 of the subject property. The applicant has coordinated with the City about filing this application package and the City has consented. Temporary and permanent easements are being established on Lot 1700 of the subject property where the receiving shaft for the trenchless pipeline crossing of Arrowhead Creek is proposed.[2] TVWD has adopted a Resolution of Need that is attached to the development application form, demonstrating that the agency is "in the process of acquiring the property" (i.e., acquiring an easement for Lot 1700) in accordance with Section 4.009(.01). Therefore, TVWD is authorized to file this application.

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[1] The WWSP was originally a partnership between TVWD and the City of Hillsboro (Hillsboro). Effective July 1, 2019, TVWD, Hillsboro, and the City of Beaverton formed a new intergovernmental entity called the Willamette Water Supply System Commission (WWSS Commission). TVWD and Hillsboro assigned all of their rights and obligations with respect to the WWSS to the WWSS Commission. The WWSS Commission, however, will still run the WWSP for purposes of constructing the WWSS. Therefore, the WWSP will remain the applicant in this proceeding, but will be acting on behalf of the WWSS Commission rather than on behalf of TVWD and Hillsboro.

[2] As indicated on the application form and elsewhere in this narrative, the subject property consists of land in three tax lots – the two tax lots that comprise the WRWTP site and the Water Treatment Plant Park (Lots 1800 and 1900), as well as the lot adjacent to the Upper Site (Lot 1700) where the receiving shaft for the trenchless crossing of Arrowhead Creek is proposed. (See the Upper Site's Site Plan in Exhibit A, Sheet LUP-06.) The area of the temporary easement proposed on Lot 1700 is approximately 8,583 square feet (0.20 acres) and the area of the permanent easement proposed on Lot 1700 is approximately 10,895 square feet (0.25 acres).

Development in the Willamette River (replacement of intake screens and installation of new protection piles) is proposed as part of this application. However, the river is not referred to as the "subject property" insofar as property lines do not extend into the river (Figure 2) and the State of Oregon owns and manages the river.

1.2 PROJECT CONTEXT

1.2.1 Willamette Water Supply System Context

The WWSS will provide a resilient and redundant water supply for the TVWD-Hillsboro service area and partnering urban areas. When complete, the WWSS will be one of Oregon's most seismically resilient water systems – built to better withstand natural disasters, protect public health, and speed regional economic recovery by restoring critical services more quickly than existing systems.

The Willamette River will be the new water supply source for the WWSS. The RWF will be located at the site of the existing WRWTP in Wilsonville. The WRWTP was originally developed in partnership between the City and TVWD in 2002. As noted above, the City and TVWD jointly own the WRWTP site. Since initial construction of the WRWTP, a governance process known as the Willamette Intake Facilities (WIF) has been established between TVWD, Wilsonville, Hillsboro, Tigard, Sherwood, and Beaverton related to this water source and these intake facilities. The WIF facilities consist of existing, expanded, or upgraded facilities used to withdraw and transmit water from the Willamette River, including fish screens, an intake pipe, caisson, pump station building, and other equipment leading to a system separation point between the WRWTP and WWSS.

From the RWF, raw water will be pumped to a new state-of-the-art water filtration plant in Sherwood's Tonquin Employment Area, where multiple treatment processes will produce high quality drinking water. Drinking water will be pumped to the Reservoir Facilities on Cooper Mountain and then gravity-fed to the existing distribution system serving users. Construction of the WWSS is planned to be completed by 2026. Other water providers in the region are considering participating in the WWSP.

1.2.2 Summary of Proposed Facilities

The proposed RWF consists of modifications to the existing WIF and new facilities at the WRWTP site. The WWSP has been coordinating with the City over the last several years to design and plan operations for the RWF in a manner that is compatible with the City's existing and future needs. The proposed facilities include:

- Modifications to the existing WIF, including replacement of the existing fish screens with larger-capacity screens
- Seismic stability measures, including stabilization along the Willamette River bank. The seismic improvements have been designed to provide seismic resiliency for the WIF and the new WWSS facilities.
- Raw water pump station upgrades, including seismic reinforcement of the north-, east-, and south-facing walls and addition of an exterior ladder on the north-facing wall[3]
- Raw water pipeline (66 inches)
- Electrical ductbank
- Arrowhead Creek pipeline crossing (trenchless construction)
- New electrical building (approximately 7,853 square feet) and related facilities

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[3] The south, east, and north sides of the pump station building are being refaced with "cast-in-place concrete with smooth form liner" and "vertical form liner," consistent with the rest of the existing building, See Exhibit A, Sheet 50, including Notes 3, 6, 12, and 13.

- Stormwater management facilities
- Mitigation plantings and related environmental work
- Landscape improvements
- New trails along the Willamette River bank
- Upgraded Willamette River overlook and new west and lower bank overlooks

1.2.3 Existing Land Use Context

General information about the subject property is summarized below. A vicinity map with zoning is presented in Figure 2.

- Tax lot ID: 31W 23B 01700 (Lot 1700), 01800 (Lot 1800), and 01900 (Lot 1900)
- Site Address: 10350 SW Arrowhead Creek Lane, Wilsonville, OR 97070
- Lot Area: 4.95 acres (Lot 1700)[4], 11.1 acres (Lot 1800), and 20.1 acres (Lot 1900)
- Zoning: Residential (R) (Lot 1700), Residential Agricultural Holding (RA-H) (Lot 1800), and RA-H/Planned Development Industrial (PDI) (Lot 1900)

The project site is shown in in the Vicinity Plan (Exhibit A, Sheets 4-5). It is located at the WRWTP site along the Willamette River in southwest Wilsonville. In this application, the subject property is referred to in two geographic parts: the Lower Site and the Upper Site. The Lower Site includes the Willamette River waterfront and forested river bank, existing WRWTP facilities, and the Willamette River Water Treatment Plant Park (a City park). A pathway loops through the park and features an overlook at the top of the river bank. The western edge of the Lower Site is a forested ravine that drains to the Willamette River.

The Upper Site is currently vacant. Fill from the original construction of the WRWTP is stored on the southern part of the Upper Site. Orchard (filbert) trees are growing in the northwest part of the Upper Site. Arrowhead Creek flows northwest to southeast through the center of the Upper Site.

A Bonneville Power Administration (BPA) easement runs east-west between the Lower Site and the Upper Site. The Ice Age Tonquin Trail also runs east-west through the site as a multi-use path on the north side of Arrowhead Creek Lane; the trail extends to the west of the site in the BPA easement. A north-south path runs along the western border of the Upper Site and connects to the Ice Age Tonquin Trail in the BPA easement.

The site can be accessed by driving on local streets (Arrowhead Creek Lane and Industrial Way) that connect to Wilsonville Road, which is a minor arterial street at its intersection with Industrial Way. Eventually this access will be modified by the City's 5th Street to Kinsman Road Extension project, with construction expected to begin summer 2019 and be completed fall 2020.[5] The site can also be accessed by walking,

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[4] The total lot area of Lot 1700 is 4.95 acres. The area of temporary easement on Lot 1700 is approximately 8,583 square feet (0.20 acres) and the area of permanent easement on Lot 1700 is approximately 10,895 square feet (0.25 acres).

[5] The 5th Street to Kinsman Road Extension project has been planned to increase connectivity between Wilsonville neighborhoods and provide an alternative to driving on Wilsonville Road. The project will extend 5th Street west to intersect with Kinsman Road, which is

rolling, or biking on the north-south pathway that connects Wilsonville Road to the site and the east-west Tonquin Ice Age Trail.

Land uses adjacent to the project site are shown in the Vicinity Plan (Exhibit A, Sheets 4-5) and are summarized as follows:

- West: Residential neighborhoods (Morey's Landing Subdivision and Oakleaf Mobile Home Park)
- South: Willamette River
- East: Willamette Concrete Products
- North: Hazelnut orchards (formerly cultivated), Arrowhead Creek, and ornamental tree and shrub production

The WWSP has regularly reached out to neighbors in the vicinity of the site, as is discussed below in Section 1.2.4, Summary of Outreach and Coordination.

1.2.4 Planning Context

The subject property has been included in a number of land use planning-related actions, including the actions briefly described below.

Prior Land Use Approvals

The process of approving the original development of the WRWTP is documented in the record for the City of Wilsonville Case Number 00DB18. The Development Review Board (DRB) approved the proposed WRWTP with conditions on May 1, 2000. Appeals of the decision were filed, primarily regarding how the WRWTP would be accessed. The City Council denied the appeals on June 1, 2000, but modified conditions of approval to clarify that a separate public process would be required for determining access to the site.

The original approval was followed by approval of architectural and landscape modifications, site signage, and site access on Industrial Way (Case Number 00DB44) in December 2000 and approval of a minor modification of building materials (Case Number 01AR35) in June 2001.

Water Master Plans

The need and plans for the proposed RWF improvements on the WRWTP site have been established in the following water master plans: the 2017 City of Wilsonville Willamette River Water Treatment Plant Master Plan Update; the 2018 TVWD Water Master Plan Update; and the 2013 City of Hillsboro Water Master Plan.[6]

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being extended south from Wilsonville Road. Arrowhead Creek Lane will then intersect with the extension of 5th Street. Web page https://www.ci.wilsonville.or.us/administration/page/final-design-review-5th-street-kinsman-road-extension-plans-set-april-10-city, accessed April 9, 2019.

[6] The City of Hillsboro Water Master Plan, which was undergoing an update during the preparation of this application, supports the proposed RWF improvements in more detail than the 2013 Water Master Plan. The updated master plan was adopted in June 2019.

These three master plans are addressed in more detail in response to the Conditional Use (Section 4.184) criteria in this application narrative.

Other Master Plans

As part of the City's park system, the site is addressed in the City's Parks and Recreation Master Plan, including the recent 2018 update. The Ice Age Tonquin Trail passes through the site, as identified in the 2013 Ice Age Tonquin Trail Master Plan. The plan shows "neighborhood connections" including the Water Treatment Plant Park's pathway to the south and the pathway connection north to Wilsonville Road. These master plans are addressed in more detail in response to the Conditional Use (Section 4.184) criteria in this application narrative.

1.2.5 Summary of Outreach and Coordination

Prior to the submittal of this land use application, the WWSP conducted outreach activities with neighbors and others in Wilsonville to create a high level of awareness about the proposed improvements and provide early opportunities for input. The applicant's communications staff have worked with City Public Affairs staff in planning and coordinating this outreach since 2014.

Table 1 below provides a detailed summary of public outreach and coordination related to the RWF.

Table 1: Summary of Outreach and Coordination

Outreach/Coordination Activity	**Date**
Coordinated with City public affairs staff on developing and implementing outreach strategy	2014 - present
Prepared and mailed a park survey fact sheet to every residence in Morey's Landing NA boundary (plus HOA contact)	November 2017
Knocked on doors of most directly impacted neighbors and distributed park survey fact sheet	November 2017
Published a joint press release about park survey work with City and WWSP logos	November 2017
Prepared and posted signs at entrance to the park at parking lot, where trail intersects Jobsy Lane, and Brockway Street	November 2017
Briefed Morey's Landing HOA	November 7, 2017
Prepared a Water Intake Facilities (WIF) fact sheet	Fall 2018
Set up a RWF project page on WWSP website	Fall 2018
Presented to Wilsonville Parks and Recreation Department Advisory Board	January 10, 2019
Contacted Oakleaf Mobile Home Park	Early 2019
Briefed Morey's Landing HOA	February 5, 2019
Mailed RWF fact sheet to property owners within 1,000 feet of the WRWTP site	May 3, 2019
Presented to Wilsonville Parks and Recreation Department Advisory Board	November 7, 2019

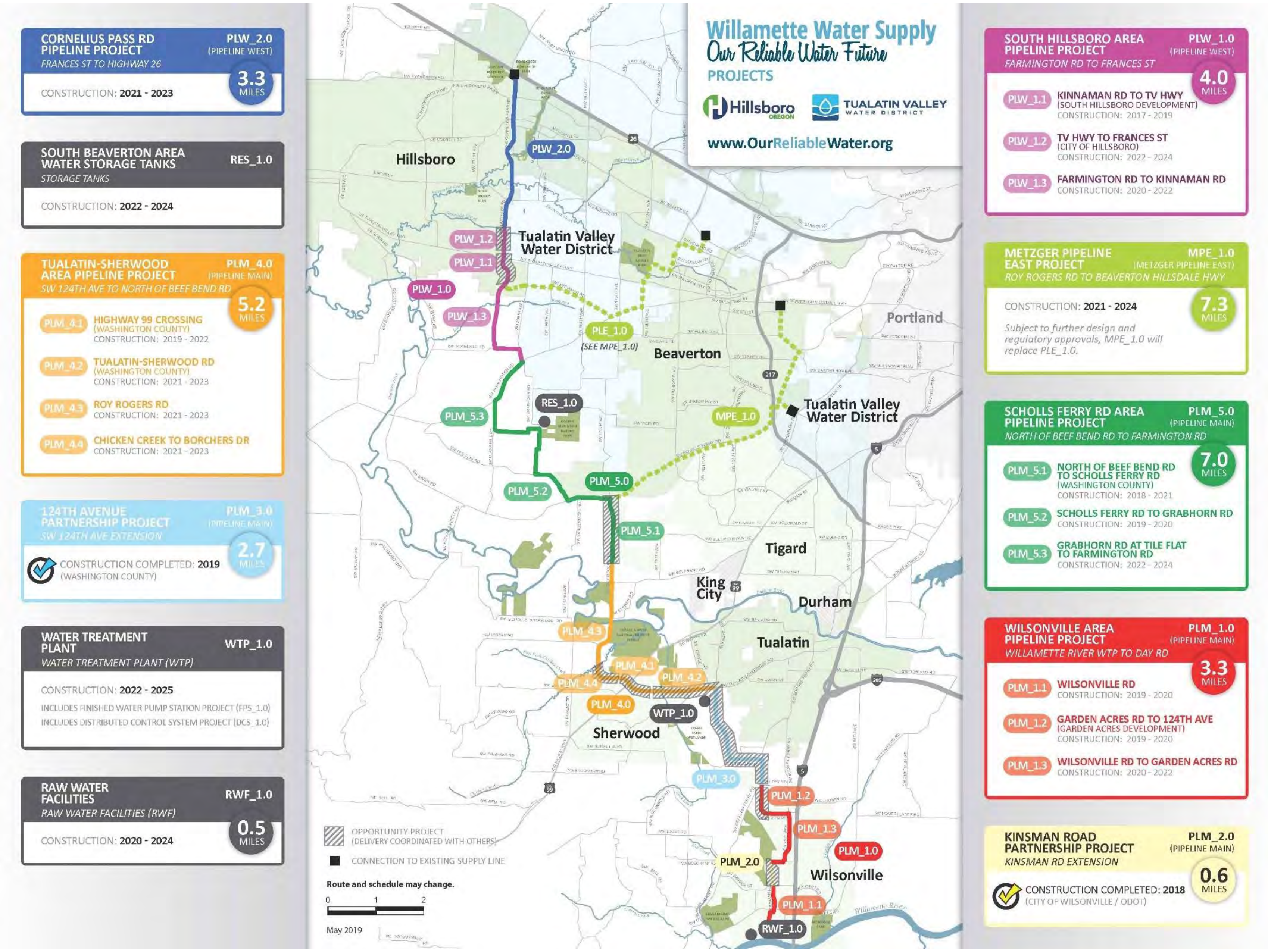
The WWSP has worked closely with Wilsonville public works and engineering staff throughout the engineering design process. In 2018, this coordination was expanded to include meetings and site walks where multiple City departments (Planning, Engineering, Public Works, Natural Resources, Parks, and Legal) and the WWSP team worked together in an interdisciplinary format. Interdisciplinary meetings were held on the following dates: April 5, 2018; July 19, 2018; September 26, 2018; November 29, 2018; and, December 4, 2018. Following the pre-application conference on January 10, 2019, WWSP team members and the project arborist met on-site with City staff to review tree conditions.

Coordination with the City has also involved formal agreements. These agreements apply both to the facilities proposed in this application and to the raw water pipeline that will carry water from the RWF through the city. In early 2018, the City, TVWD, and the City of Hillsboro agreed to a ground lease. The ground lease allows for the construction of the WWSS pipeline once it leaves the subject property, and from there to the edge of the City, which is contemplated to be at the intersection of the Basalt Creek Parkway and Grahams Ferry Road. As part of the agreement establishing the WIF, TVWD and the City granted an easement allowing the placement of a raw water pipe from the intake facilities, across the Lower Site and Upper Site, to the beginning of the WWSS water line at the edge of the subject property. The development proposed in this application is consistent with the terms of the easement over the Upper Site and Lower Site and does not trigger any of the ground lease provisions.

1.3 PROJECT TIMELINE

Notice to Proceed for RWF is currently scheduled for June 5, 2020, a date that drives all the other dates in the project timeline. The WWSP plans to have the final design of the RWF completed by the end of 2019. Construction is slated to begin in the summer of 2020, with bidding processes and guaranteed maximum price (GMP) development scheduled to occur in late 2019/early 2020. Construction is scheduled to be completed in 2024.

Figure 1: Willamette Water Supply System



Willamette Water Supply
Our Reliable Water Future
PROJECTS
Hillsboro OREGON
TUALATIN VALLEY WATER DISTRICT
www.OurReliableWater.org

CORNELIUS PASS RD PIPELINE PROJECT — PLW_2.0 (PIPELINE WEST)
FRANCES ST TO HIGHWAY 26
3.3 MILES
CONSTRUCTION: **2021 - 2023**

SOUTH BEAVERTON AREA WATER STORAGE TANKS — RES_1.0
STORAGE TANKS
CONSTRUCTION: **2022 - 2024**

TUALATIN-SHERWOOD AREA PIPELINE PROJECT — PLM_4.0 (PIPELINE MAIN)
SW 124TH AVE TO NORTH OF BEEF BEND RD
5.2 MILES
- PLM_4.1 HIGHWAY 99 CROSSING (WASHINGTON COUNTY) CONSTRUCTION: 2019 - 2022
- PLM_4.2 TUALATIN-SHERWOOD RD (WASHINGTON COUNTY) CONSTRUCTION: 2021 - 2023
- PLM_4.3 ROY ROGERS RD CONSTRUCTION: 2021 - 2023
- PLM_4.4 CHICKEN CREEK TO BORCHERS DR CONSTRUCTION: 2021 - 2023

124TH AVENUE PARTNERSHIP PROJECT — PLM_3.0 (PIPELINE MAIN)
SW 124TH AVE EXTENSION
2.7 MILES
✓ CONSTRUCTION COMPLETED: **2019** (WASHINGTON COUNTY)

WATER TREATMENT PLANT — WTP_1.0
WATER TREATMENT PLANT (WTP)
CONSTRUCTION: **2022 - 2025**
INCLUDES FINISHED WATER PUMP STATION PROJECT (FPS_1.0)
INCLUDES DISTRIBUTED CONTROL SYSTEM PROJECT (DCS_1.0)

RAW WATER FACILITIES — RWF_1.0
RAW WATER FACILITIES (RWF)
0.5 MILES
CONSTRUCTION: **2020 - 2024**

SOUTH HILLSBORO AREA PIPELINE PROJECT — PLW_1.0 (PIPELINE WEST)
FARMINGTON RD TO FRANCES ST
4.0 MILES
- PLW_1.1 KINNAMAN RD TO TV HWY (SOUTH HILLSBORO DEVELOPMENT) CONSTRUCTION: 2017 - 2019
- PLW_1.2 TV HWY TO FRANCES ST (CITY OF HILLSBORO) CONSTRUCTION: 2022 - 2024
- PLW_1.3 FARMINGTON RD TO KINNAMAN RD CONSTRUCTION: 2020 - 2022

METZGER PIPELINE EAST PROJECT — MPE_1.0 (METZGER PIPELINE EAST)
ROY ROGERS RD TO BEAVERTON HILLSDALE HWY
7.3 MILES
CONSTRUCTION: **2021 - 2024**
Subject to further design and regulatory approvals, MPE_1.0 will replace PLE_1.0.

SCHOLLS FERRY RD AREA PIPELINE PROJECT — PLM_5.0 (PIPELINE MAIN)
NORTH OF BEEF BEND RD TO FARMINGTON RD
7.0 MILES
- PLM_5.1 NORTH OF BEEF BEND RD TO SCHOLLS FERRY RD (WASHINGTON COUNTY) CONSTRUCTION: 2018 - 2021
- PLM_5.2 SCHOLLS FERRY RD TO GRABHORN RD CONSTRUCTION: 2019 - 2020
- PLM_5.3 GRABHORN RD AT TILE FLAT TO FARMINGTON RD CONSTRUCTION: 2022 - 2024

WILSONVILLE AREA PIPELINE PROJECT — PLM_1.0 (PIPELINE MAIN)
WILLAMETTE RIVER WTP TO DAY RD
3.3 MILES
- PLM_1.1 WILSONVILLE RD CONSTRUCTION: 2019 - 2020
- PLM_1.2 GARDEN ACRES RD TO 124TH AVE (GARDEN ACRES DEVELOPMENT) CONSTRUCTION: 2019 - 2020
- PLM_1.3 WILSONVILLE RD TO GARDEN ACRES RD CONSTRUCTION: 2020 - 2022

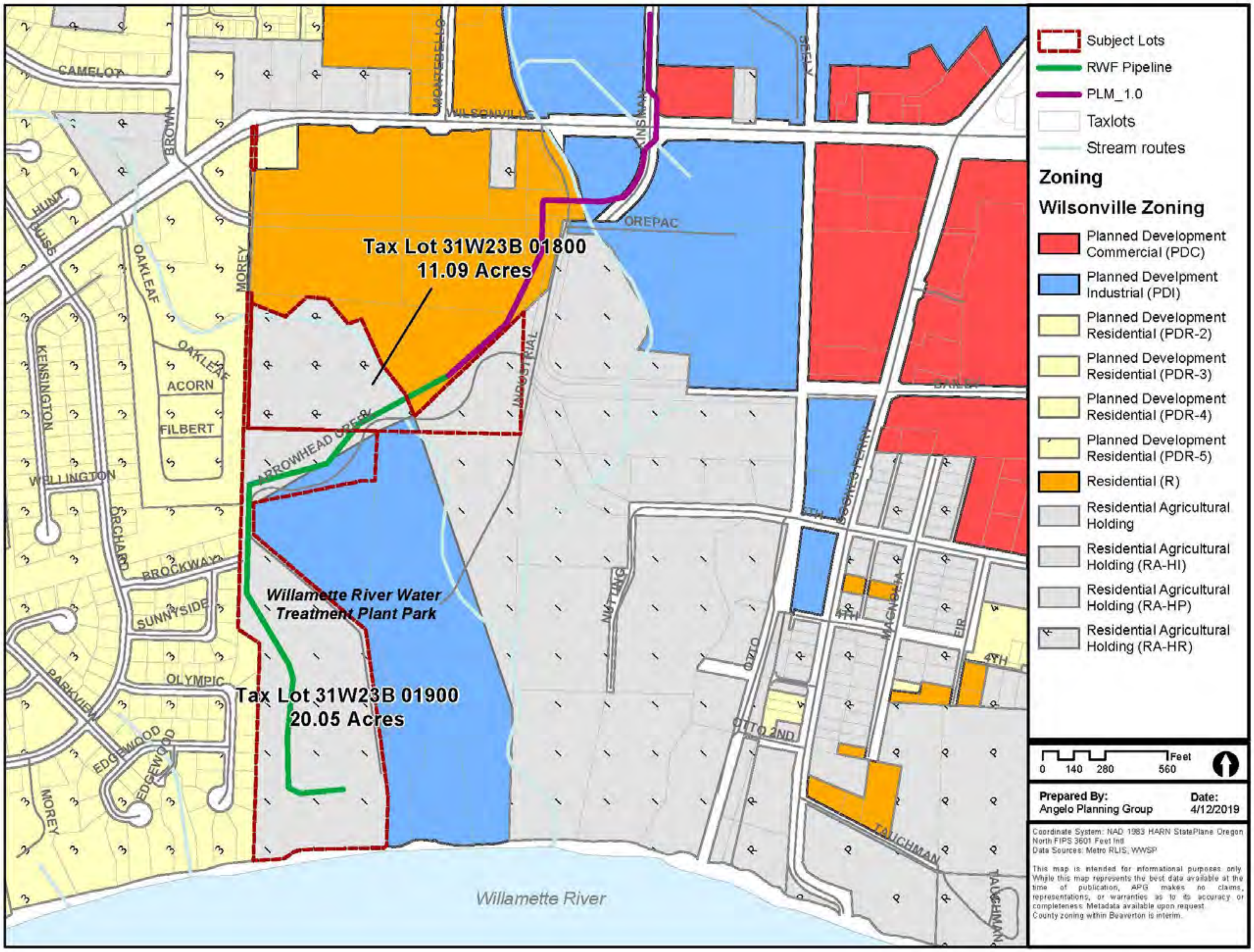
KINSMAN ROAD PARTNERSHIP PROJECT — PLM_2.0 (PIPELINE MAIN)
KINSMAN RD EXTENSION
0.6 MILES
✓ CONSTRUCTION COMPLETED: **2018** (CITY OF WILSONVILLE / ODOT)

▨ OPPORTUNITY PROJECT (DELIVERY COORDINATED WITH OTHERS)
■ CONNECTION TO EXISTING SUPPLY LINE

Route and schedule may change.

May 2019

Figure 2: Vicinity and Zoning Map



Prepared By:
Angelo Planning Group

Date:
4/12/2019

Coordinate System: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl
Data Sources: Metro RLIS, WWSP

This map is intended for informational purposes only. While this map represents the best data available at the time of publication, APG makes no claims, representations, or warranties as to its accuracy or completeness. Metadata available upon request.
County zoning within Beaverton is interim.

2 CONFORMANCE WITH THE APPLICABLE REVIEW CRITERIA

This section of the application narrative contains responses that demonstrate how this application conforms to the applicable standards and regulations of Wilsonville Planning and Land Development Ordinance.

2.1 WILSONVILLE PLANNING AND LAND DEVELOPMENT ORDINANCE ZONING

Section 4.120. Zones. RA-H Residential Agricultural - Holding Zone.

(.01) Purpose.

It is the purpose of this zone to serve as a holding zone to preserve the future urban level development potential as undeveloped property designated for more intensive development. This zone has been applied to all urbanizable properties within the city which are planned for development and which have not previously received development approval in accordance with the Comprehensive Plan.

Response: As shown in Figure 2, the RWF site is located within the Residential Agricultural Holding (RA-H) Zone and, therefore, it is subject to the provisions of this Section. The site has previously been developed with the WRWTP and the Willamette River Water Treatment Plant Park.

(.02) Uses Permitted Outright:

A. One single-family dwelling, with not more than one accessory dwelling unit per lot. Where the Comprehensive Plan calls for future non-residential zoning of the site, the building permit for any proposed residential development shall not be granted until a statement has been recorded applying to the title of the subject property, notifying any potential buyer that future development in the area is expected to be non-residential.

B. Except for existing lots of record of less than two acres, recorded prior to the effective date of this Code, partitioning or subdivision of properties designated for development shall only be considered in conjunction with or following a zone change in conformance with the Comprehensive Plan. Said zoning shall confirm the adequate provision of public facilities and the protection of future urban development potentials.

C. If the proposed development is for a less intensive interim density consisting of large lots, a pre-plat and Site Plan review shall be required that provides for future development of the property in accordance with the uses and densities shown in the Comprehensive Plan. Said plat shall be filed on the City's Lien Docket as an obligation *toward the property, together with an agreement of non-remonstrance towards the formation of any local improvement district which may serve the subject site.*

D. For properties designated in the City's Comprehensive Plan for nonresidential use, the intensity of use shall be restricted to activities which do not require construction of a permanent structure and which will not tend to restrict, obstruct, or adversely affect the future development of the property for its designated use. Except, however, that the development of a single-family dwelling shall be permitted as specified in subsection (.02), above.

E. Temporary structures or uses, subject to the procedures for temporary uses set forth in Section 4.163.

F. Agriculture, horticulture, greenhouses, nurseries (provided that any commercial sales of products shall require the approval of a conditional use permit), timber growing, grazing, and the small scale raising of livestock and animals.

G. Public parks, playgrounds, recreational and community buildings and grounds, public golf courses, tennis courts, and similar recreational uses, all of a non-commercial nature. Any principal building or public swimming pool shall be located not less than forty-five (45) feet from any other lot in a residential or RA-H district.

H. Accessory Uses Permitted:

1. Accessory uses, buildings and structures customarily incidental to any of the aforesaid principal uses permitted located on the same lot therewith.

2. Home occupations.

3. Signs, subject to the provisions of Sections 4.156.01 through 4.156.11.

Response: The radio tower proposed for communications between WWSP facilities (e.g., between the RWF and the WWSS Water Treatment Plant that is planned in Sherwood) is a use and structure that is accessory to the public utility uses proposed on the same site. (See its location on the Upper Site shown in the Site Plan in Exhibit A, Sheet 9.) The use is permitted outright in the RA-H zone pursuant to the above provision.

The reconstructed and enhanced upper overlook, new trails, new overlooks, and associated amenities that are proposed are recreational uses. (See the Trail and Overlook Plans in Exhibit A, Sheets 29 and 20 and background and more detail about the plans in Exhibit B.) They are permitted outright in the RA-H zone pursuant to the above provision.

(.03) Uses Permitted Subject to receiving approval of a Conditional Use Permit:

A. Private parks, municipal and government buildings, public utilities, public information centers, semi-public buildings of a non-commercial nature, churches, attached family dwelling units limited to two (2) family maximum, public, private, and parochial schools as provided in Section 4.184 when approved by the Development Review Board at a Public Hearing as provided in Section 4.013.

B. Roadside stands when located on the same property as the principal uses, selling only those products that are produced on the same property on which the stand is located, or on adjacent property.

Response: The principal use proposed on the subject property is a public utility. Pursuant to this provision, the use is conditionally permitted given compliance with other applicable provisions of this Section.

(.04) Dimensional Standards:

A. Minimum Lot Size: 30,000 square feet.

B. Minimum Front and Rear Yard Setbacks: Thirty (30) feet.

Minimum Side Yard Setback: Ten (10) feet.

C. Minimum Street Frontage: Seventy-five (75) feet. A reduced street frontage may be approved, based on a finding that the proposed lot frontage will not hinder the future development of the site to densities proposed in the Comprehensive Plan.

D. Maximum Height: thirty-five (35) feet.

E. Accessory buildings and uses shall conform to front and side yard setback requirements. If the accessory buildings and uses do not exceed 120 square feet or ten (10) feet in height, and they are detached and located behind the rear-most line of the main buildings, the side and rear yard setbacks may be reduced to three (3) feet.

Response: The proposed public utility improvements consist of seismic upgrades, a water pipeline, an electrical building, and ancillary structures on existing lots. See the findings below.

Dimensional Standard	**Requirement**	**Proposed**
A. Minimum Lot Size	*30,000 sq ft*	The two existing lots that comprise the RWF site are approximately 11

Dimensional Standard	**Requirement**	**Proposed**
		acres and 20 acres. (See Figure 2.) Therefore, this standard is met.
B. Minimum Front and Rear Yard Setbacks	*30 ft*	The proposed seismic stabilization measures and water pipeline are underground and/or underwater so setbacks do not pertain to them. The Electrical Building and ancillary structures are set back over 50 feet front the closest lot line-- more than the required minimum distance of 10 feet. (See the Site Plan, Exhibit A, Sheet 9.) Therefore, these standards are met.
B. Minimum Side Yard Setbacks	*10 ft*	
C. Minimum Street Frontage	*75 ft*	Frontage of the Upper Site along Arrowhead Creek Lane exceeds 75 feet, as shown in the Upper Site's Site Plan (Exhibit A, Sheet 9). Therefore, this standard is met.
D. Maximum Height	*35 ft*	The tallest building proposed is the Electrical Building at approximately 25 feet maximum height, as shown in the building elevations (Exhibit A, Sheets 30-31).[7] A radio tower for inter-facility communications is expected to exceed 35 feet in height. However, the tower qualifies for an exception to height limits pursuant to Section 4.181. (See responses to Section 4.181 later in this narrative.) Therefore, this standard is met.
E. Accessory buildings	*If 120 sf or less or 10ft in height, side and rear yard setbacks may be 3ft*	Accessory buildings are not proposed. Therefore, this standard is not applicable.

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[7] Seismic upgrades of the pump station building faces are proposed (see Exhibit A, Sheet 50). The upgrades will result in an increase of only 8 inches in the height of the existing pump station building. The parapet wall height is being increased to meet Occupational Safety and Health Administration requirements related to fall protection for operators on the roof. At approximately 29 feet, the new height does not exceed maximum height standards.

(.05) Off-Street Parking Requirements: As provided in Section 4.155.

Response: Applicable off-street parking requirements are met, as addressed in the responses to standards in Section 4.155.

(.06) Signs: As provided in Sections 4.156.01 through 4.156.11.

Response: Signs are not proposed as part of this development. Therefore, this standard is not applicable.

(.07) Corner Vision: As provided in Section 4.177.

Response: Applicable corner vision requirements are met, as addressed in the responses to standards in Section 4.177.

(.08) Prohibited Uses:

A. Uses of structures and land not specifically listed as permitted or conditionally permitted in the zone, or substantially similar to those uses, are prohibited in all RA-H Zones.

B. The use of a trailer, travel trailer, or mobile coach as a residence.

C. Service stations for petroleum products.

Response: Prohibited uses are not proposed.

(.09) Block and access standards:

1. Maximum block perimeter: 1,800 feet.

2. Maximum spacing between streets or private drives for local access: 530 feet, unless waived by the Development Review Board upon finding that barriers such as railroads, freeways, existing buildings, topographic variations, or designated Significant Resource Overlay Zone areas will prevent street extensions meeting this standard. [Amended by Ordinance No. 538, 2/21/02; Ord. 682, 9/9/10.]

3. Maximum block length without pedestrian and bicycle crossing: 330 feet, unless waived by the Development Review Board upon finding that barriers such as railroads, freeways, existing buildings, topographic variations, or designated Significant Resource Overlay Zone areas will prevent pedestrian and bicycle facility extensions meeting this standard.

Response: The proposed development does not involve the creation of new blocks. Therefore, the block perimeter and block length provisions in Subsections 1 and 3 above are not applicable.

The one access point proposed for the Upper Site (Electrical Building site) is the only on-site driveway proposed for the project. There are no other private drives or streets proposed as part of the project from which to measure spacing. (See the Site Plan in Exhibit A, Sheet 9.) Therefore, Subsection 2 above is also not applicable.

Section 4.135. PDI-Planned Development Industrial Zone.

(.01) Purpose: The purpose of the PDI zone is to provide opportunities for a variety of industrial operations and associated uses

Response: As shown in Figure 2, there is a small amount of Planned Development Industrial (PDI) zoning adjacent to the proposed Upper Site development. However, this is a small area of zoning that does not coincide with lot lines. The area is occupied by Arrowhead Creek Lane and a BPA easement. Development is not proposed for this area other than the edge of a berm and landscaping that borders the proposed Upper Site development. Therefore, there is no development proposed to which the standards of this Section apply and, therefore, these standards are not applicable.

Section 4.139.00 Significant Resource Overlay Zone (SROZ) Ordinance

Section 4.139.01 SROZ - Purpose

The Significant Resource Overlay Zone (SROZ) is intended to be used with any underlying base zone as shown on the City of Wilsonville Zoning Map. The purpose of the Significant Resource Overlay Zone is to implement the goals and policies of the Comprehensive Plan relating to natural resources, open space, environment, flood hazard, and the Willamette River Greenway. In addition, the purposes of these regulations are to achieve compliance with the requirements of the Metro Urban Growth Management Functional Plan (UGMFP) relating to Title 3 Water Quality Resource Areas, and Title 13 Habitat Conservation Areas, and that portion of Statewide Planning Goal 5 relating to significant natural resources. It is not the intent of this ordinance to prevent development where the

> *impacts to significant resources can be minimized or mitigated. [Amended by Ord. # 674 11/16/09]*

Response: As shown in existing City mapping of the Significant Resource Overlay Zone (SROZ)[8] and a SROZ Map Refinement proposed in this application (Section 4.139.10(.01)(D)), SROZ designations are located on the proposed RWF development site. Therefore, the proposed development is subject to applicable provisions of this Section.

Consistent with the purpose statement above, the proposed development will minimize and mitigate impacts to significant resources, as demonstrated in the responses to the specific standards in this Section.

> *Section 4.139.02 Where These Regulations Apply*
>
> *The regulations of this Section apply to the portion of any lot or development site, which is within a Significant Resource Overlay Zone and its associated "Impact Areas". The text provisions of the Significant Resource Overlay Zone ordinance take precedence over the Significant Resource Overlay Zone maps. The Significant Resource Overlay Zone is described by boundary lines shown on the City of Wilsonville Significant Resource Overlay Zone Map. For the purpose of implementing the provisions of this Section, the Wilsonville Significant Resource Overlay Zone Map is used to determine whether a Significant Resource Impact Report (SRIR) is required. Through the development of an SRIR, a more specific determination can be made of possible impacts on the significant resources.*
>
> *Unless otherwise exempted by these regulations, any development proposed to be located within the Significant Resource Overlay Zone and/or Impact Area must comply with these regulations. Where the provisions of this Section conflict with other provisions of the City of Wilsonville Planning and Land Development Ordinance, the more restrictive shall apply.*
>
> *The SROZ represents the area within the outer boundary of all inventoried significant natural resources. The Significant Resource Overlay Zone includes all land identified and protected under Metro's UGMFP Title 3 Water Quality Resource Areas and Title 13 Habitat Conservation Areas, as currently configured, significant wetlands, riparian corridors, and significant wildlife habitat that is inventoried and mapped on the Wilsonville Significant Resource Overlay Zone Map.*

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[8] City of Wilsonville Significant Resource Overlay Zone map (April 29, 2009), https://www.ci.wilsonville.or.us/sites/default/files/fileattachments/planning/page/83561/d_significant_resource_overlay_zone_map_201312031230510749.pdf

Section 4.139.04 Uses and Activities Exempt from These Regulations

A request for exemption shall be consistent with the submittal requirements listed under Section 4.139.06(.01)(B – I), as applicable to the exempt use and activity. [Added by Ord. # 674 11/16/09]

(.20) The installation of public streets and utilities specifically mapped within a municipal utility master plan, the Transportation Systems Plan or a capital improvement plan.

[…]

Response: The proposed RWF development (installation of public utilities) is established in the following municipal master plans: 2018 TVWD Water Master Plan Update; 2013 City of Hillsboro Water Master Plan; and 2017 WRWTP Master Plan Update. RWF improvements, in particular seismic stabilization measures on the river bank, are shown in site plans in the 2017 WRWTP Update (Figures ES.1 and ES.2 in Exhibit C).

Pursuant to Section 4.139.04(.20) above, the proposed development qualifies for an exemption from the regulations of this Section, with the exception of applicable provisions for an Abbreviated Significant Resource Impact Report (SRIR) in Section 4.139.06(.01)(B)-(I). The applicant hereby requests that exemption. Applicable provisions of Section 4.139.06(.01)(B)-(I) are addressed below.

Section 4.139.05 Significant Resource Overlay Zone Map Verification

The map verification requirements described in this Section shall be met at the time an applicant requests a building permit, grading permit, tree removal permit, land division approval, or other land use decision. Map verification shall not be used to dispute whether the mapped Significant Resource Overlay Zone boundary is a significant natural resource. Map refinements are subject to the requirements of Section 4.139.10(.01)(D).

(.01) In order to confirm the location of the Significant Resource Overlay Zone, map verification shall be required or allowed as follows:

A. Development that is proposed to be either in the Significant Resource Overlay Zone or less than 100 feet outside of the boundary of the Significant Resource Overlay Zone, as shown on the Significant Resource Overlay Zone Map.

B. A lot or parcel that:

1. Either contains the Significant Resource Overlay Zone, or any part of which is less than 100 feet outside the boundary of the Significant Resource Overlay Zone, as shown on the Significant Resource Overlay Zone Map; and

> *2. Is the subject of a land use application for a partition, subdivision, or any land use application that the approval of which would authorize new development on the subject lot or parcel.*

Response: A SROZ Map Verification process was begun between the City and David Evans & Associates (DEA) in advance of this application process in order to support the 2017 WRWTP Master Plan update process. Documentation of the verification process is provided in a memorandum from DEA to City staff (dated March 7, 2016), which is included in this application as Appendix B in the SRIR (Exhibit D). The SROZ "Final Boundary" presented in the memorandum is shown below in Figure 3. Therefore, this standard is met.

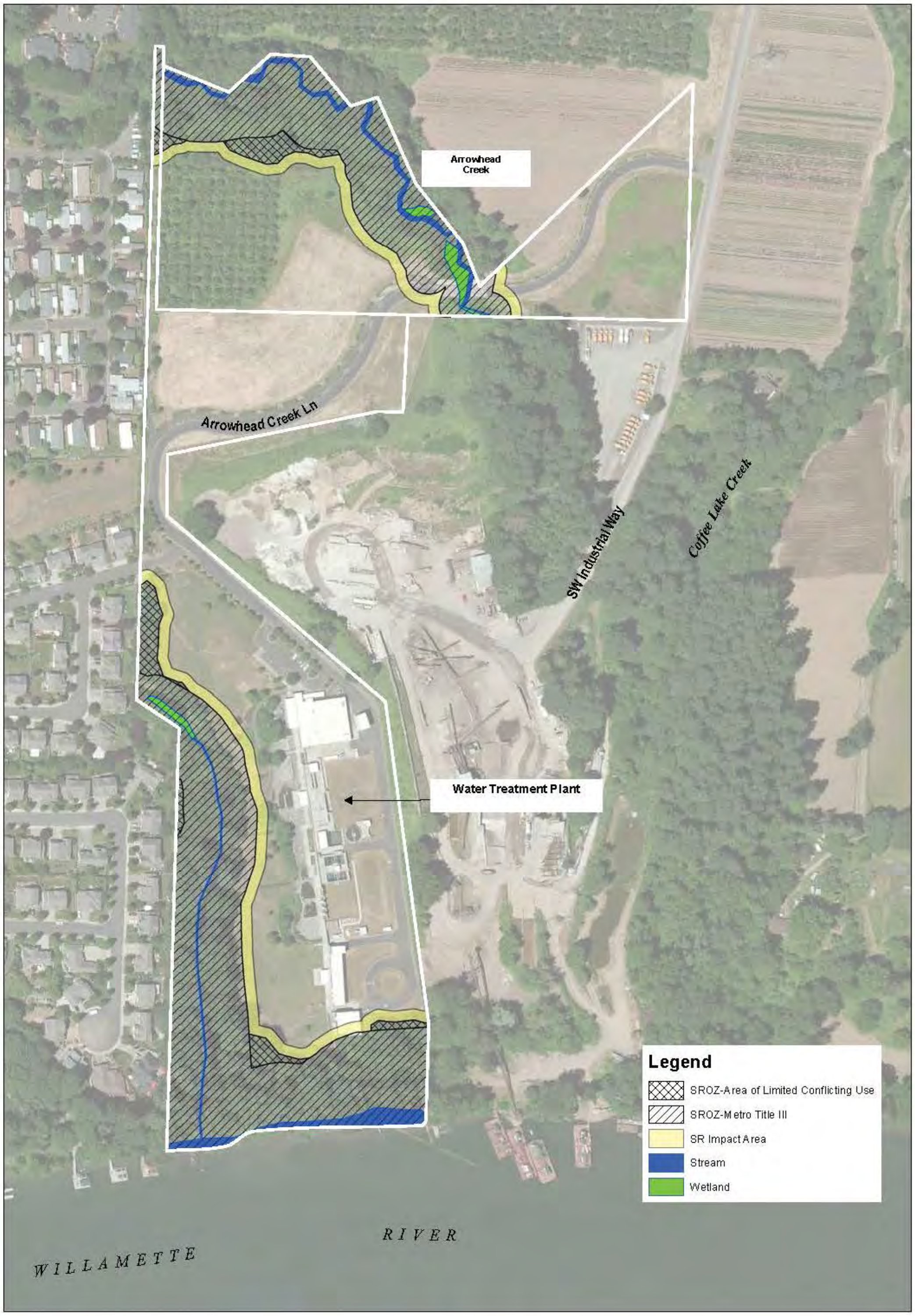
> *(.02) An application for Significant Resource Overlay Zone Map Verification may be submitted even if one is not required pursuant to Section 4.139.05(.01).*
>
> *(.03) If a lot or parcel or parcel is subject to Section 4.139.05(.01), an application for Significant Resource Overlay Zone Map Verification shall be filed concurrently with the other land use applications referenced in Section 4.139.05(.01)(B)(2) unless a previously approved Significant Resource Overlay Zone Map Verification for the subject property remains valid.*

Response: An application for a SROZ Map Verification and Refinement is included in this application package. Therefore, this standard is met.

> *(.04) An applicant for Significant Resource Overlay Zone Map Verification shall use one or more of the following methods to verify the Significant Resource Overlay Zone boundary:*
>
> *A. The applicant may concur with the accuracy of the Significant Resource Overlay Zone Map of the subject property;*
>
> *B. The applicant may demonstrate a mapping error was made in the creation of the Significant Resource Overlay Zone Map;*
>
> *C. The applicant may demonstrate that the subject property was developed lawfully prior to June 7, 2001.*

Response: The SROZ boundary verification presented in the WRWTP SROZ Map Verification Memorandum (Appendix B in Exhibit D) provides detailed site-specific mapping for the WRWTP site, consistent with Subsection B above. As stated in the memorandum, the SROZ delineation was conducted to support the City's 2017 WRWTP Master Plan Update.

Figure 3: SROZ Final Boundary



ESRI, ArcGIS Online, World Imagery. 2010. Microsoft.

Figure 3: Significant Resource Overlay Zone
SROZ Final Boundary

Document Path: P:\C\CARO00000013\0600INFO\GS\Maps\Tech Reports\SROZ_Memo\Fig_3-SROZ_Final.mxd

> *(.05) The Planning Director shall determine the location of any Significant Resource Overlay Zone on the subject property by considering information submitted by the applicant, information collected during any site visit that may be made to the subject property, information generated by Significant Resource Overlay Zone Map Verification that has occurred on adjacent properties, and any other relevant information that has been provided.*

Response: This provision does not impose an approval standard. The applicant accepts the City's authority and means to determine the location of the SROZ on the proposed development site.

> *(.06) For applications filed pursuant to Section 4.139.05(.04)(A) and (C), a Significant Resource Overlay Zone Map Verification shall be consistent with the submittal requirements listed under Section 4.139.06(.01)(B-H).*
>
> *(.07) For applications filed pursuant to Section 4.139.05(.04)(B), a Significant Resource Overlay Zone Map Verification shall be consistent with the submittal requirements listed under Section 4.139.06(.02)(D)(1).*

Response: Because the response to Section 4.139.05(.04) characterizes the Map Verification as a correction of an error (Subsection B), Section 4.139.05(.06) does not directly apply. As a result, Section 4.139.05(.07) would normally apply and subject this application to the standard SRIR submittal requirements of Section 4.139.06(.02)(D)(1). However, because of the exemption established pursuant to Section 4.139.04(.20), addressed above, only the Abbreviated SRIR submittal requirements of Section 4.139.06(.01)(B)-(H) are applicable to this application. Those submittal requirements are addressed below.

> *Section 4.139.06 Significant Resource Impact Report (SRIR) and Review Criteria*
>
> *(.01) Abbreviated SRIR Requirements. It is the intent of this subsection to provide a user-friendly process for the applicant. Only the materials necessary for the application review are required. At the discretion of the Planning Director, an abbreviated SRIR may be submitted for certain small-scale developments such as single family dwellings, additions to single family dwellings, minor additions and accessory structures. The following requirements shall be prepared and submitted as part of the abbreviated SRIR evaluation:*
>
> > *[…]*
> >
> > *B. Outline of any existing features including, but not limited to, structures, decks, areas previously disturbed and existing utility locations*;*
> >
> > *C. Location of any wetlands or water bodies on the site and the location of the stream centerline and top-of-bank;*
> >
> > *D. Within the area proposed to be disturbed, the location, size and species of all trees that are more than six (6) inches in diameter at breast height (DBH). Trees outside the area proposed to be disturbed may be individually shown or shown as drip line with an indication of species type or types;*

E. The location of the SROZ and Impact Area boundaries;*

F. A minimum of three slope cross-section measurements transecting the site, equally spaced at no more than 100-foot increments. The measurements should be made perpendicular to the stream;*

G. A map that delineates the Metro UGMFP Title 3 Water Quality Resource Area boundary (using Metro Title 3 field observed standards);*

H. Current photos of site conditions shall be provided to supplement the above information.*

I. A narrative describing the possible and probable impacts to natural resources and a plan to mitigate for such impacts.*

**Indicates information that City Staff may have readily available to assist an applicant.*

Response: Pursuant to Section 4.139.04(.20) and direction from City staff at a land use coordination meeting held on December 4, 2018, this application is subject to the submittal requirements of Section 4.139.06(.01)(B)-(I). Accordingly, an Abbreviated SRIR is provided in Exhibit D. Section 2 of the SRIR provides responses, one by one, to the requirements in Subsections B through I, above. Therefore, this standard is met.

(.03) SRIR Review Criteria. In addition to the normal Site Development Permit Application requirements as stated in the Planning and Land Development Ordinance, the following standards shall apply to the issuance of permits requiring an SRIR. The SRIR must demonstrate how these standards are met in a manner that meets the purposes of this Section.

A. Except as specifically authorized by this code, development shall be permitted only within the Area of Limited Conflicting Use (see definition) found within the SROZ;

B. Except as specifically authorized by this code, no development is permitted within Metro's Urban Growth Management Functional Plan Title 3 Water Quality Resource Areas boundary;

Response: Section 4.139.04(.20) exempts "utilities specifically mapped within a master plan" from provisions in this Section with the exception of Abbreviated SRIR requirements in Section 4.139.06(.01)(B)-(I). Therefore, the above standards are not applicable and the proposed development is permitted within the SROZ Area of Limited Conflicting Use and Title 3 Water Quality Resource Area.

In the SROZ area at the river bank, the exemption is reasonably applied and appropriate because the proposed seismic stabilization measures that will protect the caisson and raw water pipeline must be installed in the river bank, i.e., within the SROZ area. The same is true for a limited area of temporary impact in the SROZ Title 3 area on the east side of Arrowhead Creek. At that location, the receiving shaft is needed for the trenchless crossing under the creek, enabling the least-impact method of installing the pipeline.

Based on the cited exemption, these standards are met.

> *C. No more than five (5) percent of the Area of Limited Conflicting Use (see-definition) located on a property may be impacted by a development proposal. On properties that are large enough to include Areas of Limited Conflicting Use on both sides of a waterway, no more than five (5) percent of the Area of Limited Conflicting Use on each side of the riparian corridor may be impacted by a development proposal. This condition is cumulative to any successive development proposals on the subject property such that the total impact on the property shall not exceed five (5) percent;*

Response: Based on the exemption allowed in Section 4.139.04(.20), this standard is not applicable to the proposed development. However, the applicant has designed the project to minimize the impact within the SROZ area generally, as described below in the responses to Section 4.139.06(.03)(D) and (E).

> *D. Mitigation of the area to be impacted shall be consistent with Section 4.139.06 of this code and shall occur in accordance with the provisions of this Section;*

Response: The applicant is proposing mitigation that is described in the SRIR. See the SRIR in Exhibit D, including drawings in the SRIR Appendix. Mitigation is proposed in the SRIR as follows:

> *Site restoration and mitigation plans have been developed collaboratively with the City over a series of meetings and site visits throughout 2018 and early 2019. When construction of the project has been completed, temporary impact areas will be restored similar to existing grade except for allowance of a new trail along the Willamette River bluff (Appendix A DWG F4-2 and F5-0). All impacts to the SROZ will be mitigated for on a section of the Upper Site that abuts the Arrowhead Creek riparian corridor SROZ. Mitigation in this area will include the removal of existing weedy vegetation followed by replanting with a native forest community. Appendix A DWG F4-3 shows the proposed mitigation area footprint. Table 3 provides a list of proposed species to be planted in both the mitigation area and for site restoration in temporarily disturbed areas along the Willamette River bluff (note tree species may not be planted along the river bluff due to conflicts with the seismic bank stabilization improvements).*
>
> *Appendix A, and DWG F4-1 and F4-3 serve as preliminary mitigation and site restoration plans for permanent and temporary impacts. No impacts to the SROZ will occur prior to approval of the plans by the City. Only native plant materials will be used in SROZ areas, including within temporary impact areas and the proposed mitigation site. Plant material type (i.e. bare root vs container stock) and size have not been determined yet, per request by City staff, in order to allow for a collaborative approach with the City. However, this information will be provided prior to approval of the final plans by the City. Appropriate installation and plant protection measures will be developed in conjunction with City staff. Permanent irrigation is not proposed. The need for and approach to irrigation during the plant establishment period will be determined through coordination with City staff. The WWSP proposes a three-year monitoring and maintenance period to cover initial plant establishment. This will include a total tree and shrub count along with an assessment of encroachment by non-native invasive species (e.g. Himalayan blackberry) that could impede overall plant establishment success. The WWSP proposes a success criterion of 80 percent survival of trees and shrubs at the end of the three year period. This is a typical success criterion for plantings in a natural setting. Percent survival shall be*

based on the number of live plants counted at the time of monitoring divided by the initial tree and shrub planting totals from the planting plans. Monitoring shall occur annually and trees and shrubs replanted as needed to meet the success criterion. Long term monitoring and maintenance will occur as part of overall WRWTP, WIF, and WWSP RWF facility maintenance activities per agreements between the cooperating entities.

Proposed Mitigation and Site Restoration Plant List

Trees (Mitigation area only)	
Bigleaf maple (*Acer macrophyllum*)	Cascara (*Rhamnus purshiana*)
Douglas fir (*Pseudotsuga menziesii*)	Oregon oak (*Quercus garryana*)
Pacific dogwood (*Cornus nuttalli*)	
Large Shrubs	
Blue elderberry (*Sambucus cerulea*)	Red flowering currant (*Ribes sanguineum*)
Thimbleberry (*Rubus parviflorus*)	Vine maple (*Acer circinatum*)
Western serviceberry (*Amelanchier alnifolia*)	
Medium and Small Shrubs	
Baldhip rose (*Rosa gymnocarpa*)	Dwarf Oregon grape (*Mahonia nervosa*)
Evergreen huckleberry (*Vaccinium nervosa*)	Indian plum (*Oemleria cerasiformis*)
Nootka rose (*Rosa nutkana*)	Red huckleberry (*Vaccinium parviflorum*)
Salal (*Gaultheria shallon*)	Snowberry (*Symphoricarpos alba*)
Sword fern (*Polystichum munitum*)	Tall Oregon grape (*Mahonia aquifolium*)

The WWSP has received permits from the U.S. Army Corps of Engineers (USACE) and the Oregon Department of State Lands (DSL) that cover the entirety of the WWSP, including the RWF_1.0. No wetland or waterway impacts requiring mitigation will occur at RWF_1.0. The WWSP has purchased wetland mitigation bank credits for wetland impacts associated with other WWSP elements.

Therefore, this standard is met.

E. The impact on the Significant Resource is minimized by limiting the degree or magnitude of the action, by using appropriate technology or by taking affirmative steps to avoid, reduce or mitigate impacts;

Response: The applicant has minimized impacts to the river bank area by evaluating multiple alternatives for the design of seismic stabilization measures and selecting the design that would minimize impact while still meeting the specifications for protecting the facilities during a seismic event. See the response to the Willamette River Greenway Conditional Use criterion in Section 4.510(.01)(A). The findings describe the seismic improvements evaluated and how the selected alternative reduces the footprint of ground disturbance and provides for landscaping of the site post-construction. In addition to that evaluation of how to avoid and minimize impacts, the applicant is proposing mitigation as described in the SRIR (Exhibit D) and above in the response to Section 4.139.06(.03)(D). Therefore, this standard is met.

> *F. The impacts to the Significant Resources will be rectified by restoring, rehabilitating, or creating enhanced resource values within the "replacement area" (see definitions) on the site or, where mitigation is not practical on-site, mitigation may occur in another location approved by the City;*

Response: "Replacement area" mitigation is defined by the code as that "required to compensate for an encroachment into the SROZ when allowed in accordance with Section 4.139." (Section 4.001, Definition 239) The proposed development is a use that is exempt from the requirements of Section 4.139, with the exception of Abbreviated SRIR requirements in Section 4.139.06(.01)(B)-(I). Therefore, the standard is not applicable.

The exemption notwithstanding, the applicant is proposing mitigation that is in the spirit of this standard. The proposed mitigation is described in the SRIR, (Exhibit D) and in the response to Section 4.139.06(.03)(D).

Therefore, this standard is met.

> *G. Non-structural fill used within the SROZ area shall primarily consist of natural materials similar to the soil types found on the site;*
>
> *H. The amount of fill used shall be the minimum required to practically achieve the project purpose;*

Response: Based on the exemption allowed in Section 4.139.04(.20), these standards are not applicable to the proposed development. The exemption notwithstanding, fill is not proposed in the SROZ as part of the river bank seismic stabilization measures; those improvements will consist of below-grade jet grout or similar material. Original grades will be restored in the SROZ on the river bank except in limited areas where the improved upper overlook, new trails, and new west and lower overlooks will be located. Natural materials will be used in these areas, including gravel on the trails. See the River Bank Grading Plan in Exhibit A (Sheet 10), the River Bank Final Conditions Plan in Exhibit D (Appendix A, Figure F4-1), and the Trail Plan in Exhibit A (Sheets 19-20). Therefore, this standard is met.

> *I. Other than measures taken to minimize turbidity during construction, stream turbidity shall not be significantly increased by any proposed development or alteration of the site;*

Response: Based on the exemption allowed in Section 4.139.04(.20), this standard is not applicable to the proposed development. The exemption notwithstanding, the applicant has received approval of its Joint Permit Application (JPA) from the U.S. Army Corps of Engineers (USACE) and the Oregon Department of State Lands (DSL). See Exhibit E. In the section on construction practices, the JPA states that an erosion control plan will be implemented to prevent the discharge of sediment to surface water and ensure that turbidity does not exceed 10 percent above existing background conditions (Exhibit F).

This application enacts that commitment by providing an Erosion Control Plan that will implemented during construction (Exhibit A, Sheets 12-14). In addition to compliance with City requirements for erosion control, the JPA obligates the applicant to comply with requirements in the issued National Pollutant Discharge Elimination System (NPDES) permit.

Therefore, this standard is met.

> *J. Appropriate federal and state permits shall be obtained prior to the initiation of any activities regulated by the U.S. Army Corps of Engineers and the Oregon Division of State Lands in any jurisdictional wetlands or water of the United States or State of Oregon, respectively.*

Response: Based on the exemption allowed in Section 4.139.04(.20), this standard is not applicable to the proposed development. The exemption notwithstanding, appropriate permits from the USACE and DSL have been obtained and are included in this application as Exhibit E. Therefore, this standard is met.

> *Section 4.139.10 Development Review Board (DRB) Process*
>
> *The following actions require review through a Development Review Board quasi-judicial process. Nothing contained herein shall be deemed to require a hearing body to approve a request for a permit under this Section.*
>
> *(.01) Exceptions. The following exceptions may be authorized through a Development Review Board quasi-judicial review procedure.*
>
> *D. Map Refinement process. The applicant may propose to amend the SROZ boundary through a Development Review Board quasi-judicial zone change where more detailed information is provided, such as a state approved wetland delineation. The criteria for amending the SROZ are as follows:*
>
> *1. Any map refinement must be evaluated by considering the riparian corridor types contained in this ordinance.*
>
> *2. Other supporting documents to be considered in evaluating a proposal to refine a map include, but are not limited to:*
>
> *a. Natural Resources Inventories (LWI/RCI);*
>
> *b. The Economic, Social, Environmental and Energy (ESEE) Analysis;*
>
> *c. Metro Functional Plans;*
>
> *d. Wilsonville Comprehensive Plan;*
>
> *e. State approved wetland delineations;*

f. Detailed slope analysis

Response: As stated in the SROZ Map Verification memorandum (Appendix B in Exhibit D), the SROZ delineation was conducted by considering resource types. The methodology applied was to combine Metro Title 3 mapping, which establishes buffers of resources depending on resource type and adjacent slopes, and direction from City development code (Section 4.139.00), which establishes SROZ boundaries based on the extent of native tree canopy beyond the edges of water resource features.

The proposed SROZ boundary includes Wetlands A, B, and C as identified in a wetland delineation performed by DEA (WD #2016-0249, Exhibit G), with which the DSL concurred in a report dated August 31, 2016 (Exhibit H). The JPA submitted to the USACE and DSL in April 2017 documents that the RWF improvements will be constructed such that no work in or impacts on Wetlands A, B, or C is proposed. (See Exhibit F.) The absence of impacts at these wetlands was confirmed in the permits issued by DSL in May 2018 and by USACE in December 2018 (Exhibits E).

Therefore, this standard is met.

3. An SRIR must be prepared by the applicant in conformance with the provisions of this Section.

Response: The applicant prepared an Abbreviated SRIR (Exhibit D). The report complies with provisions of this Section, as addressed in responses to standards in Section 4.139.06(.01). Therefore, this standard is met.

4. The Hearing Body (including City Council) may amend the Significant Resource Overlay Zone (in or out) upon making a determination that the land area in question is or is not a significant resource. The criteria for determining that land is significant shall be based on finding that the site area has at least one rating of "high" using the function criteria listed in the Natural Resource Function Rating Matrices.

Response: It is understood that the Hearing Body has the authority to amend the SROZ based on natural resource function criteria.

GENERAL DEVELOPMENT REGULATIONS

Section 4.154 On-Site Pedestrian Access and Circulation

(.01) On-site Pedestrian Access and Circulation

A. The purpose of this section is to implement the pedestrian access and connectivity policies of the Transportation System Plan. It is intended to provide for safe, reasonably direct, and convenient pedestrian access and circulation.

B. Standards. Development shall conform to all of the following standards:

1. Continuous Pathway System. A pedestrian pathway system shall extend throughout the development site and connect to adjacent sidewalks, and to all future phases of the development, as applicable.

Response: The development site is also the site of the Willamette River Water Treatment Plant Park. The park has an existing continuous pathway that loops between the north and south ends of the park, with access to an overlook above the bank of the Willamette River. (See Existing Conditions in Exhibit A, Sheet 4 and Figure 4 below.)

The pathway connects to the Ice Age Tonquin Trail, which runs east-west across the site. The Ice Age Tonquin Trail runs in the BPA easement to the west of the site and on an existing multi-use path along Arrowhead Creek Lane on the site, with plans to extend the multi-use path to the east of the site as part of the City's 5th Street-Kinsman Road project. The north-south park pathway also connects to Morey Lane to the north, which ultimately connects to sidewalks on Wilsonville Road, as shown in Figure 4 below.

Due to construction around the pathway and for purposes of pedestrian safety, access to the pathway in the park and along Arrowhead Creek Lane will be restricted during construction. (See the Construction Management Plan in Exhibit I.) The applicant's goal is to keep paths and trails open as much as is feasible. However, public access shutdowns or restrictions will be required depending upon sequences of construction work. These shutdowns or restrictions will be coordinated with the City and public during construction.

Following construction, the pathway in the park and along Arrowhead Creek Lane will be restored in place to improved conditions.[9] (See the Park Site Plan in Exhibit A, Sheet 8 and Final Conditions (Figure 4) in the SRIR, Exhibit D.)

In addition, new trails are proposed on the site to provide visual and physical access to the Willamette River. The new trails are shown and detailed in the Trail Plan in Exhibit A (Sheet 19).

Therefore, this standard is met.

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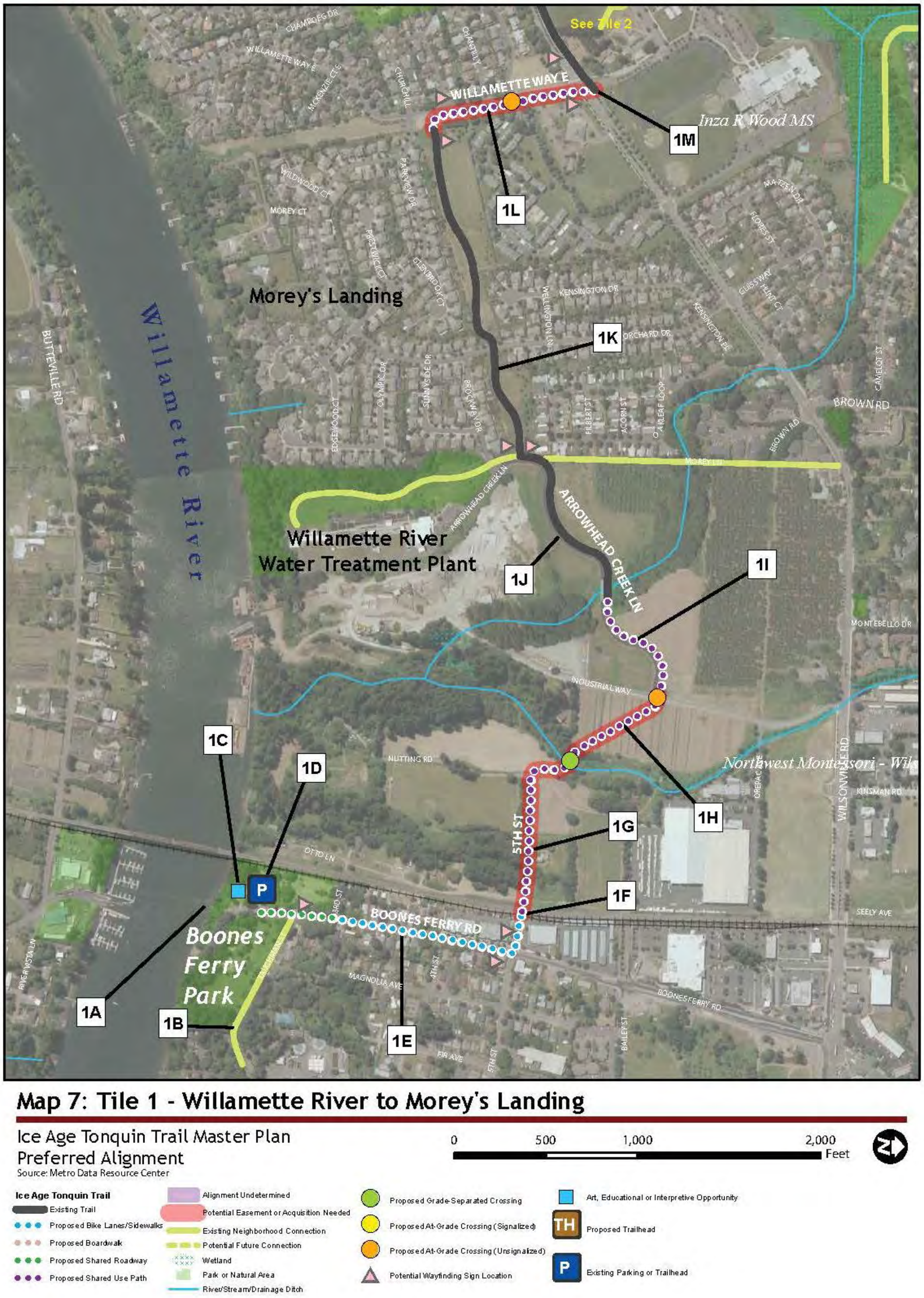
[9] The pathway in the park will be restored in place with the exception of a new alignment of the pathway to the upper overlook. The new alignment is shown in the Trail Plan in Exhibit A (Sheet 19) as well as other drawings in Exhibit A that show the path in the background.

Figure 4: Ice Age Tonquin Trail



2. Safe, Direct, and Convenient. Pathways within developments shall provide safe, reasonably direct, and convenient connections between primary building entrances and all adjacent parking areas, recreational areas/playgrounds, and public rights-of-way and crosswalks based on all of the following criteria:

a. Pedestrian pathways are designed primarily for pedestrian safety and convenience, meaning they are free from hazards and provide a reasonably smooth and consistent surface.

b. The pathway is reasonably direct. A pathway is reasonably direct when it follows a route between destinations that does not involve a significant amount of unnecessary out-of-direction travel.

c. The pathway connects to all primary building entrances and is consistent with the Americans with Disabilities Act (ADA) requirements.

d. All parking lots larger than three acres in size shall provide an internal bicycle and pedestrian pathway pursuant to Section 4.155(.03)(B.)(3.)(d.).

Response: As shown in Figure 4 and the Existing Conditions Plan (Exhibit A, Sheet 4), the pathway on the site is reasonably direct in providing access to the top of the Willamette River bank and upper overlook. Direct access is currently provided between existing building entrances and the parking area, consistent with ADA requirements.

Existing pathways serve pedestrian safety and convenience in that they are constructed of relatively smooth and consistent concrete or asphalt and are clear of obstructions or hazards. The pathways in the park will be restored after construction to existing or improved conditions.

There are no parking areas larger than three acres on the site.

Therefore, the applicable standards are met.

3. Vehicle/Pathway Separation. Except as required for crosswalks, per subsection 4, below, where a pathway abuts a driveway or street it shall be vertically or horizontally separated from the vehicular lane. For example, a pathway may be vertically raised six inches above the abutting travel lane, or horizontally separated by a row of bollards.

Response: Where the existing pathway is adjacent to the parking area or street (Arrowhead Creek Lane), it is separated by a curb. Those curbs will be maintained or restored as needed following project construction. Therefore, this standard is met.

4. Crosswalks. Where a pathway crosses a parking area or driveway, it shall be clearly marked with contrasting paint or paving materials (e.g., pavers, light-color concrete inlay between asphalt, or similar contrast).

Response: The park pathway and the section of the Tonquin Ice Age Trail on the site will not cross parking areas or driveways except for where the Tonquin Ice Age Trail – a multi-use path along Arrowhead Creek Lane – will cross one driveway to the Upper Site facilities. However, this driveway will be rarely used and will be gated and, thus, will not function as a typical driveway. Therefore, the standard above is not necessary.

The existing park pathway crosses a gated accessway at SW Brockway Drive. However, that accessway is available only for emergency access and, thus, is not marked as a crosswalk currently, nor is it proposed to be marked as a crosswalk. Therefore, the standard above is not necessary.

> *5. Pathway Width and Surface. Primary pathways shall be constructed of concrete, asphalt, brick/masonry pavers, or other durable surface, and not less than five (5) feet wide. Secondary pathways and pedestrian trails may have an alternative surface except as otherwise required by the ADA.*

Response: The existing pathway to and through the park is constructed of concrete or asphalt and will be restored as needed with the same or similar durable surface. When restored, the section of pathway in the park from SW Brockway Drive to the river bank will be improved with new asphalt and base that can accommodate park maintenance vehicles, per requests from City staff. The improved pathway can also accommodate WWSP and City maintenance vehicles, as needed.

The width of existing pathways is at least 5 feet wide and this width will be maintained or widened when restored. Specifically, the restored path in the park would be approximately 12 feet wide from SW Brockway Drive to the river bank. This width can encourage recreational use, as well as accommodate park maintenance vehicles without causing damage to grass on either side of the path.

The surface of the proposed lower trail will be gravel, which is acceptable for a secondary pathway or trail. The trail will be approximately 3 feet in width. See the Trail Plan, Exhibit A, Sheet 19.

Therefore, this standard is met.

> *6. All pathways shall be clearly marked with appropriate standard signs.*

Response: As an existing park pathway and connection to the Ice Age Tonquin Trail system, there are currently appropriate standard signs, which will be maintained or replaced after construction as needed.

Signs for the proposed trails are expected to consist primarily of interpretive signs. Concepts for signs will be further coordinated with the City's Parks and Recreation Department.

Therefore, this standard is met.

Section 4.155 Parking, Loading, and Bicycle Parking

(.01) Purpose:

A. The design of parking areas is intended to enhance the use of the parking area as it relates to the site development as a whole, while providing efficient parking, vehicle circulation and attractive, safe pedestrian access.

B. As much as possible, site design of impervious surface parking and loading areas shall address the environmental impacts of air and water pollution, as well as climate change from heat islands.

C. The view from the public right of way and adjoining properties is critical to meet the aesthetic concerns of the community and to ensure that private property rights are met. Where developments are located in key locations such as near or adjacent to the I-5 interchanges, or involve large expanses of asphalt, they deserve community concern and attention.

Response: The existing parking area adjacent to the WRWTP on the Lower Site will not be changed. Limited parking will be needed and provided for the Electrical Building and ancillary facilities on the Upper Site. Therefore, the provisions of this Section are applicable to the parking needed and proposed on the Upper Site.

Parking during construction will generally be located in the staging area on the Upper Site while Lower Site improvements are being constructed. (See this indicated on the Proposed Work Zones Plan, Exhibit A, Sheet 34.) Construction parking will be addressed in more detail in construction permitting. Potential surface impacts from parking and other construction-related uses and activities are accounted for in the Erosion Control Plans included in this application (Exhibit A, Sheets 10-12).

(.02) General Provisions:

A. The provision and maintenance of off-street parking spaces is a continuing obligation of the property owner. The standards set forth herein shall be considered by the Development Review Board as minimum criteria.

1. The Board shall have the authority to grant variances or planned development waivers to these standards in keeping with the purposes and objectives set forth in the Comprehensive Plan and this Code.

2. Waivers to the parking, loading, or bicycle parking standards shall only be issued upon a findings that the resulting development will have no significant adverse impact on the surrounding neighborhood, and the community, and that the development considered as a whole meets the purposes of this section.

Response: It is understood that provision and maintenance of off-street parking is a continuing obligation of the property owner and that the standards herein shall be considered as minimum criteria. Variances or waivers to these standards are not being requested.

B. No area shall be considered a parking space unless it can be shown that the area is accessible and usable for that purpose, and has maneuvering area for the vehicles, as determined by the Planning Director.

Response: A standard parking space and an ADA-accessible parking space will be provided for service vehicles on the Upper Site, as indicated on the Site Plan (Exhibit A, Sheet 9). The Site Plan shows that there is sufficient maneuvering area for a service vehicle. Therefore, this standard is met.

C. In cases of enlargement of a building or a change of use from that existing on the effective date of this Code, the number of parking spaces required shall be based on the additional floor area of the enlarged or additional building, or changed use, as set forth in this Section. Current development standards, including parking area landscaping and screening, shall apply only to the additional approved parking area.

Response: An enlargement of a building or a change of use is not proposed. Therefore, this standard is not applicable.

D. In the event several uses occupy a single structure or parcel of land, the total requirement for off-street parking shall be the sum of the requirements of the several uses computed separately, except as modified by subsection "E," below.

E. Owners of two (2) or more uses, structures, or parcels of land may utilize jointly the same parking area when the peak hours of operation do not overlap, provided satisfactory legal evidence is presented in the form of deeds, leases, or contracts securing full and permanent access to such parking areas for all the parties jointly using them. [Amended by Ord. # 674 11/16/09

Response: Several uses are not proposed to occupy a single structure or parcel and joint parking is not proposed. Therefore, these standards are not applicable.

F. Off-street parking spaces existing prior to the effective date of this Code may be included in the amount necessary to meet the requirements in case of subsequent enlargement of the building or use to which such spaces are necessary.

Response: There are no off-street parking spaces that existed for the Upper Site prior to the effective date of this Code. Therefore, this standard is not applicable.

G. Off-Site Parking. Except for single-family dwellings, the vehicle parking spaces required by this Chapter may be located on another parcel of land, provided the parcel is within 500 feet of the use it serves and the DRB has approved the off-site parking through the Land Use Review. The distance from the parking area to the use shall be measured from the nearest parking space to the main building *entrance, following a sidewalk or other pedestrian route. The right to use the off-site parking must be evidenced in the form of recorded deeds, easements, leases, or contracts securing full and permanent access to such parking areas for all the parties jointly using them. [Amended by Ord. # 674 11/16/09]*

Response: Off-street parking on a separate parcel is not proposed. Therefore, this standard is not applicable.

H. The conducting of any business activity shall not be permitted on the required parking spaces, unless a temporary use permit is approved pursuant to Section 4.163.

Response: It is understood that business activity is not permitted in required parking spaces unless a temporary use permit is approved.

I. Where the boundary of a parking lot adjoins or is within a residential district, such parking lot shall be screened by a sight-obscuring fence or planting. The screening shall be continuous along that boundary and shall be at least six (6) feet in height.

Response: The boundary of the proposed parking and vehicle circulation area does not adjoin a residential district per se. Therefore, this standard is not applicable.

A high berm with plantings that total at least 6 feet in height is proposed on the west side of the Upper Site that faces adjacent residential zoning to help buffer and screen the uses. See the Upper Site Landscape Plans (Exhibit A, Sheets 21-23) and Upper Site Cross-Section Perspectives (Exhibit A, Sheet 35).

J. Parking spaces along the boundaries of a parking lot shall be provided with a sturdy bumper guard or curb at least six (6) inches high and located far enough within the boundary to prevent any portion of a car within the lot from extending over the property line or interfering with required screening or sidewalks.

Response: Parking spaces for service vehicles are proposed adjacent to the Electrical Building, not along the boundary of the parking area. (See the Site Plan, Exhibit A, Sheet 9.) Therefore, this standard is not applicable.

K. All areas used for parking and maneuvering of cars shall be surfaced with asphalt, concrete, or other surface, such as pervious materials (i. e. pavers, concrete, asphalt) that is found by the City's authorized representative to be suitable for the purpose. In all cases, suitable drainage, meeting standards set by the City's authorized representative~~,~~ shall be provided. [Amended by Ord. # 674 11/16/09]

Response: The Upper Site parking and vehicle circulation area will be asphalt, as noted in the Site Plan (Exhibit A, Sheet 9). Drainage from the parking and vehicle circulation area will be collected in swales on the north and south side of the Upper Site that will lead to new proposed storm drains, which will connect to a reconstructed outfall at Arrowhead Creek, located further towards the creek than the existing outfall in response to a request from the City. (See the Upper Site Utility Plan (Exhibit A, Sheet 17), Upper Site Stormwater Plan (Exhibit A, Sheet 45), and the Stormwater Management Memorandum, Exhibit J.) Therefore, this standard is met.

L. Artificial lighting which may be provided shall be so limited or deflected as not to shine into adjoining structures or into the eyes of passers-by.

Response: The type, full shielding, and levels of proposed lighting on the Upper Site – in addition to landscaping and berm screening proposed on the west, south, and southeast sides of the site – will prevent light from shining into any nearby structure or the eyes of passers-by. See the Lighting Plans in Exhibit A, Sheets 37 and 39, and Lighting Cut Sheets in Exhibit K. Therefore, this standard is met.

M. Off-street parking requirements for types of uses and structures not specifically listed in this Code shall be determined by the Development Review Board if an application is pending before the Board. Otherwise, the requirements shall be specified by the Planning Director, based upon consideration of comparable uses.

Response: The Electrical Building, a use to support the proposed public utility improvements, is not a type of use or structure for which off-street parking requirements are specifically listed in this Code. It is understood that the Development Review Board is authorized to determine the requirements. However, given the sporadic nature of personnel-based use of the Upper Site (maintenance and emergency visits), the applicant proposes that two parking spaces outside the building will be sufficient for the use (one standard space and one ADA-accessible space). See the location of the proposed parking spaces in the Site Plan (Exhibit A, Sheet 9).

N. Up to forty percent (40%) of the off-street spaces may be compact car spaces as identified in Section 4.001 - "Definitions," and shall be appropriately identified.

Response: Compact spaces are not proposed. Therefore, this standard is not applicable.

O. Where off-street parking areas are designed for motor vehicles to overhang beyond curbs, planting areas adjacent to said curbs shall be increased to a minimum of seven (7) feet in depth. This standard shall apply to a double row of parking, the net effect of which shall be to create a planted area that is a minimum of seven (7) feet in depth.

Response: A double row of parking and planting areas are not proposed. Therefore, this standard is not applicable.

(.03) Minimum and Maximum Off-Street Parking Requirements:

A. Parking and loading or delivery areas shall be designed with access and maneuvering area adequate to serve the functional needs of the site and shall:

1. Separate loading and delivery areas and circulation from customer and/or employee parking and pedestrian areas. Circulation patterns shall be clearly marked.

2. To the greatest extent possible, separate vehicle and pedestrian traffic.

Response: The Upper Site will not have active parking areas, loading areas, or pedestrian areas. The sporadic traffic to the site and on the site can be accommodated by the proposed parking spaces, a sidewalk around the northeast and north side of the building, and vehicle circulation around the site from the gate and driveway. See the Site Plan and Floor Plan in Exhibit A (Sheets 9 and 36). In these ways, the parking and loading areas will be adequate to serve the needs of the site. Therefore, this standard is met.

B. Parking and loading or delivery areas shall be landscaped to minimize the visual dominance of the parking or loading area, as follows:

1. Landscaping of at least ten percent (10%) of the parking area designed to be screened from view from the public right-of-way and adjacent properties. This landscaping shall be considered to be part of the fifteen percent (15%) total landscaping required in Section 4.176.03 for the site development.

Response: Parking and loading on the Upper Site will be very limited (two spaces each) and there is not a "parking area" per se. Thus, the landscaping and screening that is needed should also be very limited. However, a large area of landscaping and screening will be provided by the high berm and variety of trees, shrubs, and ground cover on the berm proposed on the Upper Site. See the Site Plan and Cross-Section Perspectives in Exhibit A, Sheets 9 and 35. This proposed landscaping will screen the parking and loading spaces from view from Arrowhead Creek Lane and from the residential uses to the west. Therefore, this standard is met.

2. Landscape tree planting areas shall be a minimum of eight (8) feet in width and length and spaced every eight (8) parking spaces or an equivalent aggregated amount.

a. Trees shall be planted in a ratio of one (1) tree per eight (8) parking spaces or fraction thereof, except in parking areas of more than two hundred (200) spaces where a ratio of one (1) tree per six (six) spaces shall be applied as noted in subsection (.03)(B.)(3.). A landscape design that includes trees planted in areas based on an aggregated number of parking spaces must provide all area calculations.

b. Except for trees planted for screening, all deciduous interior parking lot trees must be suitably sized, located, and maintained to provide a branching minimum of seven (7) feet clearance at maturity.

Response: Given only two service vehicle parking spaces that are needed and proposed, these standards are not necessary or applicable.

A large area of landscaping will be provided by the proposed high berm and variety of trees, shrubs, and ground cover on the berm, as shown in the Site Plan and Cross-Section Perspectives for the Upper Site (Exhibit A, Sheets 9 and 35).

> *3. Due to their large amount of impervious surface, new development with parking areas of more than two hundred (200) spaces that are located in any zone, and that may be viewed from the public right of way, shall be landscaped to the following additional standards…*

Response: The proposed development does not include a parking area with more than 200 spaces. Therefore, this standard is not applicable.

> *e. All parking lots viewed from the public right of way shall have a minimum twelve (12) foot landscaped buffer extending from the edge of the property line at the right of way to the edge of the parking area. Buffer landscaping shall meet the low screen standard of 4.176(.02)(D) except that trees, groundcovers and shrubs shall be grouped to provide visual interest and to create view openings no more than ten (10) feet in length and provided every forty (40) feet. Notwithstanding this requirement, view of parking area that is unscreened from the right of way due to slope or topography shall require an increased landscaping standard under 4.176(.02) in order to buffer and soften the view of vehicles as much as possible. For purposes of this section, "view from the public right of way" is intended to mean the view from the sidewalk directly across the street from the site, or if no sidewalk, from the opposite side of the adjacent street or road.*

Response: The berm that will provide a buffer between the circulation and parking area on the Upper Site and the adjacent section of the Ice Age Tonquin Trail will be approximately 20-40 feet wide (from its narrowest point to widest point), as shown in the Site Plan (Exhibit A, Sheet 9). This landscaping buffer is being provided according to the high berm standard of Section 4.17(.02)(G), which will include varied and visually interesting plantings with spacing and openings that meet or exceed this standard. See the Upper Site Landscape Plans in Exhibit A, Sheets 18 and 21 through 23. Therefore, this standard is met.

> *f. Where topography and slope condition permit, the landscape buffer shall integrate parking lot storm water treatment in bioswales and related plantings. Use of berms or drainage swales are allowed provided that planting areas with lower grade are constructed so that they are protected from vehicle maneuvers. Drainage swales shall be constructed to Public Works Standards.*

Response: Stormwater for the Upper Site will be managed by two sets of swales (north and south) shown in the Upper Site Utility Plan and Site Plan (Exhibit A, Sheets 9 and 17). Stormwater in the vehicle circulation and parking area will drain into these swales, which will in turn drain into proposed new storm drains that will connect to a reconstructed outfall at Arrowhead Creek. Therefore, this standard is met.

g. In addition to the application requirements of section 4.035(.04)(6)(d), where view of signs is pertinent to landscape design, any approved or planned sign plan shall accompany the application for landscape design approval.

Response: Signs are not proposed as part of this application. Therefore, this standard is not applicable.

C. Off Street Parking shall be designed for safe and convenient access that meets ADA and ODOT standards. All parking areas which contain ten (10) or more parking spaces, shall for every fifty (50) standard spaces., provide one ADA-accessible parking space that is constructed to building code standards, Wilsonville Code 9.000.

Response: The two parking spaces outside the Electrical Building on the Upper Site are on an even grade and have enough room for vehicles to maneuver in the circulation area. One of the two spaces will be designated as ADA-accessible (Exhibit A, Sheet 9). Therefore, this standard is met.

D. Where possible, parking areas shall be designed to connect with parking areas on adjacent sites so as to eliminate the necessity for any mode of travel of utilizing the public street for multiple accesses or cross movements. In addition, on-site parking shall be designed for efficient on-site circulation and parking.

Response: There are no parking areas on adjacent sites to which to connect. Parking on the Upper Site consists of two parking spaces in a small circulation area (Exhibit A, Sheet 9), which is efficient. Therefore, this standard is met.

E. In all multi-family dwelling developments, there shall be sufficient areas established to provide for parking and storage of motorcycles, mopeds and bicycles. Such areas shall be clearly defined and reserved for the exclusive use of these vehicles.

Response: The proposed development is not a multi-family development. Therefore, this standard is not applicable.

F. On-street parking spaces, directly adjoining the frontage of and on the same side of the street as the subject property, may be counted towards meeting the minimum off-street parking standards.

Response: On-street parking spaces are not adjacent to the Upper Site and are not needed to meet minimum off-street parking standards. Therefore, this standard is not applicable.

G. Tables 5 shall be used to determine the minimum and maximum parking standards for various land uses. The minimum number of required parking spaces shown on Tables 5 shall be determined by rounding to the nearest whole parking space. For example, a use containing 500 square feet, in an area where the standard is one space for each 400 square feet of floor area, is required to provide one off-street parking space. If the same use contained more than 600 square feet, a second parking space would be required. Structured parking and on-street parking are exempted from the parking maximums in Table 5. [Amended by Ordinance No. 538, 2/21/02.]

Response: Pursuant to Section 4.155(.02)(M), off-street parking requirements for types of uses and structures not listed in the Code (including Table 5) shall be determined by the Development Review Board. It is understood that the Development Review Board is authorized to determine the requirements for the proposed development.

Parking is already provided for the Lower Site. Given the sporadic nature of personnel-based use of the Upper Site (maintenance and emergency visits), the applicant proposes that two parking spaces outside the building will be sufficient for the use. See the location of the parking spaces in the Site Plan (Exhibit A, Sheet 9).

H. Electrical Vehicle Charging Stations:

1. Parking spaces designed to accommodate and provide one or more electric vehicle charging stations on site may be counted towards meeting the minimum off-street parking standards.

2. Modification of existing parking spaces to accommodate electric vehicle charging stations on site is allowed outright.

Response: Electric vehicle parking spaces are not proposed as part of the development. Therefore, these standards are not applicable.

I. Motorcycle parking:

1. Motorcycle parking may substitute for up to 5 spaces or 5 percent of required automobile parking, whichever is less. For every 4 motorcycle parking spaces provided, the automobile parking requirement is reduced by one space.

2. Each motorcycle space must be at least 4 feet wide and 8 feet deep. Existing parking may be converted to take advantage of this provision.

Response: Motorcycle parking is not proposed as part of this development. Therefore, this standard is not applicable.

(.04) Bicycle Parking:

A. Required Bicycle Parking - General Provisions.

1. The required minimum number of bicycle parking spaces for each use category is shown in Table 5, Parking Standards.

2. Bicycle parking spaces are not required for accessory buildings. If a primary use is listed in Table 5, bicycle parking is not required for the accessory use.

3. When there are two or more primary uses on a site, the required bicycle parking for the site is the sum of the required bicycle parking for the individual primary uses.

4. Bicycle parking space requirements may be waived by the Development Review Board per Section 4.118(.03)(A.)(9.) and (10.).

Response: Table 5 does not specify bicycle parking requirements for public utility uses such as the proposed Raw Water Facilities. Consistent with the earlier response to the standard in Section 4.155(.02)(M), the proposed use is a unique use that will not be permanently staffed and will receive sporadic visits (maintenance visits and, if needed, emergency visits). Therefore, two vehicle parking spaces are proposed to be sufficient for the use, and bicycle parking spaces are not considered appropriate or needed for trips generated by the proposed use.

(.05) Minimum Off-Street Loading Requirements:

A. Every building that is erected or structurally altered to increase the floor area, and which will require the receipt or distribution of materials or merchandise by truck or similar vehicle, shall provide off-street loading berths on the basis of minimum requirements as follows:

1. Commercial, industrial, and public utility uses which have a gross floor area of 5,000 square feet or more, shall provide truck loading or unloading berths in accordance with the following tables:

Square feet of Floor Area	Number of Berths Required
Less than 5,000	0
5,000 - 30,000	1
30,000 - 100,000	2
100,000 and over	3

Response: The Electrical Building proposed on the Upper Site is a public utility use that will be approximately 7,853 square feet. Thus, one loading berth is required. Two truck loading spaces that are at least 12 feet wide by 35 feet long will be provided along the edge of the parking area as shown in the Upper Site’s Site Plan (Exhibit A, Sheet 9). Therefore, this standard is met.

2. Restaurants, office buildings, hotels, motels, hospitals and institutions, schools and colleges, public buildings, recreation or entertainment facilities, and any similar use which has a *gross floor area of 30,000 square feet or more, shall provide off-street truck loading or unloading berths in accordance with the following table:*

Square feet of Floor Area	Number of Berths Required
Less than 30,000	0
30,000 - 100,000	1
100,000 and over	2

Response: The proposed development does not involve the uses listed above. Therefore, this standard is not applicable.

3. A loading berth shall contain space twelve (12) feet wide, thirty-five (35) feet long, and have a height clearance of fourteen (14) feet. Where the vehicles generally used for loading and unloading exceed these dimensions, the required length of these berths shall be increased to accommodate the larger vehicles.

Response: Two truck loading spaces that are at least 12 feet wide by 35 feet long with 14 feet of clearance will be provided on the Upper Site as shown in the Site Plan (Exhibit A, Sheet 9). Therefore, this standard is met.

4. If loading space has been provided in connection with an existing use or is added to an existing use, the loading space shall not be eliminated if elimination would result in less space than is required to adequately handle the needs of the particular use.

Response: The loading space is not being provided with or as an addition to an existing use. Therefore, this standard is not applicable.

5. Off-street parking areas used to fulfill the requirements of this Ordinance shall not be used for loading and unloading operations except during periods of the day when not required to meet parking needs.

Response: Off-street parking areas are not proposed to fulfill loading requirements. Therefore, this standard is not applicable.

B Exceptions and Adjustments.

1. The Planning Director or Development Review Board may approve a loading area adjacent to or within a street right-of-way where it finds that loading and unloading operations:

a. Are short in duration (i.e., less than one hour);

b. Are infrequent (less than three operations daily);

c. Do not obstruct traffic during peak traffic hours;

d. Do not interfere with emergency response services or bicycle and pedestrian facilities; and

e. Are acceptable to the applicable roadway authority.

Response: A loading area is not proposed adjacent to or within a street right-of-way. Therefore, this standard is not applicable.

(.06) Carpool and Vanpool Parking Requirements:

A. Carpool and vanpool parking spaces shall be identified for the following uses:

1. New commercial and industrial developments with seventy-five (75) or more parking spaces,

2. New institutional or public assembly uses, and

3. Transit park-and-ride facilities with fifty (50) or more parking spaces.

B. Of the total spaces available for employee, student, and commuter parking, at least five percent, but not fewer than two, shall be designated for exclusive carpool and vanpool parking.

C. Carpool and vanpool parking spaces shall be located closer to the main employee, student or commuter entrance than all other parking spaces with the exception of ADA parking spaces.

D. Required carpool/vanpool spaces shall be clearly marked "Reserved - Carpool/Vanpool Only."

Response: Carpool and vanpool parking is not needed or required for the proposed use. Therefore, these standards are not applicable.

(.07) Parking Area Redevelopment. The number of parking spaces may be reduced by up to 10% of the minimum required parking spaces for that use when a portion of the existing parking area is modified to accommodate or provide transit-related amenities such as transit stops, pull-outs, shelters, and park and ride stations.

Response: Parking area redevelopment for transit-related amenities is not proposed. Therefore, this standard is not applicable.

Section 4.156 Sign Code Regulations

Section 4.156.01. Sign Regulations Purpose and Objectives.

(.01) Purpose. The general purpose of the sign regulations are to provide one of the principal means of implementing the Wilsonville Comprehensive Plan by fostering an aesthetically pleasing, functional, and economically vital community, as well as promoting public health, safety, and well-being. The sign

regulations strive to accomplish the above general purpose by meeting the needs of sign owners while maintaining consistency with the development and design standards elsewhere in Chapter 4. This code regulates the design, variety, number, size, location, and type of signs, as well as the processes required to permit various types of signs. Sign regulations have one or more of the following specific objectives:

A. Well-designed and aesthetically pleasing signs sufficiently visible and comprehensible from streets and rights-of-way that abut a site as to aid in wayfinding, identification and provide other needed information.

B. Sign design and placement that is compatible with and complementary to the overall design and architecture of a site, along with adjoining properties, surrounding areas, and the zoning district.

C. A consistent and streamlined sign review process that maintains the quality of sign development and ensures due process.

D. Consistent and equitable application and enforcement of sign regulations.

E. All signs are designed, constructed, installed, and maintained so that public safety, particularly traffic safety, are not compromised.

F. Sign regulations are content neutral.

Response: Signs are not proposed as part of this development. Therefore, the standards in this Section are not applicable.

Section 4.167. Access, Ingress and Egress

(.01) Each access onto streets or private drives shall be at defined points as approved by the City and shall be consistent with the public's health, safety and general welfare. Such defined points of access shall be approved at the time of issuance of a building permit if not previously determined in the development permit. [Amended by Ord. 682, 9/9/10]

Response: One access point is proposed onto Arrowhead Creek Lane for a driveway to and from the Upper Site. (See the Site Plan in Exhibit A, Sheet 9.) It is understood that this access point will need to be approved by the City at the time of development permit issuance or building permit issuance. Therefore, this standard is met.

Section 4.171. Protection of Natural Features and Other Resources

(.01) <u>Purpose</u>. It is the purpose of this Section to prescribe standards and procedures for the use and development of land to assure the protection of valued natural features and cultural resources. The requirements of this Section are intended to be used in conjunction with those of the Comprehensive Plan and other zoning standards. It is further the purpose of this Section:

A. To protect the natural environmental and scenic features of the City of Wilsonville.

B. To encourage site planning and development practices which protect and enhance natural features such as riparian corridors, streams, wetlands, swales, ridges, rock outcroppings, views, large trees and wooded areas.

C. To provide ample open space and to create a constructed environment capable and harmonious with the natural environment.

Response: The subject property includes the land along the Willamette River and riverfront, land designated as SROZ, and the Water Treatment Plant Park. These resources are subject to the provisions of this Section.

(.02) General Terrain Preparation:

A. All developments shall be planned, designed, constructed and maintained with maximum regard to natural terrain features and topography, especially hillside areas, floodplains, and other significant landforms.

Response: Water-dependent and water-related improvements (seismic stabilization measures and trails) are proposed on slopes and flood plain associated with the Willamette River, with footprints that balance minimizing impacts in these areas, engineering requirements, and improving access to the river. Otherwise, development of the pipeline and the Upper Site facilities have been planned and designed to avoid steep slope and SROZ Title 3 areas. Detail is provided in responses to SROZ and SRIR criteria in Section 4.139, flood plain regulations in Section 4.172, and Willamette River Greenway standards in Section 4.500-4.515. Therefore, this standard is met.

B. All grading, filling and excavating done in connection with any development shall be in accordance with the Uniform Building Code

Response: It is understood that grading, filling, and excavating will be required to be done in accordance with Uniform Building Code. Therefore, this standard will be met.

C. In addition to any permits required under the Uniform Building Code, all developments shall be planned, designed, constructed and maintained so as to:

l. Limit the extent of disturbance of soils and site by grading, excavation and other land alterations.

Response: The extent of disturbance in the Willamette River Greenway has been limited in ways including:

- Refining the access road to the river bank to be further upslope and away from the river, closer to the existing treatment plant building and avoiding the Greenway as opposed to earlier designs (Exhibit A, Sheet 7).
- Designing the bank stabilization measures to minimize grading area and impact to trees.

- Designing the new lower trail to terminate at a new lower overlook, rather than continue west and impact more of the slope.
- Proposing to restore grades, in large part, on the river bank and to provide restoration plantings, including reclamation of existing informal trails (Exhibit A, Sheet 19 and Exhibit D, Figures F3-1 and F4-1).

On other parts of the Lower Site, disturbance has been limited by restricting the work limits area along the proposed pipeline to approximately 50 feet in width (Exhibit A, Sheet 8). Existing grades will be restored after the pipeline is installed.

On the Upper Site, disturbance has been limited by designing installation of pipeline underneath Arrowhead Creek to be constructed with trenchless methods instead of open-cut methods (Exhibit A, Sheet 9). Existing grades at the launch shaft will be restored and otherwise, grades on the Upper Site will be created to support proposed building and ancillary facilities and to remove fill that has been stockpiled in this area for years. See the Upper Site Grading Plan (Exhibit A, Sheet 11).

Pipeline design on the Lower and Upper Site was collaboratively and deliberately planned to avoid disturbance in SROZ Title 3 areas. (See Exhibit A, Sheets 8-9.)

Therefore, this standard is met.

> *2. Avoid substantial probabilities of: (l) accelerated erosion; (2) pollution, contamination, or siltation of lakes, rivers, streams and wetlands; (3) damage to vegetation; (4) injury to wildlife and fish habitats.*
>
> *3. Minimize the removal of trees and other native vegetation that stabilize hillsides, retain moisture, reduce erosion, siltation and nutrient runoff, and preserve the natural scenic character.*

Response: The proposed development has been planned and designed in order to minimize these impacts in the following ways.

- Erosion – Accelerated erosion will be avoided by the following: adhering to the proposed Erosion Control Plan and protocols during construction (Exhibit A, Sheets 12-14); restoring some existing grades consistent with Grading Plans (Exhibit A, Sheets 10 and 11, and Exhibit D, Figures F3-1 and F4-1); and planting consistent with proposed Landscape and Mitigation Plans (Exhibit A, Sheets 18 and 21-23, and Exhibit D, Figures F4-1 and F4-3).

- Pollution and siltation – The specifications to the contractor will include requirements to implement containment measures adequate to prevent pollutants or construction materials (such as waste spoils, petroleum products, concrete cured less than 24 hours, concrete cure water, silt, and welding slag and grindings) from entering the Permitted Work Area or any regulated waters. In the event of any oil or product discharges into public waters, or onto land with a potential for entry into public waters, the contractor will be required to immediately commence response actions to protect human health and the environment. The contractor will follow approved plans including a pollution control plan, spill prevention control and countermeasure plan, and contingency plan, as appropriate. If the quantity released exceeds the State or federal reportable quantities, or if the release impacts or threatens to impact any surface water body, the contractor will immediately notify the Oregon Department of Environmental Quality (DEQ) via the Oregon Emergency Response System (OERS) as well as the Environmental Protection Agency and U.S. Coast Guard via the National Response Center (NRC). If the quantity released is unknown, the contractor will proceed with OERS and NRC notifications. Reportable quantities are listed in Code of Federal Regulations 40 CFR 302.4 and Oregon Administrative Rules (OAR) 340-142-0040 to 340-142-0050.

- Vegetation removal and damage – Vegetation removal and damage is being limited and mitigated for as addressed in response to SROZ and SRIR criteria in Section 4.139 and tree mitigation criteria in Section 4.620.
- Habitat damage – Habitat damage will be minimized by limiting (and mitigating for) vegetation removal, as referred to above. Conservation measures presented in the April 2017 WWSS Biological Assessment also address limiting habitat damage in ways including the following: perform in-water work during windows designated and approved by Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS); conduct fish salvage as needed; implement work area isolation measures; and clean all construction equipment – removing external oil, grease, and soil – before operating within 150 feet of permitted work area. Relevant excerpts of the Biological Assessment, including the conservation measures section, are included in this application as Exhibit L.

Therefore, these standards are met.

(.03) <u>Hillsides</u>: All developments proposed on slopes greater than 25% shall be limited to the extent that:

A. An engineering geologic study approved by the City, establishes that the site is stable for the proposed development, and any conditions and recommendations based on the study are incorporated into the plans and construction of the development. The study shall include items specified under subsection 4.171(.07)(A.)(2.)(a-j):

Response: A Geotechnical Data Report and Geotechnical Design Report have been prepared for the proposed development. The Geotechnical Design Report is included in this application as Exhibit M and addresses the criteria in Subsection 4.171(.07)(A.)(2.), as is discussed in response to those criteria later in this Section. Therefore, this standard is met.

B. Slope stabilization and re-vegetation plans shall be included as part of the applicant's landscape plans.

Response: Replanting of the river bank is addressed in the proposed Mitigation Plans provided in Exhibit A (Sheet 19) and Exhibit D (Appendix A, Figure F4-1). Therefore, this standard is met.

C. Buildings shall be clustered to reduce alteration of terrain and provide for preservation of natural features.

D. Creation of building sites through mass pad grading and successive padding or terracing of building sites shall be avoided where feasible.

Response: Buildings are not proposed on hillsides as part of this development. Therefore, this standard is not applicable.

E. Roads shall be of minimum width, with grades consistent with the City's Public Works Standards.

Response: Permanent roads are not proposed on hillsides as part of this development. Therefore, this standard is not applicable.

An access road is proposed on the Lower Site, adjacent to the river bank, for construction of the seismic stabilization measures. The construction access road has been designed to be close to existing development (WRWTP facilities) and to minimize intrusion onto the river bank, avoiding the Willamette River Greenway. See the Lower Site/River Bank Site Plan (Exhibit A, Sheet 7).

F. Maintenance, including re-vegetation, of all grading areas is the responsibility of the developer, and shall occur through October 1 of the second growing season following receipt of Certificates of Occupancy unless a longer period is approved by the Development Review Board.

Response: It is understood that maintenance of grading areas is the applicant's responsibility and will occur for a duration as specified in this standard. Therefore, this standard is met.

G. The applicant shall obtain an erosion and sediment control permit from the City's Building and Environmental Services Division's.

Response: Erosion control plans are included in this application (Exhibit A, Sheets 12-14). It is understood that an erosion and sediment control permit must be acquired. Therefore, this standard is and will be met.

(.04) Trees and Wooded Areas.

A. All developments shall be planned, designed, constructed and maintained so that:

l. Existing vegetation is not disturbed, injured, or removed prior to site development and prior to an approved plan for circulation, parking and structure location.

Response: Existing vegetation will generally not be disturbed, injured, or removed prior to site development and an approval plan for circulation, parking, and structure location. A small number of shrubs were removed for pre-development site survey work, which was approved by the City of Wilsonville. Therefore, this standard has and will be met.

2. Existing wooded areas, significant clumps/groves of trees and vegetation, and all trees with a diameter at breast height of six inches or greater shall be incorporated into the development plan and protected wherever feasible.

Response: On the river bank, trees and vegetation are being protected wherever feasible. Continuous refinement of seismic improvement designs – for example, finding ways to eliminate the need for a tie-back wall while still achieving seismic performance objectives – have allowed for reduction of impacts, including tree and vegetation removal. Trees to be preserved or mitigated for are shown in the Tree Protection Plan (Exhibit A, Sheet 26) and in the River Bank Mitigation Plan (Exhibit D, Appendix A, Figure F4-1). Trees to be preserved include trees identified by City staff as priorities for preservation on the upper bank and two “cable trees” used in past boating activity on the lower bank.

On the rest of the Lower Site, including the ravine to the west of the park, collaboration between the applicant team and City staff resulted in a project (pipeline) design and work area that avoid disturbance in Title 3 areas in this part of the SROZ, including tree removal in the ravine. See the Park Tree Removal and Protection Plan (Exhibit A, Sheet 27).

On the Upper Site, only one tree needs to be removed in order to construct the Electrical Building and ancillary facilities. Five trees are proposed for removal at the launch shaft site for pipeline to be installed under Arrowhead Creek; however, installation of this pipeline has been designed to avoid the Title 3 area of this part of the SROZ. (See the Tree Removal and Protection Plan in Exhibit A, Sheet 28.) Far more landscaping will be provided on the Upper Site than is present under current conditions, as shown in Upper Site Landscaping Plans (Exhibit A, Sheets 21-22).

Therefore, this standard is met.

3. Existing trees are preserved within any right-of-way when such trees are suitably located, healthy, and when approved grading allows.

Response: According to the Arborist Report, there are no street trees or right-of-way trees on the proposed development site (Exhibit N). Therefore, this standard is not applicable.

Several new trees are proposed to line Arrowhead Creek Lane adjacent to the Upper Site. (See the Upper Site Landscape Plans in Exhibit A, Sheets 21-22.)

B. Trees and woodland areas to be retained shall be protected during site preparation and construction according to City Public Works design specifications, by:

l. Avoiding disturbance of the roots by grading and/or compacting activity.

2. Providing for drainage and water and air filtration to the roots of trees which will be covered with impermeable surfaces.

3. Requiring, if necessary, the advisory expertise of a registered arborist/horticulturist both during and after site preparation.

4. Requiring, if necessary, a special maintenance, management program to insure survival of specific woodland areas of specimen trees or individual heritage status trees.

Response: Trees and woodland areas to be preserved will be protected consistent with this standard as described in the Arborist Report (Exhibit N). Therefore, this standard is met.

(.05) High Voltage Powerline Easements and Rights of Way and Petroleum Pipeline Easements:

A. Due to the restrictions placed on these lands, no residential structures shall be allowed within high voltage powerline easements and rights of way and petroleum pipeline easements, and any development, particularly residential, adjacent to high voltage powerline easements and rights of way and petroleum pipeline easements shall be carefully reviewed.

B. Any proposed non-residential development within high voltage powerline easements and rights of way and petroleum pipeline easements shall be coordinated with and approved by the Bonneville Power Administration, Portland General Electric Company or other appropriate utility, depending on the easement or right of way ownership.

Response: Residential structures are not proposed as part of this development. Therefore, the standard in Subsection A is not applicable.

Non-residential development (underground pipeline) is proposed to cross a BPA easement that intersects the development site. Coordination with BPA to date has included the following: (a) a meeting between BPA and the WWSP at the beginning of the RWF design process (October 2017); and (b) preparation of an analysis of the WWSS pipeline's crossing of the BPA easement to be reviewed by the WWSP leadership and included in the BPA land use application. Therefore, this standard is met.

(.07) Standards for Earth Movement Hazard Areas:

A. No development or grading shall be allowed in areas of land movement, slump or earth flow, and mud or debris flow, except under one of the following conditions:

1. Stabilization of the identified hazardous condition based on established and proven engineering techniques which ensure protection of public and private property. Appropriate conditions of approval may be attached by the City.

2. An engineering geologic study approved by the City establishing that the site is stable for the proposed use and development. The study shall include the following:

a. Index map.

b. Project description, to include: location; topography, drainage, vegetation; discussion of previous work; and discussion of field exploration methods.

c. Site geology, to include: site geologic map; description of bedrock and superficial materials including artificial fill; location of any faults, folds, etc.; and structural data including bedding, jointing, and shear zones.

d. Discussion and analysis of any slope stability problems.

e. Discussion of any off-site geologic conditions that may pose a potential hazard to the site or that may be affected by on-site development.

f. Suitability of site for proposed development from geologic standpoint.

g. Specific recommendations for cut slope stability, seepage and drainage control, or other design criteria to mitigate geologic hazards.

h. Supportive data, to include: cross sections showing subsurface structure; graphic logs of subsurface explorations; results of laboratory tests; and references.

i. Signature and certification number of engineering geologist registered in the State of Oregon.

B. Vegetative cover shall be maintained or established for stability and erosion control purposes.

C. Diversion of storm water into these areas shall be prohibited.

D. The principal source of information for determining earth movement hazards is the State Department of Geology and Mineral Industries (DOGAMI) Bulletin 99 and any subsequent bulletins and accompanying maps. Approved site-specific engineering geologic studies shall be used to identify the extent and severity of the hazardous conditions on the site, and to update the earth movement hazards database.

Response: The Geotechnical Design Report prepared for the proposed development did not identify earth movement hazard areas on the site (Exhibit M). Therefore, these standards are not applicable.

The application includes the following information related to these standards.

- Grading – Grading proposed on the river bank has been minimized for the access road, moving the road closer to the top of the bank and the existing water treatment plant building through design iterations. (See River Bank Grading Plans in Exhibit A, Sheet 10.) Grading needed for the proposed trails on the river bank will be limited. The trails have been designed to work with the existing contours of the river bank and features “cribbed” steps boxed in by timbers to prevent erosion. (See the Trail Plan in Exhibit A, Sheet 19.)

- Engineering geologic study – The Geotechnical Design Report included in this application addresses applicable elements of Subsection 2 above (Exhibit M).

- Vegetative cover – Vegetative cover is being maintained around Arrowhead Creek on the Upper Site, in the ravine on the west side of the Lower Site, and to the extent feasible on the river bank on the Lower Site to allow for the proposed development. Existing vegetation will be maintained and new vegetation will be established as shown in the Tree Removal and Protection Plans (Exhibit A, Sheets

25-28), Landscape Plans (Exhibit A, Sheets 18-24), and Mitigation Plans (Exhibit D, Figures F4-1 and F4-3).

- Stormwater – A limited amount of new impervious surface will be added on the Lower Site by widening the existing pathway through the park to accommodate service and emergency vehicles and creating a new connection between the park pathway and the Arrowhead Creek Lane turnaround in the southeastern part of the site. Stormwater draining from the park pathway is proposed to be naturally dispersed given the amount of vegetation surrounding the pathway, the crowned shed profile proposed for the restoration of the existing pathway, and gravel or pavers used for where the pathway makes a new connection to the Arrowhead Creek Lane turnaround. See the updated Utility Plan (Exhibit A, Sheet 15 and the updated Stormwater Report (Exhibit J). City staff have preliminarily indicated that this will be an acceptable approach to addressing stormwater on the Lower Site.[10]
  On the Upper Site, surface water will drain to swales proposed on the north and south sides of the site. The swales will lead to proposed new storm drains that will connect to a reconstructed outfall at Arrowhead Creek. See the Upper Site Utility Plan (Exhibit A, Sheet 17) and Upper Site Stormwater Plan (Exhibit A, Sheet 45).
  Drainage and stormwater facilities proposed for the entire site are addressed in detail in the Preliminary Stormwater Report provided in Exhibit J. Surface water drainage and potential erosion during construction will be managed on the Upper Site and Lower Site according to the Erosion Control Plans provided in Exhibit A (Sheets 12-13).

(.08) Standards for Soil Hazard Areas:

A. Appropriate siting and design safeguards shall insure structural stability and proper drainage of foundation and crawl space areas for development on land with any of the following soil conditions: wet or high water table; high shrink-swell capability; compressible or organic; and shallow depth-to-bedrock.

B. The principal source of information for determining soil hazards is the State DOGAMI Bulletin 99 and any subsequent bulletins and accompanying maps. Approved site-specific soil studies shall be used to identify the extent and severity of the hazardous conditions on the site, and to update the soil hazards database accordingly.

Response: The Geotechnical Design Report prepared for the proposed development did not identify soil hazard areas on the site (Exhibit M). Therefore, these standards are not applicable. The Geotechnical Design Report has been used to inform project siting and design, and can be used to update soils databases as applicable and as needed.

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[10] Email communication between Kerry Rappold, City of Wilsonville, and Ashley Canton, Otak (project consultant), July 3, 2019.

(.09) Historic Protection: Purpose:

A. To preserve structures, sites, objects, and areas within the City of Wilsonville having historic, cultural, or archaeological significance.

Response: As found in the land use application for the original development of the WRWTP (Casefile 00DB18), no cultural resources have been documented on the WRWTP site. The cultural resources survey of the site performed by Archaeological Investigations Northwest, Inc. found that the development of the WRWTP would not affect any significant cultural resources. There are two cable trees identified along the river bank used in past boating activity on the lower bank; these trees will be preserved. Although portions of existing informal river bank trails will be decommissioned and replanted during RWF construction, a portion of the existing informal trail will be retained to provide access to the cable trees. (See the Trail Plan in Exhibit A, Sheet 19.) Therefore, this standard is met.

(.10) Alteration and Development Criteria:

A. Demolition or alteration of any structure, or any change in any site or object which has been designated as a cultural resource, is prohibited unless it is determined:

1. In the case of a designated cultural resource, the proposed work would not detrimentally alter, destroy or adversely affect any exterior architectural or other identified feature; or

2. In the case of any property located within a historic district, the proposed construction, removal, rehabilitation, alteration, remodeling, excavation or exterior alteration conforms to any prescriptive standards as adopted by the City, and does not adversely affect the character of the district; or

3. In the case of construction of a new improvement, building or structure upon a cultural resource site, the exterior of such improvements will not adversely affect and will be compatible with the external appearance of existing designated improvements, buildings and structures on said site; or

4. That no reasonable use can be made of the property without such approval.

Response: Demolition or alteration of a structure, or change in a site or object that has been designated as a cultural resource, is not proposed. Therefore, these standards are not applicable.

(.11) Cultural Resource Designation Criteria: A cultural resource may be designated and placed on the Cultural Resources Inventory if it meets the following criteria:

A. It exemplifies or reflects special elements of the City's cultural, social, economic, political, aesthetic, engineering or architectural history; or

B. It is identified with persons or events significant in local, state, or national history; or

C. It embodies distinctive characteristics of a style, type, period, or method of construction, or it is a valuable example of the use of indigenous materials or craftsmanship; or

D. It is representative of the notable work of a builder, designer, or architect.

Response: Cultural resources are not proposed to be designated and placed on the Cultural Resources Inventory. Therefore, these standards are not applicable.

Section 4.172 Flood Plain Regulations

(.01) <u>Purpose</u>:

A. To minimize public and private losses due to flood conditions in flood-prone areas.

B. To regulate uses and alteration of land which would otherwise cause erosion, decreased storm water storage capability, increased flood heights or velocities.

C. To require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction, alteration or remodeling.

D. To restrict filling, grading, dredging, and other development which would increase flood damage.

E. To prevent construction of flood barriers which would unnaturally divert flood waters or increase flood hazards in other areas.

F. To properly regulate the l00-year flood plain identified by the Federal Insurance Administration (FIA) in the "Flood Insurance Study for Clackamas County and Incorporated Areas dated effective June 17, 2008l, and displayed on FIA Floodway and Flood Insurance Rate Maps dated effective June 17, 2008, which are on file with the City’s Community Development Department.

G. To implement the policies of the Comprehensive Plan and to provide standards consistent with Wilsonville’s adopted Storm Drainage Master Plan.

H. To insure the City and its residents and businesses, continued eligibility in the National Flood Insurance Program by complying with the requirements of the National Flood Insurance Act of l968 and the Flood Disaster Protection Act of l973.

Response: Development is proposed within the 100-year flood plain, consisting of the lower portion of the proposed new lower trail and associated amenities, i.e., a lower overlook (Exhibit A, Sheet 19 and Exhibit D, Figures F4-1 and F4-2). Development is proposed within the floodway, consisting of the replacement of fish screens and installation of protection piles (Exhibit A, Sheet 6). Therefore, the standards of this Section apply and applicable standards are addressed in the responses below.

(.02) General Provisions Affecting Flood Plains:

A. This section shall apply to all flood plain areas in the City of Wilsonville identified by the Flood Insurance Rate Map. No Building Permits, Construction Permits, or Development Permits for *development within the flood plain shall be issued except in compliance with the provisions of the Section. [Amended by Ord 686, 11/1/10]*

B. Basis for Establishing the Areas of Special Flood Hazard. The areas of special flood hazard identified by the Federal Insurance Administration in a scientific and engineering report entitled "Flood Insurance Study – Clackamas County, Oregon and Incorporated Areas, effective June 17, 2008," with accompanying Flood Insurance Rate Maps (effective date June 17, 2008) is hereby adopted by reference and declared part of this ordinance. The Flood Insurance Study is on file at the City of Wilsonville Community Development Department.

C. The City of Wilsonville Community Development Director shall review all Building and Grading Permit applications for new construction or substantial improvement to determine whether proposed building or grading sites will be located in a flood plain. If a proposed building or grading site is located within a flood plain, any proposed new construction, grading, or substantial improvement (including prefabricated and manufactured housing) must:

> *l. Be designed (or modified) and anchored to prevent flotation, collapse or lateral movement of the structure.*
>
> *2. Use construction materials and utility equipment that are resistant to flood damage,*
>
> *3. Use construction methods and practices that will minimize flood damage, and*
>
> *4. Limit the addition of any fill material such that the total volume of fill within the flood plain does not exceed the volume of material removed from the flood plain in the same area.*

Response: The lower portion of the new lower trail, including a lower overlook, is proposed within the flood plain. Given that the trail will be unpaved (gravel), it will be resilient after flooding. (See the Trail Plan in Exhibit A, Sheet 19.) Replacement of the existing fish screens (intake screens) and installation of protection piles adjacent to the intake are proposed in the floodway, as shown in Exhibit A, Sheet 6. Development in the flood plain and floodway will result in no rise of the flood height as documented in the engineer's letter in Exhibit O. Therefore, this standard is met.

D. That the City of Wilsonville Planning Director shall review subdivision proposals and other proposed new developments within the flood plain to assure that:

> *1. all such proposals are consistent with the need to minimize flood damage,*
>
> *2. all public utilities and facilities, such as sewer, gas, electrical and water systems are located, elevated and constructed to minimize or eliminate flood damage,*
>
> *3. adequate drainage is provided so as to reduce exposure to flood hazards, and*
>
> *4. No new lots or parcels shall be created for the purpose of increasing the development of buildings for human occupancy within the flood plain.*

Response: The proposed new lower trail will be unpaved and will be a very minor alteration within the flood plain. Therefore, it will cause and be subject to minimal or no flood damage within the flood plain.

New public utilities and facilities are not proposed in the flood plain. An existing 76-inch raw water pipeline, which will be maintained as part of this development, runs underground from the floodway to the caisson structure at an elevation of approximately 45 feet, roughly 45 feet below the 100-year flood plain elevation (91 feet). (See the Bank Stabilization Profile in Exhibit A, Sheet 33.) Being underground, the pipeline is not subject to flood damage.

New lots or parcels are not proposed.

Therefore, these standards are met.

E. That the City of Wilsonville Community Development Director shall require new or replacement water supply systems and/or sanitary sewage systems to be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters and require on-site waste disposal systems to be located so as to avoid impairment of them or contamination from them during flooding.

Response: The existing water supply pipeline is underground in the flood plain. No sanitary sewer systems are proposed in the flood plain. Therefore, this standard is not applicable.

(.03) Development Permit Required:

A. A Development Permit shall be obtained before construction or development, including grading, begins within any area of special flood hazard. The Permit shall be for all structures including manufactured homes and for all development including fill and other activities.

B. Outright Permitted Uses in the l00-year Flood Plain:

l. Agricultural use that is conducted without a structure other than a boundary fence.

2. Recreational uses which would require only minor structures such as picnic tables and barbecues.

3. Residential uses that do not contain buildings.

4. Underground utility facilities.

5. Repair, reconstruction or improvement of an existing structure, the cost of which is less than 50 percent of the market value of the structure, as determined by the City's Building Official, prior to the improvement or the damage requiring reconstruction, provided no development occurs in the floodway.

Response: Development is proposed in the 100-year flood plain and, therefore, a Flood Plain Permit is required. Development of a trail is proposed in the flood plain. These uses are recreational uses that are permitted outright in the flood plain pursuant to the above provisions.

(.04) Uses within the l00-year Flood Plain requiring a Flood Plain Permit:

A. Any development except as specified in subsection (.03), above, that is otherwise permitted within the Zoning District provided such development is consistent with the Flood Plain Standards.

B. All subdivisions and land partitions.

C. Installation of dikes to provide buildable or usable property, provided that said dikes do not conflict with the policies of the Comprehensive Plan and this Section.

Response: Replacement of the fish screens and installation of protection piles are proposed in the floodway (Exhibit A, Sheet 6) and, therefore, a Flood Plain Permit is required. These facilities are underwater utility facilities, similar in impact to the "underground utility facilities" that are permitted outright in the 100-year flood plain pursuant to Subsection (.03) above. While these facilities may be interpreted to be exempt from the provisions in this Section, responses to provisions in this Section are provided to ensure a thorough and complete application.

(.05) Prohibited Uses in the l00-year Flood Plain:

A. Any use or building which stores or otherwise maintains hazardous materials, chemicals, explosives or any other similar materials.

B. Storage of any materials that are not properly anchored, enclosed or protected to prevent movement or flotation beyond the property lines.

C. Critical Facility. Construction of new critical facilities shall be, to the extent possible, located outside the limits of the Special Flood Hazard Area (SFHA) (100-year floodplain). Construction of new critical facilities shall be permissible within the SFHA if no feasible alternative site is available. Critical facilities constructed within the SFHA shall have the lowest floor elevated three feet or to the height of the 500-year flood, whichever is higher. Access to and from the critical facility should also be protected to the height utilized above. Flood-proofing and sealing measures must be taken to ensure that toxic substances will not be displaced by or released into floodwaters. Access routes elevated to or above the level of the base flood elevation shall be provided to all critical facilities to the extent possible.

Response: The prohibited uses specified in the provisions above are not proposed as part of this development.

(.06) Flood Plain Permit Review Process:

F. Submittal requirements.

l. A field survey in relation to mean sea level by a licensed surveyor or civil engineer of the actual location of the l00-year flood plain, fringe, floodway and the lowest habitable finished floor elevations, including basements, of all existing structures.

2. A Site Plan map showing all existing and proposed contours and development and supplemented by a soils and hydrologic report sufficient to determine the net effect of the *proposed development on the flood plain elevations on the subject site and adjacent properties. Proposed areas of cut or fill shall be clearly indicated.*

3. A soils stabilization plan for all cuts, fills and graded areas.

Response: The 100-year flood plain and floodway are indicated in Exhibit D, Figures F4-1 and F4-2. Limited grading and balanced cut and fill is proposed in the flood plain in order to construct the lower portion of the new lower trail. The lower trail will work with existing contours, including using part of an existing informal trail as shown in the Trail Plan (Exhibit A, Sheet 19). Existing, temporary, and proposed final contours on the river bank are shown in the River Bank Grading Plan (Exhibit A, LUP-07), River Bank Existing Conditions (Exhibit D, Appendix A, Figure F2-1), River Bank Temporary Conditions (Exhibit D, Appendix A, Figure F3-1), and River Bank Final Conditions (Exhibit D, Appendix A, Figure F4-1). Soil conditions and stabilization are addressed in the Geotechnical Design Report (Exhibit M). An engineer's statement about no rise in flood height as a result of the proposed development is included in this application as Exhibit O. Therefore, this standard is met.

G. Use and Interpretation of Base Flood Data and maps.

l. When specific l00-year flood plain elevation data has not been provided in as required in this Section, the Community Development Director shall obtain, review and reasonably utilize any base flood elevation data available from Federal, State or other sources, in order to determine compliance with this Section.

2. The Community Development Director shall make the final interpretation of the exact l00-year flood plain boundaries on the FIRM and the Floodway Map. Appeals shall be granted consistent with the Standards of the rules and regulations of the National Flood Insurance Program and pursuant to WC 4.172(.08) Appeal Board.

Response: The Bank Stabilization Profile (Exhibit A, Sheet 33) and the SRIR (Exhibit D, Figures F4-1 and F4-2) provide 100-year flood plain elevation data in profile view and plan view. It is understood that the Community Development Director has authority to obtain and interpret flood plain elevation data.

H. Monumentation and Recordation:

1. Prior to issuance of a Flood Plain Permit, the Community Development Director shall cause the placement of an elevation marker, set at two (2) feet above the l00-year flood elevation, on the subject property. The marker shall be properly identified and permanently monumented in concrete.

2. A Site Plan or map showing the location and elevation of the monument shall be submitted to and maintained on file by the Community Development Director.

3. Prior to issuance of an Occupancy Permit, for any structure within the l00-year flood plain, the Community Development Director shall insure by signature of a licensed surveyor or civil engineer (elevation certificate) that the finished floor elevation of commercial, industrial and public buildings are one and one-half (l-l/2) feet above the l00-year flood elevation and that *residential uses are two (2) feet above the 100-year flood elevation. The finished floor elevation shall be in relation to mean sea level, of the lowest floor (including basement) of all structures. A copy of the finished construction elevation certificate for all new and substantially improved structures shall be provided to and maintained on file by the Community Development Director.*

4. For all new or substantially improved flood proofed structures where base flood elevation data is provided through the Flood Insurance Study, FIRM, or as required in Section 4.172(.06)(G):

a. Verify and record the actual elevation (in relation to mean sea level) to which the structure was flood proofed, and

b. Maintain the flood proofing certifications required in Section 4.172(.07)(F)(1)(c).

5. Maintain for public inspection all records pertaining to the provisions of this ordinance.

Response: It is understood that the Community Development Director will arrange for the placement of a flood elevation marker and that a site plan or map of this marker must be submitted to and maintained by the Community Development Director. Further, it is understood that records will be maintained related to these provisions. No structures requiring occupancy permits or flood proofing are proposed within the flood plain. Therefore, these standards will be met.

(.07) General Standards:

A. Anchoring requirements:

l. All new construction and substantial improvements shall be anchored to prevent flotation, collapse or lateral movement of the structure.

2. All manufactured homes must likewise be anchored to prevent flotation, collapse or lateral movement, and shall be installed using methods and practices that minimize flood damage. Anchoring methods may include, but are not limited to, use of over-the-top of frame ties to ground anchors (Reference FEMA's "Manufactured Home Installation in Flood Hazard Areas" guidebook for additional techniques).

3. All recreational vehicles must either be elevated two (2) feet or more above the 100-year flood elevation and anchored in accordance with paragraph 2, above, or be on the site for less than 180 consecutive days and be fully licensed and highway ready. A recreational vehicle is ready for highway use if its wheels are in place and it is attached to the site only by quick disconnect type utilities and security devices and has no permanently attached additions.

Response: Improvements requiring anchoring are not proposed. Therefore, these standards are not applicable.

B. Construction materials and methods:

1. All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.

2. All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.

3. Electrical, heating, ventilation, plumbing, and air-conditioning equipment and other service facilities shall be designed and/or otherwise elevated or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

4. Below-grade crawl spaces:

a. Below-grade crawlspaces are allowed subject to the following standards as found in FEMA Technical Bulletin 11-01, Crawlspace Construction for Buildings Located in Special Flood Hazard Areas:

i. The building must be designed and adequately anchored to resist flotation, collapse, and lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy. Hydrostatic loads and the effects of buoyancy can usually be addressed through the required openings stated in Section B below. Because of hydrodynamic loads, crawlspace construction is not allowed in areas with flood velocities greater than five (5) feet per second unless the design is reviewed by a qualified design professional, such as a registered architect or professional engineer. Other types of foundations are recommended for these areas.

ii. The crawlspace is an enclosed area below the base flood elevation (BFE) and, as such, must have openings that equalize hydrostatic pressures by allowing the automatic entry and exit of floodwaters. The bottom of each flood vent opening can be no more than one (1) foot above the lowest adjacent exterior grade.

iii. Portions of the building below the BFE must be constructed with materials resistant to flood damage. This includes not only the foundation walls of the crawlspace used to elevate the building, but also any joists, insulation, or other materials that extend below the BFE. The recommended construction practice is to elevate the bottom of joists and all insulation above BFE.

iv. Any building utility systems within the crawlspace must be elevated above BFE or designed so that floodwaters cannot enter or accumulate within the system components during flood conditions. Ductwork, in particular, must either be placed above the BFE or sealed from floodwaters.

v. The interior grade of a crawlspace below the BFE must not be more than two (2) feet below the lowest adjacent exterior grade.

vi. The height of the below-grade crawlspace, measured from the interior grade of the crawlspace to the top of the crawlspace foundation wall must not exceed four (4) feet at any point. The height limitation is the maximum allowable unsupported wall height according to the engineering analyses and building code requirements for flood hazard areas.

vii. There must be an adequate drainage system that removes floodwaters from the interior area of the crawlspace. The enclosed area should be drained within a reasonable time after a flood event. The type of drainage system will vary because of the site gradient and other drainage characteristics, such as soil types. Possible options include natural drainage through porous, well-drained soils and drainage systems such as perforated pipes, drainage tiles or gravel or crushed stone drainage by gravity or mechanical means.

viii. The velocity of floodwaters at the site should not exceed five (5) feet per second for any crawlspace. For velocities in excess of five (5) feet per second, other foundation types should be used.

Response: The proposed lower trail will be constructed with natural materials (e.g., gravel), which are naturally resistant to flood damage. Therefore, the standards in Subsections 1 and 2 above are met.

Below-grade crawl spaces and equipment for electrical, heating, ventilation, plumbing, and air-conditioning are not proposed as part of the development in the flood plain. Therefore, the standards in Subsections 3 and 4 above are not applicable.

C. Utilities:

1. All new replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system.

2. New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge from the systems into flood waters.

3. On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding.

Response: Whole new or replacement water supply systems, sanitary sewer systems, or disposal systems are not proposed as part of the development in the flood plain. Therefore, the standards in Subsections 1, 2, and 3 above are not applicable.

The existing 76-inch raw water pipeline, the intake screens that are proposed to be replaced, and the protection piles that are proposed to be installed in the floodway are all designed to take in water or be submerged in water.

D. Alteration of Watercourses

Response: The proposed replacement of the intake screens and installation of protection piles adjacent to the intake will not result in or require an alteration of the Willamette River's watercourse. Development in the flood plain and floodway will result in no rise of the flood height as documented in the engineer's letter in Exhibit O. Therefore, this standard is not applicable.

E. Residential Construction

Response: Residential construction is not proposed as part of this development or in the flood plain. Therefore, these standards are not applicable.

F. Nonresidential Construction:

l. New construction and substantial improvement of any commercial, industrial or other nonresidential structure shall either have the lowest finished floor, including basement, elevated one and one-half (l-l/2) feet above the l00-year flood elevation; or, together with attendant utility and sanitary facilities, shall:

a. Be floodproofed so that below the base flood level the structure is water-tight with walls substantially impermeable to the passage of water.

b. Have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy.

c. Be certified by a registered professional engineer or architect that the standards of this subsection are satisfied. Floodproofing certifications are required to be provided to the Community Development Director.

d. Nonresidential structures that are elevated, not flood-proofed, must meet the same standards for space below the lowest floor as prescribed for residential construction, above.

e. Applicants floodproofing nonresidential buildings shall be notified that flood insurance premiums will be based on rates that are one foot below the flood-proofed level (e.g., a building constructed to the base flood level will be rated as one foot below that level).

2. Manufacture homes shall meet the requirements of Section 4.172(.07)(E)(3).

Response: Non-residential structures and manufactured homes addressed in the above provisions are not part of the development proposed in the flood plain. Therefore, these standards are not applicable.

G. Before Regulatory Floodway. In areas where a regulatory floodway has not been designated, no new construction, substantial improvements, or other development (including fill) shall be permitted *within Zone AE on the community's FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community.*

Response: A regulatory floodway has been designated. Therefore, this standard is not applicable.

H. Floodways:

l. Located within the flood plain are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters which carry debris, potential projectiles, and erosion potential, the following provisions apply:

a. Encroachments, including fill, new construction, or substantial improvements, and other development shall be prohibited unless certification by a registered professional civil engineer is provided, demonstrating through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that encroachments shall not result in any increase flood levels during the occurrence of the base flood discharge.

b. All development shall comply with all applicable flood plain standards of Section 4.172.

c. All buildings designed for human habitation and/or occupancy shall be prohibited within the floodway.

Response: The intake screen replacement and protection pile installation proposed in the floodway will result in no rise in the flood height as documented in the engineer's letter in Exhibit O. Applicable flood plain standards in Section 4.172 are met, as demonstrated in the responses in this Section. Therefore, this standard is met.

I. Parking Lots and Storage Areas:

l. All parking lots and storage areas below the flood plain elevation shall be paved.

2. A minimum of twenty-five (25) percent of the required parking space must be provided above the l00-year flood plain elevation for all nonresidential uses.

3. Residential uses shall provide at least one parking space per unit above the l00-year flood plain elevation.

Response: Parking lots and storage areas are not proposed in the flood plain. Therefore, these standards are not applicable.

J. Subdivision Proposals

Response: The proposed development does not involve a subdivision. Therefore, this standard is not applicable.

K. Review of Building Permits. Where elevation data is not available either through the Flood Insurance Study or from another authoritative source, applications for Building Permits shall be reviewed to assure that proposed construction will be reasonably safe from flooding. The test of reasonableness is a local judgment and includes use of historical data, high water marks, photographs of past flooding, etc., where available. Failure to elevate at least two feet above grade in these zones may result in higher insurance rates.

Response: Elevation data is available and development proposed within the floodway is being evaluated with available existing elevation data. Therefore, this standard is not applicable.

Section 4.175. Public Safety and Crime Prevention

(.01) All developments shall be designed to deter crime and insure public safety.

(.02) Addressing and directional signing shall be designed to assure identification of all buildings and structures by emergency response personnel, as well as the general public.

(.03) Areas vulnerable to crime shall be designed to allow surveillance. Parking and loading areas shall be designed for access by police in the course of routine patrol duties.

(.04) Exterior lighting shall be designed and oriented to discourage crime.

Response: Public safety was factored into designs and operations for the original WRWTP and has been factored into designs and operations for the proposed development.

- An address placard for new development on the Upper Site will be clearly provided as shown in the Entrance Gate Plan (Exhibit A, Sheet 32).
- Fencing will be provided around the new facilities on the Upper Site. As shown in the Site Plan (Exhibit A, Sheet 9) and the Upper Site Cross-Section Perspectives (Exhibit A, Sheet 35), an 8-foot ornamental metal fence will be installed along the western, southern, and eastern sides of the site and an 8-foot chainlink fence will be installed along the northern side of the site.
- Lighting will be provided on the Upper Site to support safe operations and site security. Lighting is discussed in detail in the responses to criteria in Section 4.199.
- Security cameras on the Upper Site and Lower Site, including a pole-mounted camera on the river bank aimed at the fish screen, will enhance safety and security on the site.
- Site access will be controlled and personal protective equipment will be required during RWF construction and maintenance activities.
- Safety measures in place for the existing WRWTP site will be maintained.

Therefore, these standards are met.

Section 4.176. Landscaping, Screening, and Buffering

(.01) Purpose. This Section consists of landscaping and screening standards and regulations for use throughout the City. The regulations address materials, placement, layout, and timing of installation. The City recognizes the ecological and economic value of landscaping and requires the use of landscaping and other screening or buffering to:

A. Promote the re-establishment of vegetation for aesthetic, health, erosion control, flood control and wildlife habitat reasons;

B. Restore native plant communities and conserve irrigation water through establishment, or re-establishment, of native, drought-tolerant plants;

C. Mitigate for loss of native vegetation;

D. Establish and enhance a pleasant visual character which recognizes aesthetics and safety issues;

E. Promote compatibility between land uses by reducing the visual, noise, and lighting impacts of specific development on users of the site and abutting sites or uses;

F. Unify development and enhance and define public and private spaces;

G. Promote the retention and use of existing topsoil and vegetation. Amended soils benefit stormwater retention and promote infiltration;

H. Aid in energy conservation by providing shade from the sun and shelter from the wind; and

I. Screen from public view the storage of materials that would otherwise be considered unsightly.

J. Support crime prevention, create proper sight distance clearance, and establish other safety factors by effective landscaping and screening.

K. Provide landscaping materials that minimize the need for excessive use of fertilizers, herbicides and pesticides, irrigation, pruning, and mowing to conserve and protect natural resources, wildlife habitats, and watersheds.

Response: The proposed development is subject to applicable landscaping provisions in this Section.

(.02) Landscaping and Screening Standards.

A. Subsections “C” through “I,” below, state the different landscaping and screening standards to be applied throughout the City. The locations where the landscaping and screening are required and the depth of the landscaping and screening is stated in various places in the Code.

B. All landscaping and screening required by this Code must comply with all of the provisions of this Section, unless specifically waived or granted a Variance as otherwise provided in the Code. The landscaping standards are minimum requirements; higher standards can be substituted as long as fence and vegetation-height limitations are met. Where the standards set a minimum based on square footage or linear footage, they shall be interpreted as applying to each complete or partial increment of *area or length (e.g., a landscaped area of between 800 and 1600 square feet shall have two trees if the standard calls for one tree per 800 square feet).*

C. General Landscaping Standard.

1. Intent. The General Landscaping Standard is a landscape treatment for areas that are generally open. It is intended to be applied in situations where distance is used as the principal means of separating uses or developments and landscaping is required to enhance the intervening space. Landscaping may include a mixture of ground cover, evergreen and deciduous shrubs, and coniferous and deciduous trees.

2. Required materials. Shrubs and trees, other than street trees, may be grouped. Ground cover plants must fully cover the remainder of the landscaped area (see Figure 21: General Landscaping). The General Landscaping Standard has two different requirements for trees and shrubs:

a. Where the landscaped area is less than 30 feet deep, one tree is required for every 30 linear feet.

b. Where the landscaped area is 30 feet deep or greater, one tree is required for every 800 square feet and two high shrubs or three low shrubs are required for every 400 square feet.

Response: The Lower Site is a generally open area where distance is the principal means of buffering and screening adjacent properties and developments. As shown in the Park Site Plan (Exhibit A, Sheet 8), vegetated areas of 20 feet to more than 170 feet wide are located between the work area limits proposed on the Lower Site and the western property line. Existing landscaping on the river bank area of the Lower Site will be largely preserved and trees in the ravine area will be preserved. Replanting and mitigation will occur for vegetation and trees proposed to be removed. (See the Tree Removal and Protection Plan in Exhibit A, Sheet 25, and the Mitigation Plan for the River Bank in Exhibit D, Appendix A, Figure F4-1.) Existing landscaping and proposed planting are consistent with the General Landscaping Standard above.

Therefore, this standard is met for the Lower Site.

The Upper Site is subject to the High Berm landscaping standards in Section 4.176(.02)(G); see the responses to those standards below.

G. High Berm Standard.

1. Intent. The High Berm Standard is intended to be applied in situations where extensive screening to reduce both visual and noise impacts is needed to protect abutting uses or developments from one-another, and where it is desirable and practical to provide separation by both distance and sight-obscuring materials. This screening is most important where either, or both, of the abutting uses or developments can be expected to be particularly sensitive to noise or visual impacts.

> *2. Required materials. The High Berm Standard requires a berm at least four (4) feet high along the interior side of the landscaped area (see Figure 25: High Berm Landscaping). If the berm is less than six (6) feet high, low shrubs meeting the Low Screen Landscaping Standard, above, are to be planted along the top of the berm, assuring that the screen is at least six (6) feet in height In addition, one tree is required for every 30 linear feet of berm, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area.*

Response: Given its closer proximity to adjacent development, proposed development on the Upper Site is subject to the High Berm Standard. As shown in Upper Site Cross-Section Perspectives (Exhibit A, Sheet 35), the berm (with plantings on top of the berm) that is proposed between the Electrical Building and the existing pathway and neighborhood to the west and Arrowhead Creek Lane to the south and east will be at least 6 feet in height, consistent with the 6-foot standard in Subsection 2 above.

Trees will be planted more closely spaced together than the minimum 30 feet. Shrubs or ground cover (bark mulch or rough seeded lawn) will be planted in the remainder of the landscaped area. (See the Landscape Plans in Exhibit A, Sheets 18 and 21-24, in addition to the Cross-Section Perspectives in Exhibit A, Sheet 35.)

Therefore, this standard is met.

> *(.03) Landscape Area. Not less than fifteen percent (15%) of the total lot area, shall be landscaped with vegetative plant materials. The ten percent (10%) parking area landscaping required by section 4.155.03(B)(1) is included in the fifteen percent (15%) total lot landscaping requirement. Landscaping shall be located in at least three separate and distinct areas of the lot, one of which must be in the contiguous frontage area. Planting areas shall be encouraged adjacent to structures. Landscaping shall be used to define, soften or screen the appearance of buildings and off-street parking areas. Materials to be installed shall achieve a balance between various plant forms, textures, and heights. The installation of native plant materials shall be used whenever practicable. (For recommendations refer to the Native Plant List maintained by the City of Wilsonville). [Amended by Ord. # 674 11/16/09]*

Response: Given the development site's designation and use as a park, approximately 63% (850,747 square feet) of the total lot area is currently vegetated, as is shown in aerial views of the site (Exhibit A, Sheets 4 and 5). Approximately 56% (750,760 square feet) of the total lot area will be vegetated after the Upper Site is developed with a building and ancillary facilities.

On the Lower Site, mitigation planting is proposed on the river bank with plants identified in the Mitigation Plan (Figure F4-1 in Appendix A of Exhibit D). New landscaping is proposed in an area that is currently turf (lawn), in association with the upper overlook that will be replaced and enhanced. (See the Trail Plan in Exhibit A, Sheets 19-20.) Existing park landscaping and features will be preserved, except for some lawn areas that will be restored after construction.

New landscaping proposed on the Upper Site will involve a combination of trees, shrubs, and ground cover, including a robust set of plantings on its frontage along Arrowhead Creek Lane and between the site and the path and neighborhood to the west. Proposed plantings include native plants, such as Vine maple, Grand fir, Western red cedar, Oregon grape, and Sword fern. See the Upper Site Cross-Section Perspectives and Landscape Plans in Exhibit A, Sheets 18 and 21-24 and Sheet 35.

Therefore, this standard is met.

> *(.04) Buffering and Screening. Additional to the standards of this subsection, the requirements of the Section 4.137.5 (Screening and Buffering Overlay Zone) shall also be applied, where applicable.*
>
> *A. All intensive or higher density developments shall be screened and buffered from less intense or lower density developments.*
>
> *B. Activity areas on commercial and industrial sites shall be buffered and screened from adjacent residential areas. Multi-family developments shall be screened and buffered from single-family areas.*
>
> *C. All exterior, roof and ground mounted, mechanical and utility equipment shall be screened from ground level off-site view from adjacent streets or properties.*
>
> *D. All outdoor storage areas shall be screened from public view, unless visible storage has been approved for the site by the Development Review Board or Planning Director acting on a development permit.*
>
> *E. In all cases other than for industrial uses in industrial zones, landscaping shall be designed to screen loading areas and docks, and truck parking.*
>
> *F. In any zone any fence over six (6) feet high measured from soil surface at the outside of fenceline shall require Development Review Board approval.*

Response: The Upper Site will be screened and buffered from Arrowhead Creek Lane and the neighborhoods to the west by high berms planted with numerous trees and shrubs. Fencing that is 8 feet in height will surround the Upper Site; its height (over 6 feet) is for security purposes. See the Upper Site Cross-Section Perspectives (Exhibit A, Sheet 35), Landscape Plans (Exhibit A, Sheets 21-23), and Site Plan (Exhibit A, Sheet 9).

Therefore, these standards are met, pending DRB approval of the fencing height.

> *(.05) Sight-Obscuring Fence or Planting. The use for which a sight-obscuring fence or planting is required shall not begin operation until the fence or planting is erected or in place and approved by the City. A temporary occupancy permit may be issued upon a posting of a bond or other security equal to one hundred ten percent (110%) of the cost of such fence or planting and its installation. (See Sections 4.400 to 4.470 for additional requirements.)*

Response: Sight-obscuring fencing or plantings are not required for the proposed development. Therefore, this standard is not applicable.

(.06) Plant Materials.

A. Shrubs and Ground Cover. All required ground cover plants and shrubs must be of sufficient size and number to meet these standards within three (3) years of planting. Non-horticultural plastic sheeting or other impermeable surface shall not be placed under mulch. Native topsoil shall be preserved and reused to the extent feasible. Surface mulch or bark dust are to be fully raked into soil of appropriate depth, sufficient to control erosion, and are confined to areas around plantings. Areas exhibiting only surface mulch, compost or barkdust are not to be used as substitutes for plant areas. [Amended by Ord. # 674 11/16/09]

1. Shrubs. All shrubs shall be well branched and typical of their type as described in current AAN Standards and shall be equal to or better than 2-gallon containers and 10" to 12" spread.

2. Ground cover. Shall be equal to or better than the following depending on the type of plant materials used: gallon containers spaced at 4 feet on center minimum, 4" pot spaced 2 feet on center minimum, 2-1/4" pots spaced at 18 inch on center minimum. No bare root planting shall be permitted. Ground cover shall be sufficient to cover at least 80% of the bare soil in required landscape areas within three (3) years of planting. Where wildflower seeds are designated for use as a ground cover, the City may require annual re-seeding as necessary.

3. Turf or lawn in non-residential developments. Shall not be used to cover more than ten percent (10%) of the landscaped area, unless specifically approved based on a finding that, due to site conditions and availability of water, a larger percentage of turf or lawn area is appropriate. Use of lawn fertilizer shall be discouraged. Irrigation drainage runoff from lawns shall be retained within lawn areas.

4. Plant materials under trees or large shrubs. Appropriate plant materials shall be installed beneath the canopies of trees and large shrubs to avoid the appearance of bare ground in those locations.

5. Integrate compost-amended topsoil in all areas to be landscaped, including lawns, to help detain runoff, reduce irrigation and fertilizer needs, and create a sustainable, low-maintenance landscape. [Added by Ord. # 674 11/16/09]

Response: The following plant materials are proposed for landscaping on the Upper Site, shown in the Landscape Plans in Exhibit A, Sheets 18 and 21-24.

- Shrubs – Plants such as the red-flowering currant, Lewis mock orange, and tall Oregon grape shown in the Landscape Plan – will be installed as well-branched potted plants equal to or better than 2-gallon containers and 10-12 inches spread.
- Ground cover – Ground cover will be provided in minimum 4-inch pots spaced at a minimum of 24 inches on center. Depending on the species, larger pot size plants may be installed in order to reliably grow to cover bare soil within three years of planting. See the "Low Shrub" list in the Landscape Plans.
- Appropriate shade-tolerant plant materials are proposed under trees to be planted on the berm adjacent to the Upper Site Electrical Building, including Sword fern, Common snowberry, and Western hazel.

- Compost-amended topsoil is planned for use in proposed landscaped areas.

The following plant materials are examples of plants proposed for landscaping (restoration planting) on the Lower Site, shown in the Mitigation Plans in Figure F4-1 in Appendix A of Exhibit D.

- Turf in the existing park will be replanted following construction in order to restore existing conditions in the park.
- Small and medium shrubs – Evergreen huckleberry, Indian plum, Nootka rose, Salal, Sword fern, and Oregon grape
- Large shrubs – Vine maple, Red flowering currant, Thimbleberry, and Western serviceberry
- Trees – Bigleaf maple, Douglas fir, Grand fir, Pacific dogwood, Red alder, Western hemlock, and Western red cedar

Therefore, these standards are met.

B. Trees. All trees shall be well-branched and typical of their type as described in current American Association of Nurserymen (AAN) Standards and shall be balled and burlapped. The trees shall be grouped as follows:

1. Primary trees which define, outline or enclose major spaces, such as Oak, Maple, Linden, and Seedless Ash, shall be a minimum of 2" caliper.

2. Secondary trees which define, outline or enclose interior areas, such as Columnar Red Maple, Flowering Pear, Flame Ash, and Honeylocust, shall be a minimum of 1-3/4" to 2" caliper.

3. Accent trees which, are used to add color, variation and accent to architectural features, such as Flowering- Pear and Kousa Dogwood, shall be 1-3/4" minimum caliper.

4. Large conifer trees such as Douglas-Fir or Deodar Cedar shall be installed at a minimum height of eight (8) feet.

5. Medium-sized conifers such as Shore Pine, Western Red Cedar or Mountain Hemlock shall be installed at a minimum height of five to six (5 to 6) feet.

Response: All of the five tree types identified in this standard will be included in landscaping proposed on the site, at the minimum caliper sizes. See the Landscape Plans in Exhibit A (Sheets 18-24) and the Mitigation Plans in Exhibit D (Figures F4-1 and F4-3). (Note: Trees planted as mitigation for trees removed inside or outside the SROZ will be consistent with standards for mitigation plantings established in Section 4.139.06(.01)(I) and Section 4.260.00(.02).) Therefore, this standard is met.

C. Where a proposed development includes buildings larger than twenty-four (24) feet in height or greater than 50,000 square feet in footprint area, the Development Review Board may require larger or more mature plant materials:

1. At maturity, proposed trees shall be at least one-half the height of the building to which they are closest, and building walls longer than 50 feet shall require tree groups located no more than fifty (50) feet on center, to break up the length and height of the façade.

2. Either fully branched deciduous or evergreen trees may be specified depending upon the desired results. Where solar access is to be preserved, only solar-friendly deciduous trees are to be used. Where year-round sight obscuring is the highest priority, evergreen trees are to be used.

3. The following standards are to be applied:

a. Deciduous trees:

i. Minimum height of ten (10) feet; and

ii. Minimum trunk diameter (caliper) of 2 inches (measured at four and one-half [4 1/2] feet above grade).

b. Evergreen trees: Minimum height of twelve (12) feet.

Response: The proposed Electrical Building will be approximately 7,850 square feet in floor area (Exhibit A, Sheet 9) and maximum height will be approximately 25 feet (Exhibit A, Sheets 30-31).

Proposed berms will buffer and screen the Electrical Building and ancillary facilities from the adjacent north-south pathway and from Arrowhead Creek Lane, thus, buffering and screening the building’s height and length. Trees proposed for the top of the berms will be taller than the building at maturity. See the Upper Site Landscape Plans and Cross-Section Perspectives in Exhibit A, Sheets 18, 21-24, and 35.

Therefore, these standards are met.

D. Street Trees. In order to provide a diversity of species, the Development Review Board may require a mix of street trees throughout a development. Unless the Board waives the requirement for reasons supported by a finding in the record, different types of street trees shall be required for adjoining blocks in a development.

1. All trees shall be standard base grafted, well branched and typical of their type as described in current AAN Standards and shall be balled and burlapped (b&b). Street trees shall be planted at sizes in accordance with the following standards:

a. Arterial streets - 3" minimum caliper

b. Collector streets - 2" minimum caliper.

c. Local streets or residential private access drives - 1-3/4" minimum caliper. [Amended by Ord. 682, 9/9/10]

d. Accent or median tree -1-3/4” minimum caliper.

2. The following trees and varieties thereof are considered satisfactory street trees in most circumstances; however, other varieties and species are encouraged and will be considered:

a. Trees over 50 feet mature height: Quercus garryana (Native Oregon White Oak), Quercus rubra borealis (Red Oak), Acer Macrophylum (Native Big Leaf Maple), Acer nigrum (Green Column Black Maple), Fraxinus americanus (White Ash), Fraxinus pennsylvannica 'Marshall' (Marshall Seedless Green Ash), Quercus coccinea (Scarlet Oak), Quercus pulustris (Pin-Oak), Tilia americana (American Linden).

b. Trees under 50 feet mature height: Acer rubrum (Red Sunset Maple), Cornus nuttallii (NativePacific Dogwood), Gleditsia triacanthos (Honey Locust), Pyrus calleryana 'Bradford' (Bradford Pear), Tilia cordata (Little Leaf Linden), Fraxinus oxycarpa (Flame Ash).

c. Other street tree species. Other species may be specified for use in certain situations. For instance, evergreen species may be specified where year-round color is desirable and no adverse effect on solar access is anticipated. Water-loving species may be specified in low locations where wet soil conditions are anticipated.

Response: As concluded in the Arborist Report (Exhibit N), there are currently no street trees on the site. There are trees near Arrowhead Creek Drive directly south of the BPA easement that will need to be removed for the pipeline work area and will be replaced. See the Upper Site Tree Removal and Protection Plan in Exhibit A (Sheet 27) and the Upper Site Mitigation Plans in Exhibit A (Sheets 18 and 23) and Exhibit D (Appendix A, Figure F4-3).

Street trees are proposed along Arrowhead Creek Lane, adjacent to the Upper Site development, where there are currently no street trees. The frontage where street trees are proposed represents about one block and one tree species is proposed. Arrowhead Creek Lane is a local road and trees proposed to be planted along the road will be at least 1 ¾ inches in caliper. See the Upper Site Landscape Plans, Exhibit A, Sheets 18 and 21-23.

Therefore, these standards are met.

E. Types of Plant Species.

1. Existing landscaping or native vegetation may be used to meet these standards, if protected and maintained during the construction phase of the development and if the plant species do not include any that have been listed by the City as prohibited. The existing native and non-native vegetation to be incorporated into the landscaping shall be identified.

2. Selection of plant materials. Landscape materials shall be selected and sited to produce hardy and drought-tolerant landscaping. Selection shall be based on soil characteristics, maintenance requirements, exposure to sun and wind, slope and contours of the site, and compatibility with other vegetation that will remain on the site. Suggested species lists for street trees, shrubs and groundcovers shall be provided by the City of Wilsonville.

3. Prohibited plant materials. The City may establish a list of plants that are prohibited in landscaped areas. Plants may be prohibited because they are potentially damaging to *sidewalks, roads, underground utilities, drainage improvements, or foundations, or because they are known to be invasive to native vegetation.*

Response: Existing landscaping on the Upper Site consists primarily of lawn and scrubby grasses covering mounds of fill from the original construction of the WRWTP. Proposed landscaping will significantly improve the Upper Site with native, hardy, and drought-tolerant plants identified in the Landscape Plans and Plant Schedule (Exhibit A, Sheets 18 and 21-24).

On the Lower Site, existing vegetation in the ravine on the western edge of the site will be preserved, as will much of the river bank vegetation. (See the Tree Removal and Protection Plans in Exhibit A, Sheets 25-27.) This vegetation is marked by native plant species such as Douglas fir and Sword fern. Plants proposed for restoration planting on the river bank include hardy and native species such as Salal, Sword fern, Oregon grape, Vine maple, Red flowering currant, Red alder, Douglas fir, Western hemlock, and Western red cedar (Exhibit D, Appendix A, Figure F4-1).

Therefore, these standards are met.

F. Tree Credit.

Existing trees that are in good health as certified by an arborist and are not disturbed during construction may count for landscaping tree credit as follows (measured at four and one-half feet above grade and rounded to the nearest inch):

Existing trunk diameter	*Number of Tree Credits*
18 to 24 inches in diameter	*3 tree credits*
25 to 31 inches in diameter	*4 tree credits*
32 inches or greater	*5 tree credits*

1. It shall be the responsibility of the owner to use reasonable care to maintain preserved trees. Trees preserved under this section may only be removed if an application for removal permit under Section 4.610.10(01)(H) has been approved. Required mitigation for removal shall be replacement with the number of trees credited to the preserved and removed tree.

2. Within five years of occupancy and upon notice from the City, the property owner shall replace any preserved tree that cannot be maintained due to disease or damage, or hazard or nuisance as defined in Chapter 6 of this code. The notice shall be based on complete information provided by an arborist Replacement with the number of trees credited shall occur within one (1) growing season of notice.

Response: The applicant is not requesting a tree credit. It is understood that preserved trees must receive reasonable care and maintenance; that applications and mitigation are required for tree removal; and that diseased, damaged, or hazard trees must be replaced within five years of occupancy. This standard will be met as needed.

G. Exceeding Standards. Landscape materials that exceed the minimum standards of this Section are encouraged, provided that height and vision clearance requirements are met. [Amended by Ordinance No. 538, 2/21/02.]

Response: Clear vision area and height requirements will be met, as is also addressed in response to the street design standard in Section 4.177(.02)(E.)(1). See the Landscape Plans (Exhibit A, Sheets 21-22). Therefore, this standard is met.

H. Compliance with Standards. The burden of proof is on the applicant to show that proposed landscaping materials will comply with the purposes and standards of this Section.[Amended by Ordinance No. 538, 2/21/02.]

Response: It is understood that the burden of proof is on the applicant to show that proposed landscaping materials will comply with the provisions in this Section. See the responses to the provisions in this Section.

(.07) Installation and Maintenance.

A. Installation. Plant materials shall be installed to current industry standards and shall be properly staked to assure survival. Support devices (guy wires, etc.) shall not be allowed to interfere with normal pedestrian or vehicular movement.

B. Maintenance. Maintenance of landscaped areas is the on-going responsibility of the property owner. Any landscaping installed to meet the requirements of this Code, or any condition of approval established by a City decision-making body acting on an application, shall be continuously maintained in a healthy, vital and acceptable manner. Plants that die are to be replaced in kind, within one growing season, unless appropriate substitute species are approved by the City. Failure to maintain landscaping as required in this Section shall constitute a violation of this Code for which appropriate legal remedies, including the revocation of any applicable land development permits, may result.

C. Irrigation. The intent of this standard is to assure that plants will survive the critical establishment period when they are most vulnerable due to a lack of watering and also to assure that water is not wasted through unnecessary or inefficient irrigation. Approved irrigation system plans shall specify one of the following:

1. A permanent, built-in, irrigation system with an automatic controller. Either a spray or drip irrigation system, or a combination of the two, may be specified.

2. A permanent or temporary system designed by a landscape architect licensed to practice in the State of Oregon, sufficient to assure that the plants will become established and drought-tolerant.

3. Other irrigation system specified by a licensed professional in the field of landscape architecture or irrigation system design.

4. A temporary permit issued for a period of one year, after which an inspection shall be conducted to assure that the plants have become established. Any plants that have died, or that appear to the Planning Director to not be thriving, shall be appropriately replaced within one growing season. An inspection fee and a maintenance bond or other security sufficient to cover all costs of replacing the plant materials shall be provided, to the satisfaction of the Community Development Director. Additionally, the applicant shall provide the City with a written license or easement to enter the property and cause any failing plant materials to be replaced.

D. Protection. All required landscape areas, including all trees and shrubs, shall be protected from potential damage by conflicting uses or activities including vehicle parking and the storage of materials.

Response: Landscaping will be installed consistent with industry standards per the applicant's arborist and landscape architect. It is understood that maintenance of landscaping installed on the Upper Site is the ongoing responsibility of the property owner.

Regarding irrigation, an automatic system designed by a landscape architect will be installed for all proposed planting (except mitigation areas), with separate zones for planting areas with varying water needs. All proposed plants are native or drought-tolerant, so the irrigation system will primarily be used for approximately the first two years to promote establishment of the plants. After that, the irrigation system will mainly be used for supplemental watering during unusually long periods of summer drought. See irrigation plans, notes, and details in Exhibit A, Sheets 40-44.

Therefore, these standards are met.

(.08) Landscaping on Corner Lots. All landscaping on corner lots shall meet the vision clearance standards of Section 4.177. If high screening would ordinarily be required by this Code, low screening shall be substituted within vision clearance areas. Taller screening may be required outside of the vision clearance area to mitigate for the reduced height within it.

Response: The proposed development is not on a corner lot. Therefore, this standard is not applicable.

(.09) Landscape Plans. Landscape plans shall be submitted showing all existing and proposed landscape areas. Plans must be drawn to scale and show the type, installation size, number and placement of materials. Plans shall include a plant material list. Plants are to be identified by both their scientific and common names. The condition of any existing plants and the proposed method of irrigation are also to be indicated. Landscape plans shall divide all landscape areas into the following categories based on projected water consumption for irrigation:

A. High water usage areas (+/- two (2) inches per week): small convoluted lawns, lawns under existing trees, annual and perennial flower beds, and temperamental shrubs;

B. Moderate water usage areas (+/- one (1) inch per week): large lawn areas, average water-using shrubs, and trees;

C. Low water usage areas (Less than one (1) inch per week, or gallons per hour): seeded fieldgrass, swales, native plantings, drought-tolerant shrubs, and ornamental grasses or drip irrigated areas.

D. Interim or unique water usage areas: areas with temporary seeding, aquatic plants, erosion control areas, areas with temporary irrigation systems, and areas with special water–saving features or water harvesting irrigation capabilities.

These categories shall be noted in general on the plan and on the plant material list.

Response: Landscape Plans showing elements including location, scale, plant type, and a plant schedule are included in this application as Exhibit A, Sheets 18-24 and in the Mitigation Plans in Exhibit D, Figures F4-1 and F4-3. Therefore, this standard is met.

(.10) Completion of Landscaping. The installation of plant materials may be deferred for a period of time specified by the Board or Planning Director acting on an application, in order to avoid hot summer or cold winter periods, or in response to water shortages. In these cases, a temporary permit shall be issued, following the same procedures specified in subsection (.07)(C)(3), above, regarding temporary irrigation systems. No final Certificate of Occupancy shall be granted until an adequate bond or other security is posted for the completion of the landscaping, and the City is given written authorization to enter the property and install the required landscaping, in the event that the required landscaping has not been installed. The form of such written authorization shall be submitted to the City Attorney for review.

Response: It is not expected that planting will be deferred. However, if deferral is necessary, the conditions of this criterion are understood.

(.11) Street Trees Not Typically Part of Site Landscaping. Street trees are not subject to the requirements of this Section and are not counted toward the required standards of this Section. Except, however, that the Development Review Board may, by granting a waiver or variance, allow for special landscaping within the right-of-way to compensate for a lack of appropriate on-site locations for landscaping. See subsection (.06), above, regarding street trees.

Response: Street trees proposed as part of this development are not needed to meet landscaping requirements in this Section. Therefore, this standard is not applicable.

(.12) Mitigation and Restoration Plantings. A mitigation plan is to be approved by the City's Development Review Board before the destruction, damage, or removal of any existing native plants. Plantings intended to mitigate the loss of native vegetation are subject to the following standards. Where these standards conflict with other requirements of this Code, the standards of this Section shall take precedence. The desired effect of this section is to preserve existing native vegetation.

> *A. Plant Sources. Plant materials are to be native and are subject to approval by the City. They are to be non-clonal in origin; seed source is to be as local as possible, and plants must be nursery propagated or taken from a pre-approved transplantation area. All of these requirements are to be addressed in any proposed mitigation plan.*
>
> *B. Plant Materials. The mitigation plan shall specify the types and installation sizes of plant materials to be used for restoration. Practices such as the use of pesticides, fungicides, and fertilizers shall not be employed in mitigation areas unless specifically authorized and approved.*
>
> *C. Installation. Install native plants in suitable soil conditions. Plant materials are to be supported only when necessary because of extreme winds at the site. Where support is necessary, all stakes, guy wires or other measures are to be removed as soon as the plants can support themselves. Protect from animal and fowl predation and foraging until establishment.*
>
> *D. Irrigation. Permanent irrigation systems are generally not appropriate in restoration situations, and manual or temporary watering of new plantings is often necessary. The mitigation plan shall specify the method and frequency of manual watering, including any that may be necessary after the first growing season.*
>
> *E. Monitoring and Reporting. Monitoring of native landscape areas is the on-going responsibility of the property owner. Plants that die are to be replaced in kind and quantity within one year. Written proof of the survival of all plants shall be required to be submitted to the City's Planning Department one year after the planting is completed.*

Response: Native and hardy plants are proposed for restoration planting on the river bank and for mitigation planting on the Upper Site. On the Lower Site, restoration planting will consist of plant species such as Evergreen huckleberry, Salal, Sword fern, Oregon grape, Vine maple, Red flowering currant, Bigleaf maple, Douglas fir, Pacific dogwood, Red alder, and Western red cedar. On the Upper Site, mitigation planting will consist of similar plant species as well as Oregon oak. See the Mitigation Plans in Exhibit A, Sheets 18 and 23, and Exhibit D, Figures F4-1 and F4-3.

Irrigation will be provided on the Upper Site consistent with the irrigation plans, notes, and details in Exhibit A, Sheets 40-44.

It is understood that monitoring and reporting are responsibilities of the property owners.

Therefore, these standards are and will be met.

Section 4.177. Street Improvement Standards

> *This section contains the City's requirements and standards for pedestrian, bicycle, and transit facility improvements to public streets, or within public easements. The purpose of this section is to ensure that*

development, including redevelopment, provides transportation facilities that are safe, convenient, and adequate in rough proportion to their impacts.

(.01) Development and related public facility improvements shall comply with the standards in this section, the Wilsonville Public Works Standards, and the Transportation System Plan, in rough proportion to the potential impacts of the development. Such improvements shall be constructed at the time of development or as provided by Section 4.140, except as modified or waived by the City Engineer for reasons of safety or traffic operations.

Response: The proposed development does not require or include new streets. However, sections of Arrowhead Creek Lane and the multi-use path (Ice Age Tonquin Trail) adjacent to it may require restoration following construction of the RWF improvements. Restoration will be performed consistent with City Public Works Standards and the Transportation System Plan (TSP). Therefore, this standard will be met.

(.02) Street Design Standards.

A. All street improvements and intersections shall provide for the continuation of streets through specific developments to adjoining properties or subdivisions.

1. Development shall be required to provide existing or future connections to adjacent sites through the use of access easements where applicable. Such easements shall be required in addition to required public street dedications as required in Section 4.236(.04).

B. The City Engineer shall make the final determination regarding right-of-way and street element widths using the ranges provided in Chapter 3 of the Transportation System Plan and the additional street design standards in the Public Works Standards.

C. Rights-of-way.

1. Prior to issuance of a Certificate of Occupancy Building permits or as a part of the recordation of a final plat, the City shall require dedication of rights-of-way in accordance with the Transportation System Plan. All dedications shall be recorded with the County Assessor's Office.

2. The City shall also require a waiver of remonstrance against formation of a local improvement district, and all non-remonstrances shall be recorded in the County Recorder's Office as well as the City's Lien Docket, prior to issuance of a Certificate of Occupancy Building Permit or as a part of the recordation of a final plat.

3. In order to allow for potential future widening, a special setback requirement shall be maintained adjacent to all arterial streets. The minimum setback shall be 55 feet from the centerline or 25 feet from the right-of-way designated on the Master Plan, whichever is greater.

D. Dead-end Streets. New dead-end streets or cul-de-sacs shall not exceed 200 feet in length, unless the adjoining land contains barriers such as existing buildings, railroads or freeways, or environmental constraints such as steep slopes, or major streams or rivers, that prevent future street extension and connection. A central landscaped island with rainwater management and infiltration are *encouraged in cul-de-sac design. No more than 25 dwelling units shall take access to a new dead-end or cul-de-sac street unless it is determined that the traffic impacts on adjacent streets will not exceed those from a development of 25 or fewer units. All other dimensional standards of dead-end streets shall be governed by the Public Works Standards. Notification that the street is planned for future extension shall be posted on the dead-end street. [Amended by Ord. # 674 11/16/09]*

Response: New streets and rights-of-way are not needed or included in the proposed development. Therefore, these standards are not applicable.

E. Corner or clear vision area.

1. A clear vision area which meets the Public Works Standards shall be maintained on each corner of property at the intersection of any two streets, a street and a railroad or a street and a driveway. However, the following items shall be exempt from meeting this requirement:

a. Light and utility poles with a diameter less than 12 inches.

b. Trees less than 6” d.b.h., approved as a part of the Stage II Site Design, or administrative review.

c. Except as allowed by b., above, an existing tree, trimmed to the trunk, 10 feet above the curb.

d. Official warning or street sign.

e. Natural contours where the natural elevations are such that there can be no cross-visibility at the intersection and necessary excavation would result in an unreasonable hardship on the property owner or deteriorate the quality of the site.

Response: Pursuant to this provision and the clear vision area provisions in Section 201.2.22 of the City of Wilsonville Public Work Standards, plantings will not interfere with visibility between 30 inches and 10 feet height above the curb, and sidewalk strip trees will be a minimum of 10 feet from the Upper Site driveways. (See the Landscape Plans, Exhibit A, Sheets 21-22.) Therefore these standards are met.

F. Vertical clearance - a minimum clearance of 12 feet above the pavement surface shall be maintained over all streets and access drives.

Response: The applicant will manage landscaping on the Upper Site so that a minimum vertical clearance of 12 feet will be maintained above streets and access drives. Therefore, this standard will be met.

G. Interim improvement standard. It is anticipated that all existing streets, except those in new subdivisions, will require complete reconstruction to support urban level traffic volumes. However, in most cases, existing and short-term projected traffic volumes do not warrant improvements to full

Master Plan standards. Therefore, unless otherwise specified by the Development Review Board, the following interim standards shall apply.

1. Arterials - 24 foot paved, with standard sub-base. Asphalt overlays are generally considered unacceptable, but may be considered as an interim improvement based on the recommendations of the City Engineer, regarding adequate structural quality to support an overlay.

2. Half-streets are generally considered unacceptable. However, where the Development Review Board finds it essential to allow for reasonable development, a half-street may be approved. Whenever a half-street improvement is approved, it shall conform to the requirements in the Public Works Standards:

3. When considered appropriate in conjunction with other anticipated or scheduled street improvements, the City Engineer may approve street improvements with a single asphalt lift. However, adequate provision must be made for interim storm drainage, pavement transitions at seams and the scheduling of the second lift through the Capital Improvements Plan.

Response: Interim street improvements are not proposed as part of this development. Therefore, these standards are not applicable.

(.03) <u>Sidewalks</u>. Sidewalks shall be provided on the public street frontage of all development. Sidewalks shall generally be constructed within the dedicated public right-of-way, but may be located outside of the right-of-way within a public easement with the approval of the City Engineer.

A. Sidewalk widths shall include a minimum through zone of at least five feet. The through zone may be reduced pursuant to variance procedures in Section 4.196, a waiver pursuant to Section 4.118, or by authority of the City Engineer for reasons of traffic operations, efficiency, or safety.

B. Within a Planned Development, the Development Review Board may approve a sidewalk on only one side. If the sidewalk is permitted on just one side of the street, the owners will be required to sign an agreement to an assessment in the future to construct the other sidewalk if the City Council decides it is necessary.

Response: The Ice Age Tonquin Trail, a multi-use path, provides pedestrian access along the north side of Arrowhead Creek Lane on the southern edge of the Upper Site. (See the Site Plan, Exhibit A, Sheet 9.) The trail, which is approximately 14 feet wide where it is adjacent to where development is proposed on the Upper Site, will be restored following construction on the Upper Site. Therefore, these standards are met.

(.04) <u>Bicycle Facilities</u>. Bicycle facilities shall be provided to implement the Transportation System Plan, and may include on-street and off-street bike lanes, shared lanes, bike boulevards, and cycle tracks. The design of on-street bicycle facilities will vary according to the functional classification and the average daily traffic of the facility.

Response: Bicycle facilities on the site include the Ice Age Tonquin Trail, which is a multi-use path, and shared roadway on Arrowhead Creek Lane, classified as a local road in the City's TSP. Sections of the Ice Age Tonquin Trail and Arrowhead Creek Lane roadway disturbed by RWF construction will be restored following construction, thus, maintaining bicycle access on the site. Therefore, this standard is and will be met.

(.05) Multiuse Pathways. Pathways may be in addition to, or in lieu of, a public street. Paths that are in addition to a public street shall generally run parallel to that street, and shall be designed in accordance with the Public Works Standards or as specified by the City Engineer. Paths that are in lieu of a public street shall be considered in areas only where no other public street connection options are feasible, and are subject to the following standards.

A. Paths shall be located to provide a reasonably direct connection between likely pedestrian and bicyclist destinations. Additional standards relating to entry points, maximum length, visibility, and path lighting are provided in the Public Works Standards.

B. To ensure ongoing access to and maintenance of pedestrian/bicycle paths, the City Engineer will require dedication of the path to the public and acceptance of the path by the City as public right-of-way; or creation of a public access easement over the path.

Response: The Ice Age Tonquin trail, an existing multi-use path, runs parallel to Arrowhead Creek Lane on the Upper Site (Exhibit A, Sheet 9). The trail will be restored following construction on the Upper Site. Additional easements or dedications are not needed to ensure ongoing maintenance of and access to the trail. Therefore, these standards are met.

(.06) Transit Improvements

Development on sites that are adjacent to or incorporate major transit streets shall provide improvements as described in this section to any bus stop located along the site's frontage, unless waived by the City Engineer for reasons of safety or traffic operations. Transit facilities include bus stops, shelters, and related facilities. Required transit facility improvements may include the dedication of land or the provision of a public easement.

A. Development shall at a minimum provide:

1. Reasonably direct pedestrian connections, as defined by Section 4.154, between building entrances and the transit facility and between buildings on the site and streets adjoining transit stops.

2. Improvements at major transit stops. Improvements may include intersection or mid-block traffic management improvements to allow for pedestrian crossings at major transit stops.

B. Developments generating an average of 49 or more pm peak hour trips shall provide bus stop improvements per the Public Works Standards. Required improvements may include provision of benches, shelters, pedestrian lighting; or provision of an easement or dedication of land for transit facilities.

C. In addition to the requirements of 4.177(.06)(A.)(2.), development generating more than 199 pm peak hour trips on major transit streets shall provide a bus pullout, curb extension, and intersection or mid-block traffic management improvements to allow for pedestrian crossings at major transit stops.

D. In addition to the requirement s of 4.177(.06)(A.) and (B.), development generating more than 500 pm peak-hour trips on major transit streets shall provide on-site circulation to accommodate transit service.

Response: Local transit service provider SMART offers service on Wilsonville Road, which is not adjacent to the proposed development. Therefore, these standards are not applicable.

(.07) Residential Private Access Drives.

Response: The proposed development is not residential. Therefore, this standard is not applicable.

(.08). Access Drive and Driveway Approach Development Standards.

A. An access drive to any proposed development shall be designed to provide a clear travel lane free from any obstructions.

Response: One driveways is proposed between development on the Upper Site and Arrowhead Creek Lane. (See the Site Plan in Exhibit A, Sheet 9.) The access lane is designed to be unobstructed. Therefore, this standard is met.

B. Access drive travel lanes shall be constructed with a hard surface capable of carrying a 23-ton load.

Response: The proposed driveway will be constructed of asphalt and concrete. (See the notes on the Site Plan, Exhibit A, Sheet 9.) The surface will be durable enough to bear a 23-ton load as it has been designed consistent with Oregon department of Transportation (ODOT) requirements. Therefore, this standard is met.

C. Where emergency vehicle access is required, approaches and driveways shall be designed and constructed to accommodate emergency vehicle apparatus and shall conform to applicable fire protection requirements. The City may restrict parking, require signage, or require other public safety improvements pursuant to the recommendations of an emergency service provider.

Response: Fire and emergency vehicles will be able to access Upper Site facilities from the driveway given the radius and width of the driveway (Exhibit A, Sheet 9). Access through the driveway gate will be provided by a Knox Box consistent with Tualatin Valley Fire & Rescue (TVF&R) requirements. The applicant has met with TVF&R staff to coordinate access, emergency response, and fire prevention for the proposed development. Therefore, this standard is met.

> *D. Secondary or emergency access lanes may be improved to a minimum 12 feet with an all-weather surface as approved by the Fire District. All fire lanes shall be dedicated easements.*

Response: The driveway and circulation area on the Upper Site are at least 12 feet in width and are paved with asphalt and concrete (Exhibit A, Sheet 9). Designated fire lanes and easements are not necessary. Therefore, this standard is met.

> *E. Minimum access requirements shall be adjusted commensurate with the intended function of the site based on vehicle types and traffic generation.*

Response: It is understood that access requirements could be adjusted according to site function. The Upper Site will generate very little traffic; therefore, it is expected that access requirements will not need to be adjusted.

> *F. The number of approaches on higher classification streets (e.g., collector and arterial streets) shall be minimized; where practicable, access shall be taken first from a lower classification street.*

Response: Access for the Upper Site will be taken on Arrowhead Creek Lane, a lower classification street. Arrowhead Creek Lane is a local street according to the City's TSP. Therefore, this standard is met.

> *G. The City may limit the number or location of connections to a street, or impose access restrictions where the roadway authority requires mitigation to alleviate safety or traffic operations concerns.*

Response: It is understood that the City has the authority to regulate access points, particularly to alleviate safety or traffic concerns. However, proposed development on the Upper Site will generate very few trips. Therefore, it is not expected that access restrictions will be needed.

> *H. The City may require a driveway to extend to one or more edges of a parcel and be designed to allow for future extension and inter-parcel circulation as adjacent properties develop. The City may also require the owner(s) of the subject site to record an access easement for future joint use of the approach and driveway as the adjacent property(ies) develop(s).*

Response: The objective of this standard is understood. However, in the case of the Upper Site, inter-parcel access and circulation are not practical for the following reasons:

- A driveway to the west would cut across a multi-use path into an established residential neighborhood, where access has been challenged and restricted in the past. (Brockway Drive was gated for emergency access only as part of the original WRWTP approval.)

- Access to the north or east would need to cut across the SROZ and Arrowhead Creek.

See the Existing Conditions Vicinity Plan in Exhibit A, Sheet 5.

Therefore, driveways in addition to the driveway proposed on Arrowhead Creek Lane on the southwest side of the Upper Site should not be necessary.

> *I. Driveways shall accommodate all projected vehicular traffic on-site without vehicles stacking or backing up onto a street.*
>
> *J. Driveways shall be designed so that vehicle areas, including but not limited to drive-up and drive-through facilities and vehicle storage and service areas, do not obstruct any public right-of-way.*

Response: The uses proposed on the Upper Site will generate limited traffic. (See the Traffic Study Waiver Request in Exhibit P.) The proposed driveway and on-site circulation area (Exhibit A, Sheet 9) will accommodate all projected traffic, which will typically not be more than one vehicle at a time. Consequently, traffic will not to stack up in the driveway or obstruct Arrowhead Creek Lane. Therefore, these standards are met.

> *K. Approaches and driveways shall not be wider than necessary to safely accommodate projected peak hour trips and turning movements, and shall be designed to minimize crossing distances for pedestrians.*

Response: The opening of the gate across the driveway proposed on Arrowhead Creek Lane is approximately 22 feet wide, as shown on the Upper Site's Site Plan (Exhibit A, Sheet 9). This width will safely accommodate the maintenance trucks and other vehicles that will occasionally visit the site. As stated in the Traffic Study Waiver Request (Exhibit P), these trips will be avoided during p.m. peak hours. Crossing the driveway will be safe for pedestrians because the driveway is not excessively wide, few trips will be made in and out of the driveway, and the gate across the driveway will slow traffic entering and leaving the site. Therefore, this standard is met.

> *L. As it deems necessary for pedestrian safety, the City, in consultation with the roadway authority, may require traffic-calming features, such as speed tables, textured driveway surfaces, curb extensions, signage or traffic control devices, or other features, be installed on or in the vicinity of a site.*

Response: It is understood that the City has the authority to institute traffic-calming measures. However, given the limited number of vehicle trips that will be generated by uses on the Upper Site and lower speeds on the curving section of roadway adjacent to the Upper Site, traffic-calming measures are not expected to be needed.

> *M. Approaches and driveways shall be located and designed to allow for safe maneuvering in and around loading areas, while avoiding conflicts with pedestrians, parking, landscaping, and buildings.*

Response: The Upper Site's circulation area provides ample space for maneuvering and loading activities with sufficient distances from the driveway, the Ice Age Tonquin Trail that crosses the driveway, on-site landscaping, and buildings. (See the Site Plan in Exhibit A, Sheet 9 and responses to clear vision area requirements in Section 4.176(.06)(G).) Therefore, this standard is met.

N. Where a proposed driveway crosses a culvert or drainage ditch, the City may require the developer to install a culvert extending under and beyond the edges of the driveway on both sides of it, pursuant applicable Public Works standards.

Response: The proposed driveway does not cross a culvert or a drainage ditch. Therefore, this standard is not applicable.

O. Except as otherwise required by the applicable roadway authority or waived by the City Engineer, temporary driveways providing access to a construction site or staging area shall be paved or graveled to prevent tracking of mud onto adjacent paved streets.

Response: Driveways to staging areas on the Upper Site and Lower Site will be surfaced with gravel, as noted in the Erosion Control Plans (Exhibit A, Sheets 12-13) and consistent with City Standard Details for construction entrances. These hardy surfaces will prevent the tracking of mud onto Arrowhead Creek Lane. Therefore, this standard is met.

P. Unless constrained by topography, natural resources, rail lines, freeways, existing or planned or approved development, or easements or covenants, driveways proposed as part of a residential or mixed-use development shall meet local street spacing standards and shall be constructed to align with existing or planned streets, if the driveway.

1. Intersects with a public street that is controlled, or is to be controlled in the planning period, by a traffic signal;

2. Intersects with an existing or planned arterial or collector street; or

3. Would be an extension of an existing or planned local street, or of another major driveway.

Response: The proposed development is not residential or mixed-use. Therefore, these standards are not applicable.

(.09) Minimum street intersection spacing standards.

Response: New streets are not proposed as part of this development. Therefore, these standards are not applicable.

Section 4.179 Mixed Solid Waste and Recyclables Storage in New Multi-Unit Residential and Non-Residential Buildings

> *(.07) The applicant shall work with the City's franchised garbage hauler to ensure that site plans provide adequate access for the hauler's equipment and that storage area is adequate for the anticipated volumes, level of service and any other special circumstances which may result in the storage area exceeding its capacity. The hauler shall notify the City by letter of their review of site plans and make recommendations for changes in those plans pursuant to the other provisions of this section.*

Response: Documentation of coordination with Republic Services is provided in this application as Exhibit Q. As acknowledged in the letter from Republic Services, the building on the Upper Site will not be regularly staffed and will not generate trash and recycling material for disposal, except following a natural disaster or other emergency event. The hauler concluded that there is no need for trash and recycling storage and disposal service at this time. If storage and disposal service needs were to change as a result of staffing changes or an emergency, the applicant would coordinate with Republic Services regarding storage and disposal service at that time. After review of the Site Plan (Exhibit A, Sheet 9), the hauler found that there is adequate room on the site for their vehicles to maneuver if future service is needed. Therefore, this standard is met.

Section 4.181. Exceptions & Modifications - Height Limits.

> *Except as stipulated in Sections 4.800 through 4.804, height limitations specified elsewhere in this Code shall not apply to barns, silos or other farm buildings or structures on farms; to church spires; belfries; cupolas; and domes; monuments; water towers; windmills; chimneys; smokestacks; fire and hose towers; flag poles; above-ground electric transmission, distribution, communication and signal lines, towers and poles; and properly screened mechanical and elevator structures.*

Response: Pursuant to Section 4.120(.04)(D.), the maximum height permitted in the RA-H zone is 35 feet. The radio tower proposed on the Upper Site, in a location indicated in the Site Plan (Exhibit A, Sheet 9), is expected to exceed 35 feet in height. Its ultimate necessary height is still to be determined through a radio communications study that the applicant will prepare. Pursuant to the provisions above and as confirmed by City staff[11], the proposed radio tower is exempt from height limits established in the base zone.

Section 4.199 Outdoor Lighting

> *Section 4.199.10. Outdoor Lighting In General.*
>
> *(.01) <u>Purpose</u>: The purpose of this Code is to provide regulations for outdoor lighting that will:*
>
> *A. Permit reasonable uses of outdoor lighting for nighttime safety, utility, security, productivity, enjoyment and commerce.*

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[11] Email correspondence from Dan Pauly, Senior Planner, on February 7, 2019.

B. Conserve energy and resources to the greatest extent possible.

C. Minimize glare, particularly in and around public rights-of-way; and reduce visual discomfort and improve visual acuity over large areas by avoiding "light islands" and "spotlighting" that result in reduced visual perception in areas adjacent to either the source of the glare or the area illuminated by the glare.

D. Minimize light trespass, so that each owner of property does not cause unreasonable light spillover to other property.

E. Curtail the degradation of the nighttime environment and the night sky.

F. Preserve the dark night sky for astronomy and enjoyment.

G. Protect the natural environment, including wildlife, from the damaging effects of night lighting from human sources.

(.02) <u>Purpose Statement as Guidelines</u>: Declaration of purpose statements are guidelines and not approval criteria in the application of WC Section 4.199.

Section 4.199.20. <u>Applicability</u>.

(.01) This Ordinance is applicable to:

A. Installation of new exterior lighting systems in public facility, commercial, industrial and multi-family housing projects with common areas.

B. Major additions or modifications (as defined in this Section) to existing exterior lighting systems in public facility, commercial, industrial and multi-family housing projects with common areas.

(.02) Exemption. The following luminaires and lighting systems are EXEMPT from these requirements:

A. Interior lighting.

B. Internally illuminated signs.

C. Externally illuminated signs.

D. Temporary lighting for theatrical, television, and performance areas.

E. Lighting in swimming pools and other water features governed by Article 680 of the National Electrical Code.

F. Building Code required exit path lighting.

G. Lighting specifically for stairs and ramps.

H. Temporary and seasonal lighting provided that individual lamps are 10 watts or less.

I. Lighting required and/or regulated by the City (i.e. construction related activities), Federal Aviation Administration, U.S. Coast Guard or other Federal or State agency.

J. Single-family residential lighting.

K. Code Required Signs.

L. American flag.

M. Landscape lighting.

N. Lights approved by the City through an Administrative Review Temporary Use Permit process.

O. Public street lights.

P. ATM security lighting.

Q. Those "Exceptions" listed in the "Exterior Lighting Power Allowance" provisions of the Oregon Energy Efficiency Specialty Code. [Added by Ord. 688, 11/15/10]

Response: New exterior lighting is proposed for the new Electrical Building, ancillary facilities, circulation area, and driveways proposed on the Upper Site. In response to a request from the City, new low-height (bollard) lighting is also proposed along the existing pathway on the western edge of the Upper Site. Pursuant to 4.199.20(.01)(A), the proposed lighting is subject to applicable provisions of this Section.

Section 4.199.30. Lighting Overlay Zones.

(.01) The designated Lighting Zone as indicated on the Lighting Overlay Zone Map for a commercial, industrial, multi-family or public facility parcel or project shall determine the limitations for lighting systems and fixtures as specified in this Ordinance.

A. Property may contain more than one lighting zone depending on site conditions and natural resource characteristics.

(.02) The Lighting Zones shall be:

A. LZ 1. Developed areas in City and State parks, recreation areas, SROZ wetland and wildlife habitat areas; developed areas in natural settings; sensitive night environments; and rural areas. This zone is intended to be the default condition for rural areas within the City.

B. LZ 2. Low-density suburban neighborhoods and suburban commercial districts, industrial parks and districts. This zone is intended to be the default condition for the majority of the City.

C. LZ 3. Medium to high-density suburban neighborhoods and districts, major shopping and commercial districts as depicted on the Lighting Overlay Zone Map.

D. LZ 4. Reserved for limited applications with special lighting requirements. This zone is appropriate for users who have unique site or operating circumstances that warrant additional light. This zone shall not be applied to residential or agricultural areas.

Response: The proposed development site is in Lighting Zone 2 (LZ 2) according to the City Lighting Overlay Zone Map (Figure 30 in Section 4.199), shown circled in Figure 6 below.

Figure 6: City of Wilsonville Lighting Zone Map

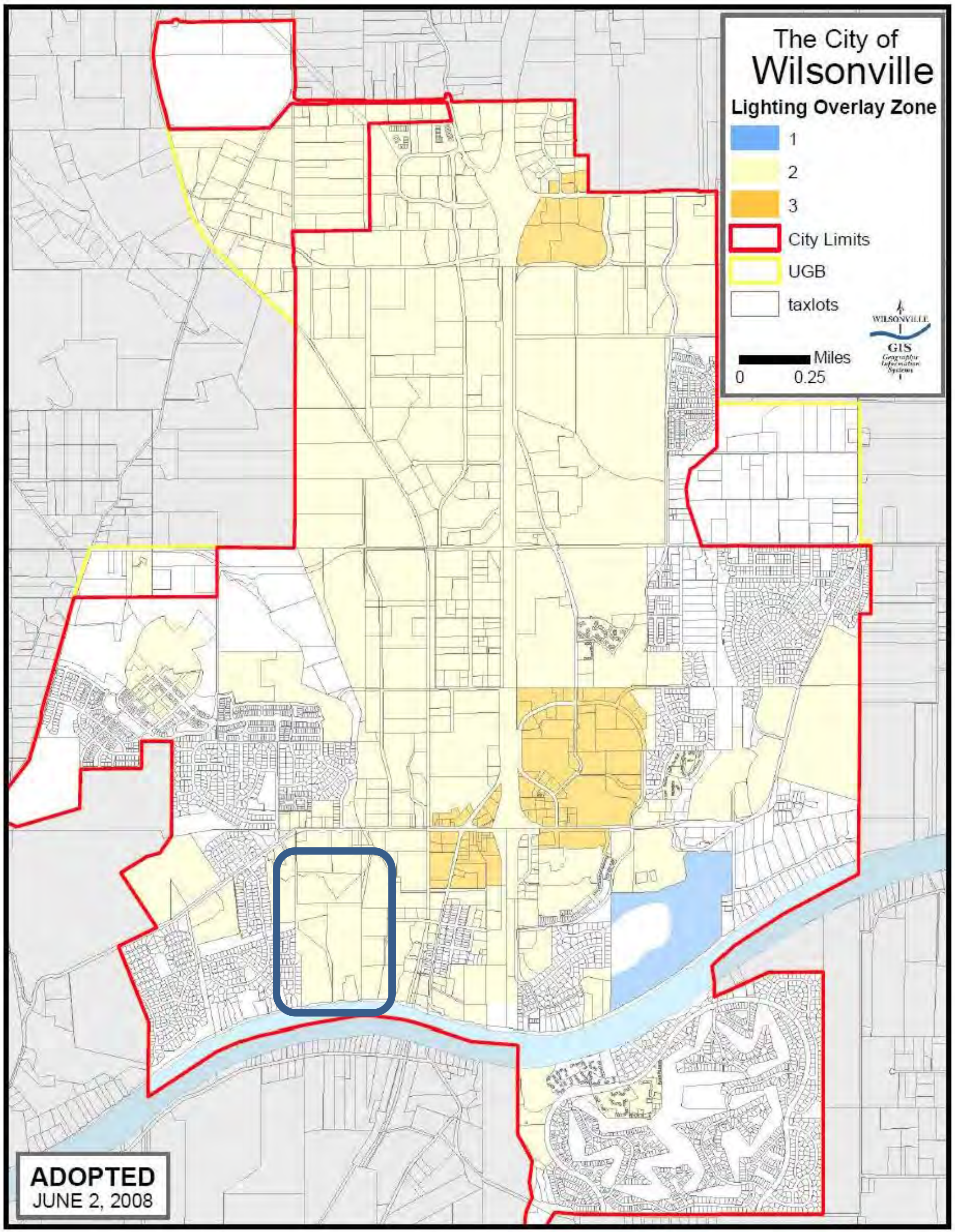


Figure 30: Lighting Overlay Zone Map

[Section 4.199 – 4.199.60 added by Ord. No. 649, adopted 6/2/08]

(.03) Modification of Lighting Zones.

A. The City Council may modify the designated Lighting Zones of one or more parcels if the City Council finds that the original Lighting Zone was in error, a change in circumstances has occurred *warranting the change since the designation was established or the purposes of this section are better served.*

B. The Development Review Board (DRB) may modify the designated Lighting Zones as part of the Stage II, Site Design Review Process if the DRB finds that the original Lighting Zone was in error, or a change in circumstances has occurred warranting the change since the designation was established or the purposes of this section are better served.

C. This ordinance establishes a Lighting Overlay Zone Map. The Planning Division shall maintain the current Lighting Overlay Zone Map.

Response: The applicant is not proposing to modify the lighting zone designation. Therefore, these standards are not applicable.

Section 4.199.40. Lighting Systems Standards for Approval.

(.01) Non-Residential Uses and Common Residential Areas.

A. All outdoor lighting shall comply with either the Prescriptive Option or the Performance Option below.

B. <u>Prescriptive Option</u>. If the lighting is to comply with this Prescriptive Option, the installed lighting shall meet <u>all</u> of the following requirements according to the designated Lighting Zone.

1. The maximum luminaire lamp wattage and shielding shall comply with Table 7.

2. Except for those exemptions listed in Section 4.199.20(.02), the exterior lighting for the site shall comply with the Oregon Energy Efficiency Specialty Code, Exterior Lighting.

3. The maximum pole or mounting height shall be consistent with Table 8.

4. Each luminaire shall be set back from all property lines at least 3 times the mounting height of the luminaire:

a. Exception 1: If the subject property abuts a property with the same base and lighting zone, no setback from the common lot lines is required.

b. Exception 2: If the subject property abuts a property which is zoned (base and lighting) other than the subject parcel, the luminaire shall be setback three times the mounting height of the luminaire, measured from the abutting parcel's setback line. (Any variance or waiver to the abutting property's setback shall not be considered in the distance calculation).

c. Exception 3: If the luminaire is used for the purpose of street, parking lot or public utility easement illumination and is located less than 3 mounting heights from the property line, the luminaire shall include a house side shield to protect adjoining property.

d. Exception 4: If the subject property includes an exterior column, wall or abutment within 25 feet of the property line, a luminaire partly shielded or better and not exceeding 60 lamp watts may be mounted onto the exterior column, wall or abutment or under or within an overhang or canopy attached thereto.

e. Exception 5: Lighting adjacent to SROZ areas shall be set back 3 times the mounting height of the luminaire, or shall employ a house side shield to protect the natural resource area.

Table 7: Maximum Wattage And Required Shielding

Lighting Zone	***Fully Shielded***	***Shielded***	***Partly Shielded***	***Unshielded***
LZ 2	*100*	*35*	*39*	*Low voltage landscape lighting 50 watts or less*

Table 8: Maximum Lighting Mounting Height In Feet

Lighting Zone	***Lighting for private drives, driveways, parking, bus stops and other transit facilities***	***Lighting for walkways, bikeways, plazas and other pedestrian areas***	***All other lighting***
LZ 2	*40*	*18*	*8*

Lighting mounted onto buildings or other structures shall not exceed a mounting height greater than 4 feet higher than the tallest part of the building or structure at the place where the lighting is installed, nor higher than 33.33 percent of the horizontal distance of the light from the nearest property line, whichever is less.

Response: The exterior lighting proposed on the Upper Site addresses the above standards as follows:

- Wattage – The maximum wattage of the proposed fully shielded lighting is 102 watts for the Lithonia pole-mounted lighting fixtures, 71 watts for the Holophane lighting fixtures, and 16 watts for the Lithonia ground-mounted lighting fixtures, consistent with or less than the 100-watt standard in Table 7.
- Oregon Energy Efficiency Specialty Code (OEESC) – Calculations demonstrating compliance with the OEESC are provided with the lighting cut sheets in Exhibit K.
- Height – Lighting for the Electrical Building, ancillary facilities, circulation area, and driveways on the Upper Site is proposed to be at a height of less than 20 feet when mounted on the building and at a height of 25 feet when pole-mounted. Lighting for the path on the western edge of the Upper Site will be ground-mounted and approximately 42 inches high. All the proposed lighting heights are less than the 40-foot maximum in Table 8.
- Setbacks – Lighting zones are the same to the west, north, east, and south of the Upper Site. Other than the low-height, low-wattage lighting proposed for the existing path on the western border of the Upper Site, lighting proposed on the west side of the Upper Site will be: on the development side of the high berm; directed away from properties to the west; and approximately 77 feet from the property line, which is more than three times the 25-foot mounting height of those fixtures. Lighting in the northeast corner of the Upper Site, nearest the SROZ associated with Arrowhead Creek, will be approximately 80 feet from the SROZ Title 3 area boundary, more three times the 20-foot mounting height of those fixtures.

See the Lighting Site Plan (Exhibit A, Sheet 37) and Fixtures 5 and 6 in the Lighting Schedule (Exhibit A, Sheet 38).

Therefore, these standards are met.

C. Performance Option. If the lighting is to comply with the Performance Option, the proposed lighting design shall be submitted by the applicant for approval by the City meeting all of the following…

Response: The applicant has opted to comply with prescriptive option requirements. Therefore, these standards are not applicable.

D. Curfew. All prescriptive or performance based exterior lighting systems shall be controlled by automatic device(s) or system(s) that:

1. Initiate operation at dusk and either extinguish lighting one hour after close or at the curfew times according to Table 10; or

2. Reduce lighting intensity one hour after close or at the curfew time to not more than 50% of the requirements set forth in the Oregon Energy Efficiency Specialty Code unless waived by the DRB due to special circumstances; and

3. Extinguish or reduce lighting consistent with 1. and 2. above on Holidays.

The following are exceptions to curfew:

a. Exception 1: Building Code required lighting.

b. Exception 2: Lighting for pedestrian ramps, steps and stairs.

c. Exception 3: Businesses that operate continuously or periodically after curfew.

Table 10: Curfew

Lighting Zone	***Curfew Time***
LZ 2	*10:00 PM (2200 hours)*

Response: The applicant will comply with the lighting curfew standard in Section 4.199.40(.01)(D) above. Lighting operation will be initiated at dusk and will be extinguished at the curfew time in Table 10 (10:00 p.m.) or otherwise as consistent with the timing of existing lighting on the site. Therefore, this standard will be met.

(.02) Special Permit for Specific Lighting Fixtures and Systems and When Exceeding Lighting Requirements.

A. This section is intended to apply to situations where more than normal foot candles are required due to a unique circumstance or use or where it is absolutely essential to perform the proposed activities after dark. All special permits shall be reviewed by the DRB.

B. Upon issuance of a special permit by the Development Review Board (DRB), lighting systems not complying with the technical requirements of this Ordinance may be installed, maintained, and replaced for lighting that exceeds the maximums permitted by this Ordinance. This section is intended to be applied to uses such as sports lighting systems including but not limited to, sport fields and stadiums, such as baseball and football field lighting, tennis court lighting, swimming pool area lighting and prisons; other very intense lighting defined as having a light source exceeding 200,000 lumens or an intensity in any direction of more than 2,000,000 candelas; building façade lighting of portions of buildings over two stories high; and public monuments.

C. To obtain such a permit, applicants shall demonstrate that the proposed lighting installation:

1. Is within Lighting Zone 3 or above.

2. Has been designed to minimize obtrusive light and artificial sky glow, supported by a signed statement from a registered civil or electrical engineer describing the mitigation measures. Such statement shall be accompanied by calculations indicating the light trespass levels (horizontal and vertical at ground level) at the property line.

3. Will not create excessive glare, sky glow, or light trespass beyond that which can be reasonably expected by application of best lighting practices, and available technology.

4. Provides appropriate lighting curfew hours based on the use and the surrounding areas.

D. The DRB may impose conditions of approval to mitigate any negative impacts resulting to the abutting parcel, based on best lighting practices and available lighting technology.

E. The City may charge a review fee and may, at the Building Official's option, employ the services of a qualified professional civil or electrical engineer to review such submittals and the cost thereof shall be an additional fee charged to the applicant.

Response: The applicant is not proposing to exceed lighting requirements. Therefore, these standards are not applicable.

Section 4.199.50. Submittal Requirements.

(.01) Applicants shall submit the following information as part of DRB review or administrative review of new commercial, industrial, multi-family or public facility projects:

A. A statement regarding which of the lighting methods will be utilized, prescriptive or performance, and a map depicting the lighting zone(s) for the property.

B. A site lighting plan that clearly indicates intended lighting by type and location. For adjustable luminaires, the aiming angles or coordinates shall be shown.

C. For each luminaire type, drawings, cut sheets or other documents containing specifications for the intended lighting including but not limited to, luminaire description, mounting, mounting height, lamp type and manufacturer, lamp watts, ballast, optical system/distribution, and accessories such as shields.

D. Calculations demonstrating compliance with Oregon Energy Efficiency Specialty Code, Exterior Lighting, as modified by Section 4.199.40(.01)(B.)(2.) [Amended by Ord. 688, 11/15/10]

E. Lighting plans shall be coordinated with landscaping plans so that pole lights and trees are not placed in conflict with one another. The location of lights shall be shown on the landscape plan. Generally, pole lights should not be placed within one pole length of landscape and parking lot trees.

F. Applicants shall identify the hours of lighting curfew.

Response: The following elements are included in this application.

- Lighting Zone and lighting standards – The applicant is using prescriptive standards for lighting design guidance. The subject property is in LZ 2 as shown in Figure 6.
- Lighting Site Plan – A Lighting Site Plan is included in the application as Exhibit A, Sheet 37. The plan shows lighting fixture location. Lighting fixture type is detailed for Fixtures 5, 6, and 11 in the Lighting Schedule (Exhibit A, Sheet 38).
- Lighting details – Details about the proposed lighting fixtures are provided in the Lighting Schedule (Exhibit A, Sheet 38) and the Lighting Cut Sheets (Exhibit K).
- OEESC requirements – Calculations demonstrating compliance with the OEESC are provided in Exhibit K.
- Landscape Plans – Lighting has been coordinated with landscaping and is shown in the Landscape Plans in Exhibit A (Sheets 21-22).
- Lighting curfew – The applicant will comply with the lighting curfew standard in Section 4.199.40(.01)(D), initiating lighting operation at dusk and extinguishing lighting at the curfew time in Table 10 (10:00 p.m.), or otherwise as consistent with the timing of existing lighting on the site.

(.02) In addition to the above submittal requirements, Applicants using the <u>Prescriptive Method</u> shall submit the following information as part of the permit set plan review:

A. A site lighting plan (items 1 A - F, above) which indicates for each luminaire the 3 mounting height line to demonstrate compliance with the setback requirements. For luminaires mounted within 3 mounting heights of the property line the compliance exception or special shielding requirements shall be clearly indicated.

Response: A Lighting Site Plan with setback lines is provided in Exhibit A, Sheet 37. Therefore, this standard is met.

(.03) In addition to the above submittal requirements, Applicants using the <u>Performance Method</u> shall submit the following information as part of the permit set plan review…

Response: The applicant is not using the performance method for lighting requirements. Therefore, these standards are not applicable.

(.04) In addition to the above applicable submittal requirements, Applicants for <u>Special Permits</u> shall submit the following to the DRB for review:

A. Tabulation of International Engineering Society of North America (IESNA) lighting recommendations for each task including area illuminated, recommended illumination level, actual maintained illumination level, and luminaires used specifically to achieve the indicated criteria.

B. Lighting plans shall be prepared by a qualified licensed engineer.

Response: The applicant is not applying for special permits. Therefore, these standards are not applicable.

(.05) For all calculations, the following light loss factors shall be used unless an alternative is specifically approved by the City:

Metal halide	*0.6*
High pressure sodium	*0.8*
Compact fluorescent	*0.7*
Full size fluorescent	*0.75*
Incandescent	*0.9*
Halogen	*0.95*
Other	*As approved*

Response: The applicant is proposing light-emitting diode (LED) lighting with a light loss factor (LLF) of 0.85, which will be reviewed as “other” lighting pursuant to the provisions above.

Section 4.199.60. Major Additions or Modifications to Pre-Existing Sites.

(01.) Major Additions. If a major addition occurs on a property, all of the luminaires on the site shall comply with the requirements of this Section. For purposes of this sub-section, the following are considered to be major additions:

A. Additions of 50 percent or more in terms of additional dwelling units, gross floor area, seating capacity, or parking spaces, either with a single addition or with cumulative additions after July 2, 2008.

B. Modification or replacement of 50 percent or more of the outdoor lighting luminaries’ within a 5-year timeframe existing as of July 2, 2008.

Response: The proposed development is not a major addition or modification of the existing site, pursuant to Subsections A and B above. Therefore, this standard is not applicable.

UNDERGROUND UITLITIES

Section 4.300. General.

(.01) The City Council deems it reasonable and necessary in order to accomplish the orderly and desirable development of land within the corporate limits of the City, to require the underground installation of utilities in all new developments.

(.02) After the effective date of this Code, the approval of any development of land within the City will be upon the express condition that all new utility lines, including but not limited to those required for power, communication, street lighting, gas, cable television services and related facilities, shall be placed underground.

(.03) The construction of underground utilities shall be subject to the City's Public Works Standards and shall meet applicable requirements for erosion control and other environmental protection.

Section 4.310 Exceptions.

Section 4.300 of this Code shall not apply to surface-mounted transformers, surface-mounted connection boxes, wireless communication facilities, and meter cabinets and other appurtenances which are reasonably necessary to be placed above ground, or to temporary utility service facilities during construction, or to high capacity electric and communication feeder lines, or to utility transmission lines operating at 50,000 volts or more.

Response: Utility lines needed on the Upper Site – including water, stormwater, and sanitary sewer – will be installed underground as shown in the Utility Plan (Exhibit A, Sheet 17). The radio tower proposed on the Upper Site (Exhibit A, Sheet 9) is a communication facility eligible for an exemption from requirements in Section 4.300 pursuant to Section 4.310 above.

Section 4.320. Requirements.

(.01) The developer or subdivider shall be responsible for and make all necessary arrangements with the serving utility to provide the underground services (including cost of rearranging any existing overhead facilities). All such underground facilities as described shall be constructed in compliance with the rules and regulations of the Public Utility Commission of the State of Oregon relating to the installation and safety of underground lines, plant, system, equipment and apparatus.

(.02) The location of the buried facilities shall conform to standards supplied to the subdivider by the City. The City also reserves the right to approve location of all surface-mounted transformers.

(.03) Interior easements (back lot lines) will only be used for storm or sanitary sewers, and front easements will be used for other utilities unless different locations are approved by the City Engineer. Easements satisfactory to the serving utilities shall be provided by the developer and shall be set forth on the plat.

Response: It is understood that the applicant is responsible for coordinating with utility service providers and the City as needed in order to provide necessary utility facilities underground.

SITE DESIGN REVIEW

Section 4.400. Purpose.

(.01) Excessive uniformity, inappropriateness or poor design of the exterior appearance of structures and signs and the lack of proper attention to site development and landscaping in the business, commercial, industrial and certain residential areas of the City hinders the harmonious development of the City, impairs the desirability of residence, investment or occupation in the City, limits the opportunity to attain the optimum use in value and improvements, adversely affects the stability and value of property, produces degeneration of property in such areas and with attendant deterioration of conditions affecting the peace, health and welfare, and destroys a proper relationship between the taxable value of property and the cost of municipal services therefor.

Response: Proposed development that is subject to Site Design Review includes development proposed on the Upper Site and Lower Site (i.e., park and pump station building).

Upper Site

Proposed structures, landscaping, and signs subject to Site Design Review include the Electrical Building and landscaping on the Upper Site. The Electrical Building and Upper Site are proposed to be improved as a cohesively designed area located between the boundaries of the path and residential development to the west, Arrowhead Creek Lane to the south and southeast, and Arrowhead Creek to the north and northeast. (See the Site Plan, Exhibit A, Sheet 9.) The Electrical Building is designed to be simple, attractive, and complementary to other buildings on the WRWTP property. (See the Perspectives and Elevations in Exhibit A, Sheets 29-31.) The building and ancillary facilities on the Upper Site are buffered and screened from the adjacent trail, residential area, and road by a high berm and variety of plantings, including trees. (See the Cross-Section Perspectives in Exhibit A, Sheet 35.)

Lower Site/Park

The proposed development on the rest of the site (essentially the park outside of the Willamette River Greenway) that is subject to Site Design Review consists of underground pipeline, exterior modifications of the pump station building related to seismic upgrades, landscaping, the pathway in the park, the upper overlook, and upper portions of the new west and lower trails. The purpose statement above is not applicable to the pipeline, being underground. However, seismic modifications of the pump station building serve safety, health, and welfare purposes and exterior modifications are designed to be consistent with the rest of the existing treatment plant buildings (e.g., replacing brick faces with cast-in-place concrete used on the rest of the building exterior). See the Building Elevations in Exhibit A, Sheet 50. Landscaping and the pathway in the park will either be restored to existing conditions or improved (e.g., the path in the park will be widened and will connect with a new west trail and lower trail on the river bank). See the Site Plan, Exhibit A, Sheet 7.

(.02) The City Council declares that the purposes and objectives of site development requirements and the site design review procedure are to:

A. Assure that Site Development Plans are designed in a manner that insures proper functioning of the site and maintains a high quality visual environment.

B. Encourage originality, flexibility and innovation in site planning and development, including the architecture, landscaping and graphic design of said development;

C. Discourage monotonous, drab, unsightly, dreary and inharmonious developments;

D. Conserve the City's natural beauty and visual character and charm by assuring that structures, signs and other improvements are properly related to their sites, and to surrounding sites and structures, with due regard to the aesthetic qualities of the natural terrain and landscaping, and that proper attention is given to exterior appearances of structures, signs and other improvements;

E. Protect and enhance the City's appeal and thus support and stimulate business and industry and promote the desirability of investment and occupancy in business, commercial and industrial purposes;

F. Stabilize and improve property values and prevent blighted areas and, thus, increase tax revenues;

G. Insure that adequate public facilities are available to serve development as it occurs and that proper attention is given to site planning and development so as to not adversely impact the orderly, efficient and economic provision of public facilities and services.

H. Achieve the beneficial influence of pleasant environments for living and working on behavioral patterns and, thus, decrease the cost of governmental services and reduce opportunities for crime through careful consideration of physical design and site layout under defensible space guidelines that clearly define all areas as either public, semi-private, or private, provide clear identity of structures and opportunities for easy surveillance of the site that maximize resident control of behavior -- particularly crime;

I. Foster civic pride and community spirit so as to improve the quality and quantity of citizen participation in local government and in community growth, change and improvements;

J. Sustain the comfort, health, tranquility and contentment of residents and attract new residents by reason of the City's favorable environment and, thus, to promote and protect the peace, health and welfare of the City.

Response: The proposed Upper Site, pump station building, and park area improvements are consistent with the purpose statements above in the following ways:

- The proposed improvements on the Upper Site create a new landscaped entry to the park along Arrowhead Creek Lane, replacing the large mound of fill material and scrubby vegetation that exists on the Upper Site today.
- The seismic upgrades of the pump station building exterior serve safety, health, and welfare purposes for neighbors and employees. The exterior modifications are consistent with the simple and attractive design of the rest of the pump station building and other treatment plant buildings.
- The functional qualities of paths on the site will be improved. Existing multi-use paths along the western edge of the site (adjacent to Oakleaf Mobile Home Park) and along Arrowhead Creek Lane –

both part of the Ice Age Tonquin Trail system – will be restored and landscaping bordering the paths will be enhanced. Bollard lighting will be added to the path along the western edge of the site. The path through the park will be restored and widened, and will connect to an enhanced upper overlook and to new trails (the west trail and lower trail) proposed on the river bank.

- The park will be restored to a state consistent with existing conditions. The proposed placement of the pipeline just east of the existing path has been designed so that trees will not be removed along most of the west edge of the park. Park visitors will be able to enjoy the visual qualities of that part of the park – a large lawn, path, and vegetated edge along the ravine and tributary – upon completion of project construction.
- The Electrical Building and ancillary facilities on the Upper Site will be screened by the proposed berm and landscaping, while visible from the driveway to the Upper Site. The building's materials and design are similar to the main WRWTP building to ensure consistency with the rest of the site.
- Overall, the project has been designed considering the aesthetics and functionality of the site, and with an awareness of the civic importance of the property.

Section 4.421. Criteria and Application of Design Standards.

(.01) The following standards shall be utilized by the Board in reviewing the plans, drawings, sketches and other documents required for Site Design Review. These standards are intended to provide a frame of reference for the applicant in the development of site and building plans as well as a method of review for the Board. These standards shall not be regarded as inflexible requirements. They are not intended to discourage creativity, invention and innovation. The specifications of one or more particular architectural styles is not included in these standards. (Even in the Boones Ferry Overlay Zone, a range of architectural styles will be encouraged.)

A. Preservation of Landscape. The landscape shall be preserved in its natural state, insofar as practicable, by minimizing tree and soils removal, and any grade changes shall be in keeping with the general appearance of neighboring developed areas.

Response: Landscaping on the site outside the Willamette River Greenway will be preserved, replaced, or improved. As shown in the Tree Removal and Protection Plans for the park and Upper Site (Exhibit A, Sheets 27-28), few trees are proposed for removal on the Upper Site and tree removal in the park is limited to what is necessary for installation of pipeline as well as conduit for future fiber optic line that the City has requested. Trees proposed for removal will be replaced in the park or within the mitigation area on the Upper Site (Exhibit A, Sheets 18 and 23, and Exhibit D, Figure F4-3 in Appendix A), consistent with replacement and mitigation standards in Section 4.620.00. Lawn in the park will be restored. As part of the replacement and enhancement of the upper overlook, native trees and shrubs will be planted (Exhibit A, Sheet 20).

The Upper Site landscaping is designed to present an attractive environment along Arrowhead Creek Lane and the two existing multi-use paths that run along the west and south edges of the Upper Site. Proposed landscaping will also include a secure perimeter fence and planted berms to visually screen the new Electrical

Building. The fence will include an automatic vehicular gate and will be located outside the berm. See Exhibit A, Sheets 21-22.

According to guidance from the City, all planting directly adjacent to either of the multi-use paths will be less than 2 feet tall to eliminate hiding spaces and create a secure feeling. Because there is an existing masonry wall along the west property line, the new fence and berm will be set further back to give a more open feel for users of the multi-use path in this area. The path will be within a 25-foot-wide clear space between the existing wall and new fence. See the Cross-Section Perspectives in Exhibit A, Sheet 35.

The plantings in the Upper Site supplement the berms to screen the new electrical building. It provides street trees along Arrowhead Creek Lane, and ornamental planting along the multi-use paths. The plant palette includes a diverse mix of evergreen and deciduous trees, shrubs, and groundcover, and all species are native or drought-tolerant. Low maintenance and resistance to invasive species are key factors in the planting design. Seeded meadow mix on the steeper inward-facing slopes of the berms. An automatic irrigation system will be used for the first two years for establishment. Afterward, the irrigation will likely only be used to keep the plants healthy through occasional hot summer weather.

Top soil removed in the park during pipeline installation will be stockpiled and re-used. Fill from the original WRWTP construction is currently stored on the Upper Site. This fill will be graded and lowered, resulting in a ground condition more similar to original conditions (before the WRWTP was constructed) than exists today. In addition, an earthen berm is proposed along the west, south, and southeast sides of the Upper Site to provide green buffering and screening. See the Grading Plan in Exhibit A, Sheet 11, and Cross-Section Perspectives in Exhibit A, Sheet 35.

Based on the above, this standard is met.

> *B. Relation of Proposed Buildings to Environment. Proposed structures shall be located and designed to assure harmony with the natural environment, including protection of steep slopes, vegetation and other naturally sensitive areas for wildlife habitat and shall provide proper buffering from less intensive uses in accordance with Sections 4.171 and 4.139 and 4.139.5. The achievement of such relationship may include the enclosure of space in conjunction with other existing buildings or other proposed buildings and the creation of focal points with respect to avenues of approach, street access or relationships to natural features such as vegetation or topography.*

Response: WWSP and City of Wilsonville staff have met and coordinated closely to review the project designs and to avoid impacts to SROZ areas on the site. The proposed pipeline through the park, and the work area to either side of it, have been designed to avoid the Title 3 area of the SROZ, as shown in the park's Site Plan (Exhibit A, Sheet 8). Likewise, the pipeline on the Upper Site will cross under Arrowhead Creek using trenchless construction methods and the launch shaft and staging area on the west side of the creek have been designed to avoid the Title 3 area of the SROZ (Upper Site's Site Plan, Exhibit A, Sheet 9).

Aboveground structures that are outside of the Willamette River Greenway and subject to Site Design Review consist of the exterior modifications of the pump station building and the structures proposed on the Upper Site. Seismic upgrades of the pump station building exterior use the same simple, attractive materials (cast-in-place concrete) and finishes as are used on the rest of the pump station building and other WRWTP buildings. (See the Building Elevations in Exhibit A, Sheet 50.)

The structures proposed on the Upper Site are enclosed by fencing and avoid Title 3 areas of the SROZ. (See the Site Plan for the Upper Site, Exhibit A, Sheet 9.) The architectural design of the Electrical Building on the Upper Site is based on a brick and modern look to match the overall aesthetics of the existing WRWTP. The building will have clearstory windows to enhance natural lighting on the interior but will be located high enough to provide a security feature given that the building is unoccupied under normal operating conditions. The roof is sloped and will be prefinished metal roof panels. Other materials include the following: prefinished metal rake edge trim; aluminum hanger rod canopy; brick facing; and prefinished metal gutter with downspouts. (See the Building Perspectives and Elevations in Exhibit A, Sheets 29-31.)

The trail along the western border of the Upper Site will be preserved. Upper Site structures will be buffered and screened from this trail and the housing to the west by a high berm with an assortment of plantings. Berms and landscaping will also help buffer and screen views of the structures from along Arrowhead Creek Lane and the Ice Age Tonquin Trail to the south and southeast. (See the Landscape Plans and Cross-Section Perspectives in Exhibit A, Sheets 21, 22, and 35.)

Based on the above, this standard is met.

> *C. Drives, Parking and Circulation. With respect to vehicular and pedestrian circulation, including walkways, interior drives and parking, special attention shall be given to location and number of access points, general interior circulation, separation of pedestrian and vehicular traffic, and arrangement of parking areas that are safe and convenient and, insofar as practicable, do not detract from the design of proposed buildings and structures and the neighboring properties.*

Response: Safe and convenient access and circulation will be maintained and improved for vehicles and pedestrians on the Lower Site related to the existing WRWTP. On the Upper Site, one new driveway is proposed to access uses on this part of the property. Efficient circulation will be accommodated on the Upper Site, with vehicles being able to enter and exit through the one access point. (See the Site Plan, Exhibit A, Sheet 9.) Minimal pedestrian activity will occur between the uses proposed within the Upper Site itself, so a formal pedestrian circulation system is not needed. Adjacent to proposed development on the Upper Site, existing paths along the west side of the site and along Arrowhead Creek Lane will be preserved or improved and are separated from vehicle traffic. Therefore, this standard is met.

D. Surface Water Drainage. Special attention shall be given to proper site surface drainage so that removal of surface waters will not adversely affect neighboring properties of the public storm drainage system.

Response: As shown in the Erosion Control Plan for the park, contours will be restored (Exhibit A, Sheet 12). Surface water will continue to follow existing natural drainage patterns (e.g., to the ravine on the western edge of the Lower Site and the Willamette River) and use existing stormwater facilities, and will not adversely affect neighboring properties. (See the Overall Site Plan, Exhibit A, Sheet 6.)

On the Upper Site, surface water will drain into swales proposed on the north and south sides of the site, which will connect to proposed storm drains and a reconstructed outfall at Arrowhead Creek. (See the Utility Plan, Exhibit A, Sheet 17.) Thus, surface water drainage will not adversely affect properties adjacent to the Upper Site. Drainage and the proposed stormwater facility (capacity, detention, and treatment) are addressed in detail in the updated Preliminary Stormwater Report provided in Exhibit J.

Therefore, this standard is met.

Surface water drainage and potential erosion during construction will be managed on the Upper Site and Lower Site according to the Erosion Control Plans provided in Exhibit A (Sheets 12-13).

E. Utility Service. Any utility installations above ground shall be located so as to have a harmonious relation to neighboring properties and site. The proposed method of sanitary and storm sewage disposal from all buildings shall be indicated.

Response: The Electrical Building's appearance and relationship to neighboring properties and the rest of the site are addressed in previous responses in this Section. As with the Electrical Building, ancillary facilities – such as the HVAC unit, generator, and surge tanks proposed on the Upper Site – will be buffered and screened from housing to the west and from the rest of the site to the south and southeast by a high berm and a variety of landscaping. (See the Cross-Section Perspectives in Exhibit A, Sheet 35.) A 4-inch sanitary sewage pipe and stormwater facilities are shown in the Utility Plan (Exhibit A, Sheet 17).The radio tower needed on the Upper Site is still being studied and designed. In general, its design will be simple and it will have a finished paint color that blends into the surroundings; final design will be coordinated with the City. Its scale will be significantly less than BPA towers that are located on the site and in an easement running through the neighborhoods to the west. Therefore, this standard is met.

F. Advertising Features. In addition to the requirements of the City's sign regulations, the following criteria should be included: the size, location, design, color, texture, lighting and materials of all exterior signs and outdoor advertising structures or features shall not detract from the design of proposed buildings and structures and the surrounding properties.

Response: Signs and advertising structures or features are not proposed. Therefore, this standard is not applicable.

> *G. Special Features. Exposed storage areas, exposed machinery installations, surface areas, truck loading areas, utility buildings and structures and similar accessory areas and structures shall be subject to such setbacks, screen plantings or other screening methods as shall be required to prevent their being incongruous with the existing or contemplated environment and its surrounding properties. Standards for screening and buffering are contained in Section 4.176.*

Response: The Electrical Building and ancillary facilities (such as the heating, ventilation, and air conditioning (HVAC) unit, generator, surge tanks, and stormwater facility) proposed on the Upper Site will be buffered and screened from housing to the west and from the rest of the site to the south and southeast by a high berm and a variety of landscaping. (See the Upper Site's Site Plan and Cross-Section Perspectives in Exhibit A, Sheet 9 and Sheet 35.) This screening and buffering is also described in response to landscaping standards in Section 4.176. Therefore, this standard is met.

> *(.02) The standards of review outlined in Sections (a) through (g) above shall also apply to all accessory buildings, structures, exterior signs and other site features, however related to the major buildings or structures.*

Response: It is understood that the standards in (A) through (G) above apply to accessory uses and site features, and these uses and features (e.g., exterior HVAC unit) are addressed in the responses above. Therefore, this standard is met.

> *(.03) The Board shall also be guided by the purpose of Section 4.400, and such objectives shall serve as additional criteria and standards.*
>
> *(.04) Conditional application. The Planning Director, Planning Commission, Development Review Board or City Council may, as a Condition of Approval for a zone change, subdivision, land partition, variance, conditional use, or other land use action, require conformance to the site development standards set forth in this Section.*
>
> *(.05) The Board may attach certain development or use conditions in granting an approval that are determined necessary to insure the proper and efficient functioning of the development, consistent with the intent of the Comprehensive Plan, allowed densities and the requirements of this Code. In making this determination of compliance and attaching conditions, the Board shall, however, consider the effects of this action on the availability and cost of needed housing. The provisions of this section shall not be used in such a manner that additional conditions either singularly or accumulatively have the effect of unnecessarily increasing the cost of housing or effectively excluding a needed housing type.*

(.06) The Board or Planning Director may require that certain paints or colors of materials be used in approving applications. Such requirements shall only be applied when site development or other land use applications are being reviewed by the City.

A. Where the conditions of approval for a development permit specify that certain paints or colors of materials be used, the use of those paints or colors shall be binding upon the applicant. No Certificate of Occupancy shall be granted until compliance with such conditions has been verified.

B. Subsequent changes to the color of a structure shall not be subject to City review unless the conditions of approval under which the original colors were set included a condition requiring a subsequent review before the colors could be changed.

Response: The authority of the Planning Director, Board, and City Council to take the actions identified above is understood.

Section 4.430. Location, Design and Access Standards for mixed Solid Waste and Recycling Areas

(.01) The following locations, design and access standards for mixed solid waste and recycling storage areas shall be applicable to the requirements of Section 4.179 of the Wilsonville City Code.

(.02) Location Standards

(.03) Design Standards

(.04) Access Standards

Response: Documentation of coordination with Republic Services is provided in this application as Exhibit Q. As acknowledged in the letter from Republic Services, the building on the Upper Site will not be regularly staffed and will not generate trash and recycling material for disposal, except following a natural disaster or other emergency event. The hauler concluded that there is no need for trash and recycling storage and disposal service at this time. If storage and disposal service needs were to change as a result of staffing changes or an emergency, the applicant would coordinate with Republic Services regarding storage and disposal service at that time. After review of the Site Plan (Exhibit A, Sheet 9), the hauler found that there is adequate room on the site for their vehicles to maneuver if future service is needed.

Based on the above, these standards are not applicable at this time. However, they would become applicable if the Upper Site were regularly staffed in the future.

Section 4.440. Procedure.

(.01) Submission of Documents. A prospective applicant for a building or other permit who is subject to site design review shall submit to the Planning Department, in addition to the requirements of Section 4.035, the following:

A. A site plan, drawn to scale, showing the proposed layout of all structures and other improvements including, where appropriate, driveways, pedestrian walks, landscaped areas, fences, walls, off-street parking and loading areas, and railroad tracks. The site plan shall indicate the location of entrances and exits and direction of traffic flow into and out of off-street parking and loading areas, the location of each parking space and each loading berth and areas of turning and maneuvering vehicles. The site plan shall indicate how utility service and drainage are to be provided.

Response: Site Plans are provided for the parts of site development subject to Site Design Review – the park (Lower Site) and the Upper Site (Exhibit A, Sheets 8, 9, and 20). The plans show proposed improvements including the replacement of the upper overlook on the river bank, the pipeline in the park, and the Electrical Building and ancillary facilities on the Upper Site as well as pedestrian and vehicles circulation areas, parking and loading, landscaped areas, and fences. More detail about landscaping is provided in the Landscape Plan for the Upper Site (Exhibit A, Sheets 21-22). Utility service and drainage for the Uppers Site are addressed on the Utility Plan and Erosion Control Plan (Exhibit A, Sheets 13 and 17). Therefore, this standard is met.

B. A Landscape Plan, drawn to scale, showing the location and design of landscaped areas, the variety and sizes of trees and plant materials to be planted on the site, the location and design of landscaped areas, the varieties, by scientific and common name, and sizes of trees and plant materials to be retained or planted on the site, other pertinent landscape features, and irrigation systems required to maintain trees and plant materials. An inventory, drawn at the same scale as the Site Plan, of existing trees of 4" caliper or more is required. However, when large areas of trees are proposed to be retained undisturbed, only a survey identifying the location and size of all perimeter trees in the mass in necessary.

Response: Details about the planting proposed on the Upper Site are provided on the Landscape Plan (Exhibit A, Sheets 21-22). Proposed irrigation is addressed in response to landscaping standards in Section 4.176(.07)(C). A survey of existing trees 4 inches diameter at breast height (DBH) or greater is provided in the Tree Removal and Protection Plans (Exhibit A, Sheets 25-28). Therefore, this standard is met.

C. Architectural drawings or sketches, drawn to scale, including floor plans, in sufficient detail to permit computation of yard requirements and showing all elevations of the proposed structures and other improvements as they will appear on completion of construction. Floor plans shall also be provided in sufficient detail to permit computation of yard requirements based on the relationship of indoor versus outdoor living area, and to evaluate the floor plan's effect on the exterior design of the building through the placement and configuration of windows and doors.

Response: Architectural drawings including Building Perspectives, Elevations, and a Floor Plan are included in this application. (See Exhibit A, Sheets 29-31, 36, and 50.) Therefore, this standard is met.

D. A Color Board displaying specifications as to type, color, and texture of exterior surfaces of proposed structures. Also, a phased development schedule if the development is constructed in stages.

Response: A Materials Board for the Upper Site Electrical Building is included with this application (Exhibit R). Therefore, this standard is met.

E. A sign Plan, drawn to scale, showing the location, size, design, material, color and methods of illumination of all exterior signs.

Response: Signs are not proposed. Therefore, this standard is not applicable.

F. The required application fee.

Response: The required application fees have been included in the initial submittal of this application. Therefore, this standard is met.

Section 4.450. Installation of Landscaping.

(.01) All landscaping required by this section and approved by the Board shall be installed prior to issuance of occupancy permits, unless security equal to one hundred and ten percent (110%) of the cost of the landscaping as determined by the Planning Director is filed with the City assuring such installation within six (6) months of occupancy. "Security" is cash, certified check, time certificates of deposit, assignment of a savings account or such other assurance of completion as shall meet with the approval of the City Attorney. In such cases the developer shall also provide written authorization, to the satisfaction of the City Attorney, for the City or its designees to enter the property and complete the landscaping as approved. If the installation of the landscaping is not completed within the six-month period, or within an extension of time authorized by the Board, the security may be used by the City to complete the installation. Upon completion of the installation, any portion of the remaining security deposited with the City shall be returned to the applicant.

Response: Landscaping will be completed prior to occupancy permit issuance or a security provided. Therefore, this standard will be met.

(.02) Action by the City approving a proposed landscape plan shall be binding upon the applicant. Substitution of plant materials, irrigation systems, or other aspects of an approved landscape plan shall

not be made without official action of the Planning Director or Development Review Board, as specified in this Code.

Response: It is understood that changes in an approved Landscape Plan shall be made only by official action of a review body.

(.03) All landscaping shall be continually maintained, including necessary watering, weeding, pruning, and replacing, in a substantially similar manner as originally approved by the Board, unless altered with Board approval.

Response: It is understood that all landscaping will need to be monitored and maintained by the property owners. Therefore, this standard will be met.

(.04) If a property owner wishes to add landscaping for an existing development, in an effort to beautify the property, the Landscape Standards set forth in Section 4.176 shall not apply and no Plan approval or permit shall be required. If the owner wishes to modify or remove landscaping that has been accepted or approved through the City's development review process, that removal or modification must first be approved through the procedures of Section 4.010.

Response: The applicant proposes to add landscaping to the Upper Site, consistent with standards in Section 4.176. (See responses in Section 4.176.)

CONDITIONAL USE

Section 4.184 Conditional Use Permits - Authorization

(.01) Conditional Use of property may be granted by the Development Review Board after concluding a public hearing as provided in Section 4.013. A land use that is "conditional" is one that is generally not compatible with surrounding uses unless mitigating conditions of approval are established. In acting on applications for Conditional Use Permits, the DRB may establish conditions of approval that are found to be necessary to implement the Comprehensive Plan or to assure compliance with the standards of this Code, based on information in the record.

A. Authorization to Grant or Deny Conditional Uses: A conditional use listed in this ordinance shall be permitted, altered, or denied in accordance with the standards and procedures of this Section. In judging whether a conditional use permit shall be approved, or determining appropriate conditions of approval, the Development Review Board shall weigh the proposal's positive and negative features that would result from authorizing the particular development at a location proposed, and to approve such use, shall find that the following criteria are either met, can be met by observance of conditions, or are not applicable:

1. The proposal will be consistent with the provisions of the Comprehensive Plan and the requirements of Chapter 4 of the Wilsonville Code and other applicable policies of the City.

Response: Consistency with applicable provisions of the Comprehensive Plan, Chapter 4 of the Wilsonville Code, and other policies is addressed in the following sections.

<u>Comprehensive Plan</u>

City of Wilsonville Comprehensive Plan policies that are applicable to this proposal include policies from the following elements of the Comprehensive Plan: Citizen Involvement, Public Facilities and Services, Residential Development, Industrial Development, Environmental Resources, and Areas of Special Concern.

Citizen Involvement

Relevant policies call for opportunities for a wide range of public involvement in City planning processes (Policy 1.1.1) and coordination with other agencies and organizations involved with Wilsonville's planning policies (Policy 1.3). As outlined in the "Summary of Outreach and Coordination" section in the beginning of this narrative (Section 1.2.4), the WWSP has participated in or organized numerous public involvement efforts in the preparation of this application, including: ongoing coordination with Wilsonville public affairs staff in planning and conducting outreach; briefings with the Morey's Landing Homeowners Association; contact with Oakleaf Mobile Home Park; and a meeting with the Wilsonville Parks and Recreation Department's Advisory Board.

There has also been a robust level of interagency and interagency coordination as part of the application process. Between March 2018 and March 2019, the City and the WWSP held a series of land use-related meetings to discuss key issues including site design, natural resources, and compatibility with surrounding uses. In 2018, there were four meetings and site walks where multiple City departments (Planning, Engineering, Public Works, Natural Resources, Parks, and Legal) and the WWSP team have worked together in an interdisciplinary format to evaluate various RWF project elements. Following the pre-application conference in January 2019, WWSP team members and the project arborist met on-site with City staff to review tree conditions and potential mitigation options.

Other interagency coordination has included:

- Environmental permitting, via the Joint Permit Application process, with USACE, DSL, NMFS, and Oregon DEQ .
- Meetings with TVF&R staff to coordinate access, emergency response, and fire prevention.

Public Facilities and Services

City policies and implementation measures related to water system facilities and services include committing the City to providing public facilities that enhance the health, safety, educational, and recreational aspects of urban living (Policy 3.1.1) and periodically reviewing and updating the Water System Master Plan (Implementation Measure 3.1.5.a).

Outside of the Greenway, the RWF improvements will consist of widened paths in the park, trail connections providing visual and physical access to the river, and a rebuilt and enhanced upper overlook. These improvements will contribute to the health, safety, education, and recreational experience of park users, consistent with the Comprehensive Plan policies.

The 2017 WRWTP Master Plan Update addresses and supports the proposed RWF improvements, as do the adopted TVWD and City of Hillsboro Water Master Plans, discussed in more detail later in this response.

The Public Facilities and Services element of the Comprehensive Plan includes policies regarding parks, recreation, and open space. Policy and implementation language commits the City to conserving open space throughout Wilsonville for objectives including park land (Policy 3.1.11) and maintaining and developing the existing park system for centralized community-wide park facilities (Implementation Measure 3.1.11.f). The proposed RWF improvements support these objectives as described in more detail in regards to the City's Parks and Recreation Master Plan later in this response.

Residential Development

The northern tax lot, or Upper Site, of the proposed development site has a Residential Comprehensive Plan designation, shown in the zoning map in Figure 2. Residential development policy obligates the City to provide opportunities for a range of housing types, sizes, densities, and prices or rents (Policy 4.1.4). The subject property is part of the larger WRWTP and Park site and is not intended for residential development. Rather, the subject property, and proposed improvements, are public uses designed to be compatible with adjacent residential uses.

The proposed improvements on the Upper Site will be compatible with adjacent residential development by providing an improved multi-use path along Arrowhead Creek Lane, which is a section of the City-approved and regionally-designated Ice Age Tonquin Trail. The proposal also includes preserving and rebuilding the path along the west edge of the Upper Site and adding bollard lighting. Visually, the Upper Site will change from its current condition (mounded fill and grasses) to a more pleasing landscaped character with a planted berm and landscaped edges. Within the park, the WWSP will widen the path by 2 feet, re-establish the lawn, and retain the trees along the ravine's riparian area. Combined, all of these changes will improve the entry into the park, enhance walking and other recreational opportunities, and support ongoing use of the site by neighbors and the larger Wilsonville community. See the Site Plans and Landscape Plans in Exhibit A, Sheets 8, 9, and 21-24.

Industrial Development

The southern tax lot, or Lower Site, has an Industrial designation, shown in the zoning map in Figure 2. Industrial development policy calls for compatibility between industrial, residential, and urban uses in Wilsonville (Policy 4.1.3). The WRWTP is an established use on the Lower Site, as is the Willamette River Water Treatment Plant Park. The pipeline that is proposed on the Lower Site as part of this development is consistent with the existing treatment plant use and is underground. Proposed pathway improvements on the Lower Site are consistent with and will enhance the existing park use. The existing uses and proposed improvements together allow the site to serve as a buffer between heavy industrial uses to the east of the site and established residential uses to the west.

Environmental Resources

Environmental resources are located on both the Upper Site and Lower Site. City environmental policy requires that natural resources be protected from incompatible development and that people and property be protected from natural hazards (Policy 4.1.5).

On the Lower Site, the pathway in the park is proposed to be restored and widened and is located within the SROZ Significant Resource Impact Area, at the outer edge of the SROZ. The pathway is an existing use in this part of the SROZ and pedestrian paths that "provide access to the sensitive area or across the sensitive area" are exempt from SROZ regulations pursuant to Section 4.139.04(.08). Proposed pipeline development on the Lower Site has been designed to avoid the Area of Limited Conflicting Use of the SROZ and the Title 3 area of the SROZ. See the Park Site Plan in Exhibit A, Sheet 8.

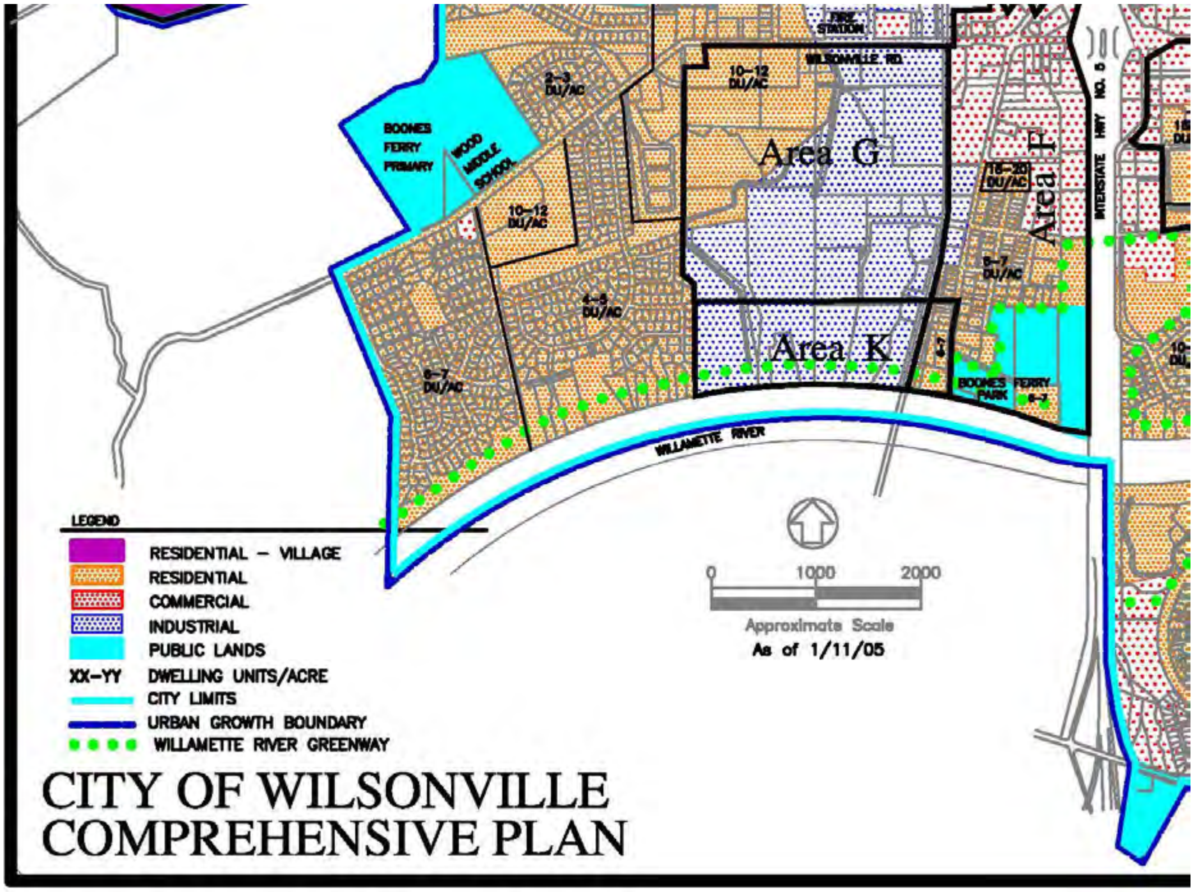
On the Upper Site, the Electrical Building and ancillary facilities have been located completely outside of the SROZ. The pipeline's crossing of Arrowcreek Creek will be constructed using trenchless construction to minimize impact of the SROZ area. The locations of the launch shaft and staging area for this trenchless construction are outside of the SROZ's Area of Limited Conflicting Use and Title 3 area on the west side of Arrowhead Creek; the staging area and receiving shaft on the east side of the creek will involve temporary impacts in the Title 3 area. See the Site Plan in Exhibit A, LUP-06.

Information regarding natural resources is provided in this narrative in response to criteria in the SROZ code section (Section 4.139), Flood Plain Regulations (Section 4.172), Protection of Natural Features and Other Resources (Section 4.171), and Willamette River Greenway code sections (Sections 4.500-4.514).

Areas of Special Concern

The Comprehensive Plan designates Areas of Special Concern, which are geographically specific designations that are regulated through unique City policies. The RWF site is located in Areas G and K of the Comprehensive Plan (Figure 5). Area G policies require long-term protection of concrete/gravel operations to the east of the WRWTP and RWF site as well as accommodation of the WRWTP and associated park. These policies support the development of RWF improvements in Area G.

Figure 5: Wilsonville Comprehensive Plan Map (Areas of Special Concern)



Area G policies also call for buffering along the western edge of the area that is adjacent to residential development. On the Lower Site, impacts to the forested ravine and creek area will be avoided, maintaining a natural buffer between the park and the residential neighborhood to the west. The Upper Site will include a buffer and screen – a high berm planted with a variety of trees, shrubs, and ground cover – between the proposed Electrical Building area and the neighborhood to the west, which is also addressed in response to criteria in Section 4.176 (Landscaping, Screening, and Buffering) and Section 4.421 (Site Design Review Criteria and Application of Design Standards). The existing pathway along the western edge of the site will be preserved and also serves as a buffer between the two uses.

Policies are not established for Area K, located along the Willamette River and designated in the West Side Master Plan for river-focused development. Responses to criteria in the SROZ, Flood Plain Regulations, and Willamette River Greenway sections of the narrative address the Willamette River in detail.

Based on the above, the proposal is consistent with relevant Comprehensive Plan policies.

Ice Age Tonquin Trail Master Plan

The Ice Age Tonquin Trail Master Plan (2013) identifies an existing “Neighborhood Connection” north-south through the WRWTP/RWF site corresponding to the pathway through the park and the pathway along the western edge of the Upper Site to Morey Lane. The plan also shows the existing Ice Age Tonquin Trail that travels east-west through the site along Arrowhead Creek Lane. (See Figure 4 earlier in this narrative for a map showing these existing trail system elements.)

The proposed RWF improvements include preserving the path alignment along the western edge of the Upper Site to Morey Lane, adding bollard lighting to this path, and restoring the trail along Arrowhead Creek Lane and the pathway through the park (on the subject property). The pathway through the park is proposed to be widened by 2 feet. In addition, a new trail is proposed off of the existing park pathway, which will provide access to additional areas of the park and to the Willamette River.

Based on the above findings, the proposed restorations and improvements complement and are consistent with the Ice Age Tonquin Trail Master Plan.

Parks and Recreation Master Plan

The WRWTP site is also the site of the City’s Water Treatment Plant Park. The “Key Challenges and Opportunities” section of the City’s 2007 Parks and Recreation Master Plan refers to improving “visibility and access of the river” for the park. The 2018 update of the Parks and Recreation Master Plan proposes the following recommendations and actions regarding the Water Treatment Plant Park (Action 1.1.i):

- Consider improving views by removing or pruning trees at river overlook.
- Explore possible river access.

The capital costs for these recommendations are identified as to be “negotiated with regional water partners” and operational budget impacts are identified as “to be determined.” Implementation timing is categorized as “mid-term” (6-10 years).

Proposed improvements include replacing the upper overlook and creating new trails (the west trail and lower trail) to provide visual and physical access to the river, which address the master plan recommendations. (See the Trail Plan in Exhibit A, Sheet 19 and the Upper Overlook Plan in Exhibit A, Sheet 20.) Tree removal along the river bank and replacement with shrub and ground cover plantings are proposed in order to implement seismic stabilization measures in that area, which will also address master plan recommendations regarding improving views to some degree (Exhibit D, Appendix A, Figure F4-1).

Access to the park will be limited during construction for safety reasons. (See the Construction Management Plan in Exhibit I.) The applicant’s goal is to keep paths and trails open as much as is feasible. However, public access closures or restrictions will be necessary for public safety during construction; the applicant is committed to coordinating these park access limitations with the City and general public.

Following construction, the pathway in the park and along Arrowhead Creek Lane will be restored to existing, if not improved, conditions, including a widening of the path through the park. (See the Park Site Plan in Exhibit A, Sheet 8.)

Based on the above findings, the proposal supports and implements long-term Parks and Recreation Master Plan actions.

Water Master Plans

The need for the WWSS, which includes the RWF, is established in adopted master plans – the Tualatin Valley Water District Water Master Plan Update (December 2018) and the City of Hillsboro Water Master Plan, Volume II (September 2013).

Tualatin Valley Water District Water Master Plan Update (2018)

The 2018 update of the Tualatin Valley Water District Water Master Plan (Exhibit S) incorporated the WWSS as an integral part of the overall water master plan. The WWSP is summarized in an appendix to the plan, titled "Program Formulation Summary" (Exhibit T). The Program Formulation Summary describes the overall WWSS structure, planning considerations, alternatives development and evaluations, and each of the following major system components: Raw Water Facilities (the subject of this application); Pipelines; Water Treatment Plant; and Reservoirs. The Program Formulation Summary demonstrates the significance of the WWSS, and integration of the proposed RWF as an essential component of this system.

City of Hillsboro Water Master Plan

The City of Hillsboro Water Master Plan includes the City of Hillsboro's Long-Term Water Supply Study. Chapter 2 of the City of Hillsboro Water Master Plan discusses water supply as compared to demand, which is explored in detail in Technical Memorandum 3 appended to Volume II of the master plan. In these documents, projected demand exceeded the existing water supply provided by the Joint Water Commission (JWC). Water supply options are evaluated in Chapter 8 and the "Mid-Willamette" WWSP option was selected as the preferred alternative based on reliability, redundancy, ownership, operational complexity, implementation risk, water quality, environmental impact, growth responsiveness, and cost criteria.

City of Wilsonville Willamette River Water Treatment Plant 2017 Master Plan Update

The proposed RWF improvements are accounted for in and consistent with the City of Wilsonville Willamette River Water Treatment Plant Master Plan. The most recent version of the master plan – the 2017 Master Plan Update – cites major events that have occurred in the last 10 years that have driven updates of the plan, including the following:

- TVWD and City of Hillsboro designated the Mid-Willamette as the preferred source for their supplemental water supplies in 2013.
- The City of Wilsonville and WWSP stakeholders updated the master plan in 2015 to meet the projected demand of Wilsonville, Sherwood, and WWSS customers, including intake and treatment on the WRWTP site for WWSS customers.

- It was determined that WWSP treatment facilities would be established as new facilities near Sherwood. See Exhibit C.

The City's 2017 Master Plan Update includes the following objectives: increasing supply resiliency and reliability and coordinating with WWSP plans to pump raw water from the WRWTP to a treatment plant in the Sherwood area (Exhibit C).

Site plans for the expansion of WRWTP capacity, as shown in the master plan, include proposed RWF improvements (Exhibit C).

Based on the findings above, the proposal is consistent with the Tualatin Valley Water District Water Master Plan, the City of Hillsboro Water Master Plan, and the City of Wilsonville Willamette River Water Treatment Plant Master Plan.

Development Code

The proposal is consistent with Chapter 4 of the Wilsonville Code (the Development Code) as demonstrated by the responses to the applicable standards provided elsewhere in this narrative.

Conclusion

The proposed development is consistent with relevant Comprehensive Plan policies, Master Plans, and Development Code provisions as stated above. Therefore, this standard is met.

> *2. The characteristics of the site are suitable for the proposed use considering size, shape, design, location, topography, existence of improvements, and natural features.*

Response: The uses proposed on the site (excluding those within the Willamette River Greenway) include the following:

- Lower Site
  - A portion of the seismic stabilization improvements
  - Expansion of capacity within the existing raw water pump station
  - A new water pipeline through the park (underground)
  - Portions of new trails (the west trail and lower trail) on the river bank
  - Replacement and enhancement of the existing upper overlook
  - Restoration and widening of the existing pathway through the park
- Upper Site
  - A new Electrical Building and ancillary facilities on the Upper Site
  - Continuation of the new pipeline, including a trenchless crossing of Arrowhead Creek
  - Restoration of the existing pathway and trail as needed

The following provides findings regarding suitability of the proposed RWF improvements relative to physical characteristics cited in the above standard:

- Expansion of pump station capacity – The original Conditional Use and Design Review application for the WRWTP (Casefile 00DB18) proposed facilities that could be expanded through the addition of pumps. (See excerpts of the original application and decisions in Exhibit U.) The proposed pump station improvements fit within the footprint of the existing building and are therefore suitable for the site.

- Seismic stabilization – The proposed seismic stabilization measures are shown in profile in the Bank Stabilization drawing (Exhibit A, Sheet 33) and in plan view in the River Bank Site Plan (Exhibit A, Sheet 7). These improvements are primarily within the area where the Willamette Greenway Conditional Use standards apply. To the extent they interface with the Lower Site area outside the Greenway, they are applicable to these general conditional use findings. They are a suitable location and design for the following reasons:
    - They are the only location where such improvements will protect the caisson from a seismic event (i.e., they are location-dependent).
    - They have been minimized with respect to impact area (see findings in Willamette Greenway CUP section). Through design iterations, the area of impact associated with these stabilization measures has been reduced so as to minimize impacts in the SROZ while still meeting the engineering and resiliency objectives.
    - The bank-top areas where they interface with the park have been designed to enhance the park experience. Paths are proposed to be improved and new trails to be constructed in order to provide better access. The upper overlook will be rebuilt and new west and lower overlooks will be built to provide long-planned visual access to the Willamette River, consistent with City objectives for this specific recreation experience.

- Pipeline – The proposed pipeline will be located underground, which can accommodate a parcel of any size or shape and which will not interfere with any existing site features. Topography is also not a limitation in this area. The work area required to install the pipeline in the park has been collaboratively designed with City staff so that it does not impact the Title 3 area of the SROZ (Exhibit A, Sheet 8). Approaching Arrowhead Creek, the launch shaft and staging area for the pipeline on the west side of the creek have been designed to avoid the Title 3 area of the SROZ (Exhibit A, Sheet 9).

- Paths and trails – Following construction, the existing pathway in the park will be restored, widened (from 10 feet to 12 feet), and have a more durable base and surface. These improvements have been coordinated with the City and designed so that maintenance and emergency vehicles may occasionally use this pathway as needed (Exhibit A, Sheet 8). The new trails proposed from the Lower Site into the Willamette River Greenway will provide visual and physical access to the river, consistent with City objectives. (See the Site Plan in Exhibit A, Sheet 7, and the Trail Plan in Exhibit A, Sheet 19.)

- Electrical Building and ancillary facilities – The Electrical Building and ancillary facilities are proposed on a part of the Upper Site that is currently undeveloped, has relatively few trees, and has been a storage area for fill from the original construction of the WRWTP and WIF. (See existing conditions in Exhibit A, Sheet 4.) The proposed building and facilities will have direct access to and from Arrowhead

Creek Lane, can be secured by fencing and gates, and are proposed to be screened and buffered by a berm and variety of landscaping. (See the Site Plan and Cross-Section Perspectives in Exhibit A, Sheets 9 and 35.) This location and design is suitable because it is away from the river, is buffered from neighbors to the west, and is still a functional and proximate location for the facilities.

- Temporary construction-related uses will include staging and an access road. (See the Overall Site Plan, River Bank Site Plan, and Proposed Work Zones in Exhibit A, Sheets 6, 7, and 34.) To the extent feasible, the staging areas and access road will make use of existing road, paved areas, and undeveloped areas on the site.

Based on the above, this standard is met.

3. All required public facilities and services exist, or will be provided, to adequately meet the needs of the proposed development.

Response: Necessary public facilities and services exist or will be provided as follows:

- Water – The limited water needs of the Electrical Building on the Upper Site can be supplied by a 8-inch water line proposed between the building and a 8-inch public water main in Arrowhead Creek Lane. See the Utility Plans in Exhibit A, Sheets 16-17.

- Sewer – Similarly, the limited sewer needs of the Electrical Building can be met by a 4-inch sanitary sewer line proposed between the building and a sewer main in SW Brockway Drive. See the Utility Plans in Exhibit A, Sheets 16-17.

- Stormwater – Stormwater management has been discussed with City staff in pre-application coordination meetings as well as at the formal pre-application meeting and in communications following the original submittal of this application. The addition of new impervious surface on the Lower Site will be limited (e.g., minor widening of the park pathway and a new connection of the park pathway to the Arrowhead Creek Lane turnaround); stormwater will be managed by existing systems including natural drainage (the ravine on the west side of the site and the river) and existing stormwater facilities. On the Upper Site, stormwater will be managed by swales proposed on the north and south sides of the site, which will connect to proposed new storm drains. The outfall for the drainage has been coordinated with the City's existing outfall to Arrowhead Creek, which will be reconstructed further towards the creek than the existing outfall in response to a request from the City. See the Utility Plan (Exhibit A, Sheet 17) and the Stormwater Plan (Exhibit A, Sheet 45). For more detail about stormwater on-site, see the updated Stormwater Report in Exhibit J.

- Electric power – A 4-inch connection to the existing power supply on the west side of the Upper Site could supply power during startup and commissioning. Additional new power supply will be needed for long-term RWF operations. The WWSP is working with Portland General Electric (PGE) in order to supply the additional power needed for long-term operation.

- Transportation – RWF operations will generate very few trips – on the order of 1-2 trips per day to the Electrical Building for operators/maintenance staff. Accordingly, a traffic study waiver request has been submitted with this application (Exhibit P). The access point to the Upper Site is located along Arrowhead Creek Lane, a suitable location for direct access that does not conflict with general access to the park or main WRWTP building. Traffic during construction will be managed consistent with the Construction Management Plan included in this application (Exhibit I).

Based on the above, this standard is or will be met.

> *4. The proposed use will not alter the character of the surrounding area in a manner which substantially limits, or precludes the use of, surrounding properties for the uses listed as permitted in the zone.*

Response: The following findings describe compatibility with the residential uses to the west and industrial uses to the east.

- Visual impacts – The pipeline improvements in the park will be underground and located east of the existing trees and vegetation in the ravine, which will not be disturbed. There will be no visual impacts, post-construction, to residences to the west or industrial uses to the east. See the Overall Site Plan and Pump Station Site Plan in Exhibit A, Sheets 6-7.

  The Electrical Building on the Upper Site will be screened from the pathway and neighborhood to the west and the road to the south by a berm and landscaping. Minimum setbacks are met and exceeded. The visual quality of the Upper Site will be improved compared to the large fill mound and non-landscaped character that the site has today. See the Site Plan for the Upper Site (Exhibit A, Sheet 9) and the Upper Site Cross-Section Perspectives (Exhibit A, Sheet 35).

  The radio tower proposed on the Upper Site is necessary for standard operations and emergency communications. The radio tower design will be simple and will be painted to blend into the surroundings. The height will be determined based on a radio path survey, and final design will be coordinated with the City. In general, the tower will have significantly less bulk and therefore limited visual impact as compared to the existing BPA towers that are adjacent to the subject property and the neighborhood to the west.

- Noise and vibration – Minimal noise and vibration are associated with operation of new and aboveground uses proposed on the Upper Site. Based on an evaluation of noise analysis results compared to requirements in Oregon Administrative Rules OAR 340-035-0035, no action or mitigation is required for noise levels associated with Upper Site facility operations. (See the noise analysis in Exhibit V.) The proposed building, berms, and specified equipment will ensure that the Upper Site facilities are in compliance with OAR requirements. During construction, noise and vibration will be limited to City-permitted construction hours on weekdays, with potential infrequent nighttime and weekend construction (Sunday construction only with special City permission). Construction noise and vibration levels will comply with related OAR requirements.

- Light – For ongoing operations, the proposed development will comply with the prescriptive method standards addressed in detail in responses to Section 4.199 in this narrative, which restrict light glare and trespass and promote protection of dark nighttime skies. Night-time construction will be minimal. WWSP will coordinate closely with the City throughout construction to address lighting issues that may arise in advance.

- Dust and odor – There are no odors anticipated with either construction or operation of the proposed development, nor dust anticipated with operation of the proposed development. Dust will be controlled during construction by standard construction practices including use of water and/or dust palliatives to reduce particulate matter.

- Construction – Construction practices and limiting short-term impacts on surrounding properties are addressed in the Construction Management Plan in Exhibit I.

Based on the above, the proposed uses are continuations or enhancements of existing uses and do not include alterations that would negatively change the character of the area. Therefore, this standard is met.

(.06) Conditional Use Regulations - Public Utility Structures.

A. Except as provided in this Section and Section 4.800, all transmission and public utility structures, including, but not limited to, distribution lines and poles, sub-transmission structures, lines and poles, double poles and steel towers for transmission lines, substations, automatic telephone exchanges, relay stations, microwave towers, satellite antennas, pumping stations and treatment plants shall be regulated as conditional uses in all zones.

Response: The proposed RWF improvements, with the exception of underground pipes pursuant to the following subsection (Section 4.184(.06)(B.)), are considered public utility structures that are conditional uses in all zones.

B. Underground pipes and conduits as provided in Sections 4.300 to 4.320 and any existing above ground electric distribution, sub-transmission and transmission, communication and signal lines and poles of a single pole system and existing above ground transformers which are not in violation of Sections 4.300 to 4.320 and any current or future applicable franchise agreement shall be a permitted use in any zone. This section shall not be construed as permitting any substantial intensification of use.

Response: The underground pipes proposed as part of the RWF improvements are a permitted use in all zones. However, because the pipes are proposed as part of a set of improvements that includes conditional uses, the entire set of proposed improvements is being reviewed pursuant to conditional use criteria.

(.08) Conditional Use Regulations – Willamette River Greenway Development.

A. The Development Review Board shall approve Conditional Use Permit applications for new development in the Willamette River Greenway only as specified in Section 4.500 and this Section.

Response: According to this subsection and direction from staff in Pre-Application Conference notes (Exhibit W), it is understood that development proposed in the Willamette River Greenway will be reviewed by staff and the Development Review Board pursuant to criteria in Section 4.500.

WILLAMETTE RIVER GREENWAY

Section 4.500. General Purpose.

The general purposes of this Section are to protect, conserve, enhance and maintain the natural, scenic, historical, agricultural, economic and recreational qualities of lands along the Willamette River as the Willamette River Greenway.

Section 4.504. General - Greenway Boundaries.

The Willamette River Greenway Boundaries in the City shall be the same as the Oregon State Parks and Recreation Department Willamette River Greenway Boundaries, and shall be defined on the City of Wilsonville Zoning and Comprehensive Plan Maps. The boundary is generally 150 feet from the ordinary low water line unless otherwise defined by the Map and this Section. Given that the Greenway Boundary does not always parallel the banks of the River, contact should be made with the City's Planning Department to verify boundary locations.

Response: Development proposed in the Willamette River Greenway and, thus, subject to provisions in this Section includes the seismic stabilization measures and new trails and trail amenities (lower trail overlook and west trail overlook with seating). On the upper river bank outside of the Greenway, an access road will temporarily serve as construction access and will permanently serve as part of the park pathway and new trail system and as vehicle access for maintenance and emergencies. The existing upper overlook will be replaced with an enhanced overlook and will connect to the new west overlook and lower overlook via the new west trail and new lower trail. Because the access road and upper overlook are connected to development proposed in the Greenway, they are also addressed in response to provisions in this Section. See the River Bank Site Plan (Exhibit A, Sheet 7), which shows the boundary of the Greenway, and the Trail Plan (Exhibit A, Sheet 19).

Section 4.506. General - Uses Permitted Outright.

(.01) The following are outright permitted uses within the Willamette River Greenway Boundary:

A. The placing, by a public agency, of signs, markers, aids, etc. to serve the public.

B. Activities to protect, conserve, enhance and maintain public recreational, scenic, historical, and natural uses on public and private lands, except that changes of use, intensification of use or development shall require Conditional Use Permit review as provided by this Code.

C. Agriculture as defined in ORS 215.203(2).

D. Reasonable emergency procedures necessary for the safety or protection of property.

E. Maintenance and repair usual and necessary for the continuance of an existing use not defined as intensification of use or change of use.

F. Uses legally existing on December 6, 1975.

Section 4.508. Conditional Use Permit - Uses Permitted Conditionally.

(.01) The following uses may be allowed within the Willamette River Greenway Boundaries subject to a Conditional Use Permit by the Development Review Board:

A. All uses permitted in the underlying zone which are not listed as permitted uses in Section 4.506.

B. All uses which are classified as intensification of use, change of use or development, other than tree removal, which shall be governed by the provisions of Section 4.600.

Response: The proposed new trails and associated markers or signs could be considered uses allowed outright pursuant to Section 4.506(.01)(A.) and (B.). The other public utility uses are uses permitted conditionally by the underlying zone and, thus, are permitted conditionally in the Willamette River Greenway pursuant to Section 4.508(.01)(A.).

Section 4.510. Conditional Use Permit - Findings In Support of Granting.

(.01) A Greenway Conditional Use Permit may be granted by the Development Review Board upon making the findings required in Section 4.184 (Conditional Use Permits) and the following additional findings:

A. That to the greatest extent possible, the maximum possible landscape area, open space or vegetation between the activity and the river are provided.

Response: The design of RWF seismic stabilization measures has been iteratively refined, in collaboration with City staff, so as to minimize impacts in the Willamette River Greenway while still achieving project objectives.

The WWSP’s Facility On-Site Alternatives Analysis Memorandum, dated September 27, 2018 (Exhibit X), evaluated three seismic alternatives for the RWF/WRWTP site in terms of criteria including seismic resiliency and effect on natural resources. Seismic Alternative A consisted of no seismic stabilization improvements. Seismic Alternative B featured improvements presented in the JPA, including a subsurface wall on the bank of the river to protect the raw water intake and a second subsurface wall near the top of the slope to protect the pump station, associated structures, and pipeline. Seismic Alternative C consisted of a subsurface buttress near the top of the slope to protect the pump station, associated structures, and pipeline.

Alternatives A and C were found to not meet the seismic resiliency criterion in that they could not protect facilities sufficiently to provide a minimum of 50 percent operational capacity within 48 hours of a magnitude 9.0 Cascadia Subduction Zone earthquake. Alternative B was found to meet this criterion.

Alternative C was also found to not meet the natural resource criterion in that it would involve excavation of an area approximately 150 feet wide by 350 feet wide for a 70-foot depth on the river bank; it would temporarily impact approximately two acres of riparian habitat, including area below regulatory ordinary high water marks where the extent of construction could not be completed within the in-water work window timeline.

Therefore, Alternative B was the only alternative of the three alternatives evaluated that satisfied all necessary criteria and that is feasible to construct.

Design of the alternative has since been refined in the following ways:

- The JPA included a design concept of 10-foot-diameter drilled shafts. The shafts have been removed from the design based on subsequent analysis, which determined this alternative would not limit movement of the caisson to the extent needed to meet project objectives.
- Instead, the design now includes subsurface seismic improvements to prevent the caisson from rotating towards the river. At 50% design, the area of disturbance for constructing the seismic improvements was approximately 54,895 square feet of the river bank area.
- Through further design refinements, the area of disturbance for constructing the seismic improvements was reduced by approximately 13,400 square feet.

See the Overall Site Plan and River Bank Site Plan in Exhibit A, Sheets 6-7.

In addition to reducing the footprint of the ground disturbance, the design has also been refined to include landscaping over the seismic improvements. The contractor for the project was hired during the design process in order to better inform design and help minimize the impact of construction staging and access areas, including on and near the river bank. Areas over and around the seismic stabilization measures will be covered with top soil and replanted with shrubs identified in river bank mitigation plans. In addition, portions of the two existing informal trails on the river bank will be decommissioned and replanted. See the River Bank Tree Removal and Protection Plan (Exhibit A, Sheet 25), the River Bank Mitigation Plan (Exhibit D, Appendix A, Figure F4-1), and the Trail Plan (Exhibit A, Sheet 19).

The widened park path will serve, when needed, as an access road for maintenance vehicles that need to access the river bank, particularly during an emergency. As compared to earlier designs, the temporary access road for construction, which overlaps with the park pathway approaching the river bank, has been moved closer to the treatment plant building and farther from the river. Both the permanent access road/park pathway and temporary access road avoid being in the Willamette River Greenway, as shown in the River Bank Site Plan (Exhibit A, Sheet 7), River Bank Temporary Conditions Plan (Exhibit D, Appendix A, Figure F3-1), and River Bank Final Conditions Plan (Exhibit D, Appendix A, Figure F4-1).

In these ways, the proposed seismic stabilization measures and temporary and permanent access roads minimize impacts to the landscape area, open space, and vegetation in the Greenway to the extent possible while also serving the safety and engineering objectives of the development.

Therefore, this criterion is met.

> *B. That to the greatest extent possible, necessary public access in accordance with the Comprehensive Plan will be provided to and along the River by appropriate legal means.*

Response: In addition to the above-cited standard, the Comprehensive Plan Implementation Measure (4.1.5.ff) calls for the following: “Provide necessary and needed public access to the river oriented through public lands, without precluding legal river access at appropriate locations across private property. Such public access shall be based upon recorded easements or other legal instruments.”

The applicant proposes to significantly improve visual and physical access to the river, consistent with the above-cited objectives, by developing public trails and overlooks and replanting the area with restoration plantings. (See Exhibit B.) These improvements are designed to:

- Integrate the existing upper overlook with the river bank landscape
- Relate the overlook to the award-winning design of the existing facility screening wall and water feature
- Reveal working components of the water treatment and conveyance systems, and link them to the rest of the WWSS
- Promote and inspire public and staff use of the site

Overlooks

The proposed replacement and enhancement of the upper overlook has been designed as a “grounded overlook,” meaning it will be a graded and terraced fill, with a rock wall connecting it to the river bank slope.[12] The plan view and landscaping details for the new upper overlook are shown in Exhibit A, Sheets 19-20, and more detail about the overlook is provided in Exhibit B.

Seating areas will be provided at the upper overlook and at the new west overlook, defining individualized but connected locations for people to gather. A new lower overlook will not have seating, but will nonetheless have space for people to stand and gather. The upper overlook design includes varied rock walls and benches. The upper overlook will be accessed by a realignment of the existing park pathway and the new west trail, which will both be ADA-accessible. Circulation areas for the upper overlook will be surfaced with pavers.

The new upper overlook will provide distinctive view experiences, which the following narrative further describes.

Viewing Area of the New Upper Overlook

According to a survey, the existing overlook viewing area is 14 feet by 15 feet, at the end of a long 10-foot-wide elevated ramp. The proposed overlook will be 34 feet wide overall and an average of 19 feet deep, and the 31-foot-wide viewing area along the south edge includes multiple options for the user. The new viewing area will be about 8 feet closer to the river than existing.

The most dramatic view will be from the new 10-foot-wide center platform, which will be surrounded by a cable guardrail since it sits at the top of the steep riverbank. The two seated viewing areas on either side will be 8 feet and 13 feet wide. Since they are set back from the

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[12] The City also reviewed an alternative Elevated Overlook (a platform supported by piles or posts) but did not prefer that alternative.

edge of the riverbank they have somewhat less panoramic views but do not need guardrails in front of them.

As a comparison, the existing overlook (ramp and viewing platform) is 1,046 square feet in size and the new overlook (viewing area plus new path to replace existing ramp) will be 1,475 square feet.

Viewshed of the New Upper Overlook

The view from the existing overlook is blocked in most directions by existing vegetation, and the river is hardly visible at all. In the winter, after leaves have fallen, the river is more present but only as a filtered view, and evergreen trees close to the viewing platform still block the view in multiple directions.

The trees removed for construction will leave an open area around the new overlook, but the tall, dense riparian forest on the lower half of the bank will remain. Therefore, from the new overlook the views will be into the interior of the forest canopy, looking up and out at the trunks and layers of canopy. The river will be more visible than it currently is, but still as a filtered view through the trees. After the trees are removed, the view of the river will be evaluated and strategic limbing will be considered to enhance the views, but only if it will not significantly alter the character of the forest.

In order to minimize future vegetation from blocking the views from the overlook (as is the case now), the riverbank restoration planting is designed to remain low within the primary field of view. In the area below the new overlook, the restoration planting mix will be relatively low shrubby native species and no trees. To either side, planting will include taller shrubs and trees. This will preserve the opening around the overlook for some time, but volunteer trees will eventually find their way in. In 20 years or so, it may make sense to do some pruning or thinning to open up the views again. The ornamental planting near the overlook, on top of the bank, will also be low so as to not block views.

The design intent for the overlook is to strategically constrain and then open the views. Approaching the overlook from the north, the view to the west of the water feature and park is open, while the process yard to the east is blocked by the existing row of screening walls. As one passes the existing pump station building, a new grove of dogwood trees will narrow the focus to the new planting, boulders, and walls surrounding the overlook, with a narrow view of the riparian forest beyond. Entering the overlook, the view opens up again but is mainly of the forest in front of the overlook. When the visitor reaches the viewing area at the front of the overlook, the reward will be a wide panoramic view into the layers of riparian forest, the steep riverbank below, and slices of the river and south bank beyond.

This sequence sets up anticipation and then the satisfaction of the wide view. The other goal of constraining the view is to screen the new access drive and the process yard to the east, which will be out of sight from most of the overlook. The 5-foot-tall stone wall on the east edge of the overlook provides much of this screening, similar to the existing screening walls to the north.

Trails

The new west and lower trails on the river bank are designed to do the following:

- Expand the path options of the existing park
- Provide an ADA-accessible experience (the west trail)
- Provide visual access to the river for staff and visitors
- Minimize impacts to the existing steep river bank
- Promote and inspire public and staff use of site

The proposed trail alignments are shown in Exhibit A (Sheet 19). Two new trails are proposed: (a) a “loop trail” (the west trail) that will extend the existing park pathway to the approximate top of the reshaped river bank top of slope, where a new overlook with seating is proposed, after which it will turn east to run along the top of bank to the reconstructed upper overlook (Exhibit A, Sheet 20); and (b) a “river bank access trail” (the lower trail) that will extend east from the upper overlook and connect to a new lower overlook through a switch-backed forest trail. The ADA-accessible loop trail will traverse the natural area with large trees and has views of the river over the top of bank. The lower trail provides a forested “journey toward the river” experience. Cribbed steps will be utilized to improve navigability and minimize the potential for erosion. Seating will be provided at the upper overlook and the west overlook.

Mitigation and Restoration Plantings

The replanting of the river bank area is an integral part of its design and benefit to the public. Replanting actions include the following:

- Replant the river bank consistent with the SROZ and Willamette Greenway
- Replant the river bank area disturbed by the grout block construction

Proposed river bank restoration planting areas encompass the entire area that will be disturbed by the installation of seismic stabilization measures, including replanting much of the two existing informal trails. The variety of trees, large shrubs, and medium-small shrubs to be used in the restoration is shown in Figure F4-1 in the SRIR (Exhibit D, Appendix A). Seismic improvements will be completely covered with top soil at a minimum depth of 5 feet. This will accommodate medium and small shrubs, but not trees. Trees will be planted outside of the jet block area. The plants will be native and consistent with the requirements of the SROZ. They will serve multiple functions including soil stabilization, beautification, and habitat.

Public access to the site and the river is expected to be restricted during construction. However, access limitations will be for the purpose of public safety and will be coordinated with and clearly communicated to the public.

Based on the above, public access will be provided to the greatest extent practicable and this criterion is met.

C. That the change of use, intensification of use, or development complies with this Code, all other applicable City Ordinances, the Comprehensive Plan, and the Oregon State Parks and Recreation Department Greenway Plan.

Response: The proposed development complies with applicable provisions of the Code as demonstrated in this narrative. The proposed development is consistent with relevant Comprehensive Plan policies as demonstrated in responses to conditional use criteria in Section 4.184(.01)(A.)(1.) and Section 4.510(.01)(B.) in this narrative. The proposed development in the Greenway will be underground (seismic stabilization measures) or will include new trails providing types of access that are consistent with the City's Parks and Recreation Master Plan. The State's Greenway Plan is reflected is the City's Parks and Recreation Master Plan and in the provisions in this Section of the Code. Compliance with other City Greenway regulations are demonstrated in responses to other standards in this Section.

Therefore, this criterion is met.

Section 4.514. Conditional Use Permit - Use Management Standards.

(.01) The natural scenic views, historical character and recreational qualities of the Willamette River shall be protected by preservation and enhancement of the vegetative fringe along the river bank.

(.02) A plan to remove any tree or trees shall be reviewed by the Development Review Board under the procedures of Section 4.600, et seq. Based on the standards and procedures of Section 4.620.10, mandatory mitigation shall be required as a condition of approval for any Conditional Use Permit granted under this Section.

Response: As found in response to historic protection criteria (Section 4.161(10)(a)) in the original application for the WRWTP, there are no documented cultural or historic resources on the site as defined for the WRWTP (Exhibit U). As described in response to the standard in Section 4.510(.01)(A.) above, vegetation is being either preserved, restored, or mitigated to the extent practicable. This includes preservation of the two cable trees, as described in response to Section 4.167(09). New trails and overlooks are being proposed to enhance the visual and physical access to the river on the site, and a portion of the existing informal river bank trail will be retained to provide access to the cable trees (Exhibit A, Sheet 19, and Exhibit B). Tree removal in the SROZ (including the Greenway) and its mitigation is addressed in detail in responses to criteria in Section 4.139 and in the SRIR (Exhibit D). Tree removal outside the SROZ is addressed in responses to criteria in Section 4.600. Therefore, this standard is met.

(.03) Developments shall be directed away from the river to the greatest possible degree; provided, however, lands committed to urban uses within the Greenway shall be permitted to continue as urban uses, including port, industrial, commercial and residential uses, uses pertaining to navigational requirements, water and land access needs and related facilities.

Response: Development proposed in the Greenway is river-dependent (WRWTP seismic stabilization measures) or river-related (new trails and related amenities). See the Overall and River Bank Site Plans in Exhibit A, Sheets 6-7. The seismic stabilization measures serve the existing public utility use, for which pumping capacity is being expanded within the existing pump station building to accommodate WWSP raw water needs. The new west trail and lower trail will provide visual and physical access to the river called for in City Comprehensive Plan policy and Parks and Recreation Master Plan recommendations.

Other RWF development has been designed to be outside of the Greenway, away from the river, including the pipeline in the park and through the Upper Site and the Electrical Building and ancillary facilities on the Upper Site. See the Upper Site and Park Site Plans in Exhibit A, Sheets 8-9.

Therefore, this standard is met.

Temporary development and construction activities in the Greenway, including the access road, have been designed to limit their impact in the Greenway. The proposed access road is a looped road so that a turnaround – and larger impact – would not be created in the Greenway. In final conditions, the access road will, in parts, be used as new trail, will be replanted, and will continue to provide access (for maintenance and emergencies). See the Trail Plan (Exhibit A, Sheet 19) and the River Bank Final Conditions Plan (Exhibit D, Appendix A, Figure F4-1).

(.04) All development after the effective date of this ordinance, except water dependent and water related uses, shall be set back a minimum of 75 feet upland from the top of each bank.

Response: The proposed water-dependent seismic stabilization measures and water-related trails are exceptions to the 75-foot setback in this standard. Otherwise, the water-related pipeline is both within and beyond the 75-foot setback and the proposed water-related Electrical Building and ancillary facilities are beyond the 75-foot setback. See the Site Plans in Exhibit A, Sheets 6-9. Therefore, this standard is met.

(.05) Fish, riparian and wildlife corridors leading into the river channel shall remain open.

Response: The ravine along the western edge of the site is an existing corridor leading into the Willamette River. The SROZ boundaries mapped as part of this application encompass the ravine and its tree cover (Figure 3). Proposed development was collaboratively designed with the City to avoid the ravine and the SROZ Area of Limited Conflicting Use and SROZ Title 3 area associated with it; the pipeline and its work area, as it travels through the park, is east of the SROZ Title 3 area and SROZ Area of Limited Conflicting Use. The existing park pathway, which is located in the SROZ Impact Area and SROZ Title 3 area, will be restored in place. See the Park Site Plan in Exhibit A, Sheet 8. This proposed development will avoid the ravine area and will allow that corridor to remain open. Therefore, this standard is met.

> *(.06) All development, change of use or intensification of use shall demonstrate, to the maximum extent possible, maintenance of public safety and protection of public and private property, especially from vandalism and trespass.*

Response: Access to the proposed development in the Greenway (e.g., trails) will be regulated as access to the existing park and park pathway is regulated, which has been successful in protecting the public and property. Further, for purposes of public safety during construction, public access will be limited to the site and the Greenway, consistent with the Construction Management Plan (Exhibit I) and in coordination with the City and the public. Therefore, this standard will be met.

TREE PRESERVATION AND PROTECTION

Section 4.610.10. Standards For Tree Removal, Relocation Or Replacement

(.01) Except where an application is exempt, or where otherwise noted, the following standards shall govern the review of an application for a Type A, B, C or D Tree Removal Permit:

A. Standard for the Significant Resource Overlay Zone. The standard for tree removal in the Significant Resource Overlay Zone shall be that removal or transplanting of any tree is not inconsistent with the purposes of this Chapter.

Response: Tree removal in the SROZ has been minimized, in each of the SROZ areas on the subject property, in the following ways:

1. On the river bank, tree removal is limited to only the areas necessary for the construction of seismic stabilization measures. The footprint of that work area has been designed to minimize tree removal.
2. In the park, the proposed pipeline will be located outside of the SROZ Area of Limited Conflicting Use and the SROZ Title III area associated with the ravine in order to limit impacts including tree removal. Proposed removal of trees in SROZ areas in the park is due to installation of conduit for future fiber optic line that the City has requested.
3. For the trenchless crossing of Arrowhead Creek, tree removal is limited to only the area necessary for the receiving shaft location (five trees) on tax lot 1700.

See the Tree Removal and Protection Plans in Exhibit A (Sheets 25-28).

The approach is consistent with the purposes of the Chapter, including the purpose “(t)o preserve SROZ areas, recognizing that development can and will occur.”

The approach described above is also consistent with the Abbreviated SRIR requirement in Section 4.139.06(.01)(I), which requires that a narrative be provided describing potential impacts to natural resources and a plan to mitigate for such impacts.

Based on the above, this standard is met.

B. Preservation and Conservation. No development application shall be denied solely because trees grow on the site. Nevertheless, tree preservation and conservation as a design principle shall be equal in concern and importance to other design principles.

Response: Along the river bank and within the park, the proposed design evaluated both tree preservation and engineering principles in an iterative process that was coordinated with City staff. On the river bank, this process resulted in a design and work area that will minimize tree impact, in balance with project engineering needs. Trees that will be preserved include trees identified by City staff as priorities for preservation. The Tree Survey and Arborist Report were used as the factual base to understand the type, size, and quality of trees under consideration for removal and preservation.

Within the park, the review of alternatives prioritized protection of the SROZ, i.e., the trees within and along the ravine. The trees to be removed within the park are the minimum impact needed to construct the pipeline along the selected alignment as well as to install the conduit that the City has requested to accommodate a future fiber optic line. On the Upper Site, the trenchless construction method for the Arrowhead Creek crossing requires removal of five trees on the east side of the creek, which is on a property adjacent to the subject property. This area will be restored with a variety of native shrubs. See the Tree Removal and Protection Plans in Exhibit A (Sheets 25-28).

Areas of tree removal on the river bank will either be restored with a variety of native shrubs over the locations of seismic stabilization measures or a variety of trees and shrubs outside of the footprint of stabilization measures as well as over the location of informal trails on the river bank. See the Mitigation Plan in Figure F4-1 of Appendix A in Exhibit D. Tree removal on the river bank will also be mitigated by proposed new trails and amenities on the river bank and a large area of new planting on the Upper Site, which will create a diverse native upland habitat connected to Arrowhead Creek where there currently is not such habitat.

Therefore, this standard is met.

> *C. Developmental Alternatives. Preservation and conservation of wooded areas and trees shall be given careful consideration when there are feasible and reasonable location alternatives and design options on-site for proposed buildings, structures or other site improvements.*
>
> *D. Land Clearing. Where the proposed activity requires land clearing, the clearing shall be limited to designated street rights-of-way and areas necessary for the construction of buildings, structures or other site improvements.*

Response: Tree removal proposed in the SROZ has been minimized to accommodate tree removal only in areas of proposed grading and development on the upper river bank and to avoid SROZ areas on the lower bank and to the west of the park on the Lower Site as well as along Arrowhead Creek on the Upper Site. See the Tree Removal and Protection Plans in Exhibit A (Sheets 25-28).

Grading proposed on the Lower Site has been reduced in line with modifications in the design of proposed river bank seismic stabilization measures (e.g., removal of the need for an underground tie-back wall) and the access road on the Lower Site, which – on the river bank – has been pulled back closely to the existing water treatment plant building. See the Grading Plans in Exhibit A (Sheet 10) and Exhibit D (Figures F3-1 and F4-1), in addition to the Construction Management Plan in Exhibit I.

Therefore, this standard is met.

E. Residential Development.

Response: Residential development is not proposed as part of this development. Therefore, this standard is not applicable.

F. Compliance With Statutes and Ordinances. The proposed activity shall comply with all applicable statutes and ordinances.

Response: The proposed activity complies with applicable statutes and ordinances as demonstrated throughout this narrative. Therefore, this standard is met.

G. Relocation or Replacement. The proposed activity shall include necessary provisions for tree relocation or replacement, in accordance with WC 4.620.00, and the protection of those trees that are not to be removed, in accordance with WC 4.620.10.

Response: Mitigation for trees proposed to be removed in the SROZ on the subject property is addressed in detail in response to SRIR review criteria in Section 4.139.06 in this narrative. Mitigation and replacement of trees proposed to be removed outside the SROZ on the subject property will be provided consistent with the provisions in Section 4.620.00, as addressed in response to those provisions. Similarly, protection of trees to be preserved will be provided consistent with the provisions in Section 4.620.10, as addressed in the responses to those provisions. Therefore, this standard is met.

H. Limitation. Tree removal or transplanting shall be limited to instances where the applicant has provided completed information as required by this Chapter and the reviewing authority determines that removal or transplanting is necessary based on the criteria of this subsection.

1. Necessary For Construction. Where the applicant has shown to the satisfaction of the reviewing authority that removal or transplanting is necessary for the construction of a building, structure or other site improvement, and that there is no feasible and reasonable location alternative or design option on-site for a proposed building, structure or other site improvement; or a tree is located too close to existing or proposed buildings or structures, or creates unsafe vision clearance.

2. Disease, Damage, or Nuisance, or Hazard. Where the tree is diseased, damaged, or in danger of falling, or presents a hazard as defined in WC 6.208, or is a nuisance as defined in WC 6.200 et seq., or creates unsafe vision clearance as defined in this Code.

(a) As a condition of approval of Stage II development, filbert trees must be removed if they are no longer commercially grown or maintained.

3. Interference. Where the tree interferes with the healthy growth of other trees, existing utility service or drainage, or utility work in a previously dedicated right-of-way, and it is not feasible to preserve the tree on site.

4. Other. Where the applicant shows that tree removal or transplanting is reasonable under the circumstances.

Response: Tree removal proposed in the SROZ has been minimized to accommodate tree removal only in areas necessary for construction on the upper river bank and at Arrowhead Creek. The development proposed in and on the river bank must occur in that location given its dependency on the river and the existing water treatment plant facilities. The removal of trees at Arrowhead Creek has been minimized by using trenchless crossing techniques. Grading proposed on the Lower Site has been reduced during the design process as a result of modifying project designs to have smaller footprints and less impact on the river bank.

Therefore, this standard is met.

I. Additional Standards for Type C Permits.

1. Tree survey. For all site development applications reviewed under the provisions of Chapter 4 Planning and Zoning, the developer shall provide a Tree Survey before site development as required by WC 4.610.40, and provide a Tree Maintenance and Protection plan, unless specifically exempted by the Planning Director or DRB, prior to initiating site development.

2. Platted Subdivisions. The recording of a final subdivision plat whose preliminary plat has been reviewed and approved after the effective date of Ordinance 464 by the City and that conforms with this subchapter shall include a Tree Survey and Maintenance and Protection Plan, as required by this subchapter, along with all other conditions of approval.

3. Utilities. The City Engineer shall cause utilities to be located and placed wherever reasonably possible to avoid adverse environmental consequences given the circumstances of existing locations, costs of placement and extensions, the public welfare, terrain, and preservation of natural resources. Mitigation and/or replacement of any removed trees shall be in accordance with the standards of this subchapter.

Response: A Tree Survey and Arborist Report is included in this application as Exhibit N. Tree Removal and Protection Plans are included in this application as Sheets 25-28 in Exhibit A.

The proposed RWF improvements are utilities. As described in response to other criteria, tree removal proposed in the SROZ has been limited to occur only in areas of proposed grading and development on the upper river bank and to avoid SROZ areas along the west of the park and around Arrowhead Creek on the Upper Site.

Utilities to serve the RWF improvements (and to which the development proposes to connect) are a matter of ongoing coordination between the applicant, City, and utility service providers. Utilities currently proposed to serve the development are shown in the Utility Plans in Exhibit A, Sheets 15-17.

Mitigation for trees proposed to be removed in the SROZ is addressed in detail in response to SRIR review criteria in Section 4.139.06 in this narrative. Mitigation and replacement of trees proposed to be removed outside the SROZ will be provided consistent with the provisions in Section 4.620.00, as addressed in response to those provisions in this narrative.

Therefore, these standards are met.

Section 4.610.40. Type C Permit

(.01) Approval to remove any trees on property as part of a site development application may be granted in a Type C permit. A Type C permit application shall be reviewed by the standards of this subchapter and all applicable review criteria of Chapter 4. Application of the standards of this section shall not result in a reduction of square footage or loss of density, but may require an applicant to modify plans to allow for buildings of greater height. If an applicant proposes to remove trees and submits a landscaping plan as part of a site development application, an application for a Tree Removal Permit shall be included. The Tree Removal Permit application will be reviewed in the Stage II development review process, and any plan changes made that affect trees after Stage II review of a development application shall be subject to review by DRB. Where mitigation is required for tree removal, such mitigation may be considered as part of the landscaping requirements as set forth in this Chapter. Tree removal shall not commence until approval of the required Stage II application and the expiration of the appeal period following that decision. If a decision approving a Type C permit is appealed, no trees shall be removed until the appeal has been settled.

(.02) The applicant must provide ten copies of a Tree Maintenance and Protection Plan completed by an arborist that contains the following information:

A. A plan, including a topographical survey bearing the stamp and signature of a qualified, registered professional containing all the following information:

1. Property Dimensions. The shape and dimensions of the property, and the location of any existing and proposed structure or improvement.

Response: Property dimensions and contours are included in the Site Plans and Grading Plans for the subject property (Exhibit A, Sheets 7-11). Therefore, this standard is met.

2. Tree survey. The survey must include:

a. An accurate drawing of the site based on accurate survey techniques at a minimum scale of one inch (1") equals one hundred feet (100') and which provides a) the location of all trees having six inches (6") or greater d.b.h. likely to be impacted, b) the spread of canopy of those trees, (c) the common and botanical name of those trees, and d) the approximate location and name of any other trees on the property.

Response: An accurate drawing of the site is included in the Tree Removal and Protection Plans (Exhibit A, Sheets 25-28). According to the report, the spread of the tree canopy on the site is relatively connected and determining exact drip lines for all trees on site is not feasible. The Existing Site Conditions Plan (Exhibit A, Sheet 4) shows the canopy spread of the trees on the site. The common and botanical name of trees found on the site are included in the tree survey table at the end of the Arborist Report (Exhibit N). The approximate location and name of any other trees on the property can be found on both the Tree Removal and Protection Plans and the table at the end of the Arborist Report. Therefore, this standard is met.

> *b. A description of the health and condition of all trees likely to be impacted on the site property. In addition, for trees in a present or proposed public street or road right-of-way that are described as unhealthy, the description shall include recommended actions to restore such trees to full health. Trees proposed to remain, to be transplanted or to be removed shall be so designated. All trees to remain on the site are to be designated with metal tags that are to remain in place throughout the development. Those tags shall be numbered, with the numbers keyed to the tree survey map that is provided with the application.*

Response: The tree survey table at the end of the Arborist Report (Exhibit N) includes an indication of the health and condition of trees on the site that may be impacted by the proposed development. Trees surveyed on the site do not include trees that are considered street streets or right-of-way trees. All trees proposed to be removed or preserved are indicated on the Tree Removal and Protection Plans in red or green, respectively (Exhibit A, Sheets 25-28). All trees that are to be preserved have been tagged with associated survey numbers. Therefore, this standard is met.

> *c. Where a stand of twenty (20) or more contiguous trees exist on a site and the applicant does not propose to remove any of those trees, the required tree survey may be simplified to accurately show only the perimeter area of that stand of trees, including its drip line. Only those trees on the perimeter of the stand shall be tagged, as provided in "b," above.*

Response: The western section of the Lower Site will generally be undisturbed and protected as shown in the Tree Removal and Protection Plans (Exhibit A, Sheets 25-27). Perimeter trees in this area have been tagged as required. Therefore, this standard is met.

> *d. All Oregon white oaks, native yews, and any species listed by either the state or federal government as rare or endangered shall be shown in the tree survey.*

Response: Oregon white oaks, yew, madrone, or any other species that would otherwise be considered at risk or endangered were not found in the survey. Therefore, this standard is not applicable.

> *3. Tree Protection. A statement describing how trees intended to remain will be protected during development, and where protective barriers are necessary, that they will be erected before work starts. Barriers shall be sufficiently substantial to withstand nearby construction activities. Plastic tape or similar forms of markers do not constitute "barriers."*

Response: All tree protection will be erected prior to the start of any site work including construction of the temporary access road. To best protect the trees, the arborist makes the following recommendations in the Arborist Report (Exhibit N).

- An erosion fence should be installed on the upslope of all trees below major grade changes to prevent trunks and root zones from being buried.
- Six-foot chain link fencing on 8-foot posts should be installed along the route of all major construction activity including temporary roads and work zones.
- The fencing should be highlighted with tree protection signage that prohibits entry of vehicles, equipment, or persons not associated with the trees directly.
- The tree protection fencing shall be routinely inspected during the site work for sturdiness and protection efficiency.
- In the event that damage occurs or if there is a concern by equipment operators that damage could occur to a tree(s), the arborist shall be notified immediately to resolve the issue.
- All tree protection materials shall remain in place throughout the project and removed after final inspection by the City of Wilsonville.

Therefore, this standard is met.

4. Easements and Setbacks. Location and dimension of existing and proposed easements, as well as all setbacks required by existing zoning requirements.

Response: Easements and setbacks, as applicable, are shown on project site plans. (See Exhibit A, Sheets 7-9.) Therefore, this standard is met.

5. Grade Changes. Designation of grade changes proposed for the property that may impact trees.

Response: Grade changes and tree impacts are shown in the Grading Plans and Tree Removal and Protections Plans (Exhibit A, Sheets 10, 11, and 25-28). Therefore, this standard is met.

6. Cost of Replacement. A cost estimate for the proposed tree replacement program with a detailed explanation including the number, size and species.

Response: The Arborist Report indicates that all trees removed outside the SROZ on the site will be replaced one-for-one with a similar native species. Only native species that are removed shall be replaced. Any nuisance species do not require replacement. Restoration of the site’s woodlands shall occur during applicable planting seasons. Replacement tree size shall be determined by the City of Wilsonville.

For purposes of a conservative cost estimate, 6-foot conifers and 2-inch deciduous trees have been used to estimate an average tree replacement cost of $250 (labor and the cost of an individual tree). Based on an estimated total of 91 trees being replaced, this yields a replacement cost of approximately $22,750. Ideally, smaller plant stock will be used when replanting in natural areas since smaller native stock tends to be more adaptive to such settings.

Therefore, this standard is met.

7. Tree Identification. A statement that all trees being retained will be identified by numbered metal tags, as specified in subsection "A," above in addition to clear identification on construction documents.

Response: All trees that are to be retained are identified by numbered metal tags that are directly associated with the survey table in the Arborist Report (Exhibit N) and the trees shown in Tree Removal and Protection Plans (Exhibit A, Sheets 25-28). Ideally, all metal tags should be removed after the project is complete to reduce any disruption to tree growth or health. Therefore, this standard is met.

Section 4.620.00. Tree Relocation, Mitigation, Or Replacement

(.01) <u>Requirement Established</u>. A Type B or C Tree Removal Permit grantee shall replace or relocate each removed tree having six (6) inches or greater d.b.h. within one year of removal.

(.02) <u>Basis For Determining Replacement</u>. The permit grantee shall replace removed trees on a basis of one (1) tree replanted for each tree removed. All replacement trees must measure two inches (2”) or more in diameter. Alternatively, the Planning Director or Development Review Board may require the permit grantee to replace removed trees on a per caliper inch basis, based on a finding that the large size of the trees being removed justifies an increase in the replacement trees required. Except, however, that the Planning Director or Development Review Board may allow the use of replacement Oregon white oaks and other uniquely valuable trees with a smaller diameter.

Response: Eighteen trees are proposed for removal outside the SROZ. (See the Tree Removal and Protection Plans in Exhibit A, Sheets 25-28, and the SRIR in Exhibit D.) The applicant will replace each tree having 6 inches or greater DBH that is removed outside the SROZ with trees that are at least 2 inches DBH. Trees removed in the SROZ will be replaced or mitigated for on a discretionary basis as established by the SRIR criterion in Section 4.139.06(.01)(I), which requires that a description of potential impacts to natural resources as well as a plan to mitigate for such impacts. See the Tree Survey/Arborist Report (Exhibit N), SRIR (Exhibit D), and Mitigation Plans (Exhibit A, Sheets 18 and 23, and Exhibit D, Figures F4-1 and F4-3).

(.03) <u>Replacement Tree Requirements</u>. A mitigation or replacement tree plan shall be reviewed by the City prior to planting and according to the standards of this subsection.

A. Replacement trees shall have shade potential or other characteristics comparable to the removed trees, shall be appropriately chosen for the site from an approved tree species list supplied by the City, and shall be state Department of Agriculture Nursery Grade No. 1 or better.

B. Replacement trees must be staked, fertilized and mulched, and shall be guaranteed by the permit grantee or the grantee's successors-in-interest for two (2) years after the planting date.

C. A "guaranteed" tree that dies or becomes diseased during that time shall be replaced.

D. Diversity of tree species shall be encouraged where trees will be replaced, and diversity of species shall also be maintained where essential to preserving a wooded area or habitat.

(.04) All trees to be planted shall consist of nursery stock that meets requirements of the American Association of Nurserymen (AAN) American Standards for Nursery Stock (ANSI Z60.1) for top grade.

Response: Replacement trees proposed on the river bank and on the Upper Site will have shade potential and other characteristics of the removed trees, will be of nursery stock, and will be maintained consistent with these standards. Replacement and mitigation tree species will include diverse and/or native species such as: Bigleaf maple; Cascara; Pacific dogwood; Oregon oak; Red alder; Western hemlock; Western red cedar; and Douglas fir. See the Mitigation Plans in Exhibit A (Sheets 18 and 23) and Exhibit D (Figures F4-1 and F4-3). Therefore, these standards are met.

(.05) <u>Replacement Tree Location</u>.

A. City Review Required. The City shall review tree relocation or replacement plans in order to provide optimum enhancement, preservation and protection of wooded areas. To the extent feasible and desirable, trees shall be relocated or replaced on-site and within the same general area as trees removed.

B. Relocation or Replacement Off-Site. When it is not feasible or desirable to relocate or replace trees on-site, relocation or replacement may be made at another location-approved by the City.

Response: Tree replacement is not proposed off-site. It is understood that the City will review proposed plans for replacing trees on-site, as presented in the Mitigation Plans in Exhibit A (Sheets 18 and 23) and Exhibit D (Figures F4-1 and F4-3). Therefore, this standard is and will be met.

(.06) <u>City Tree Fund</u>. Where it is not feasible to relocate or replace trees on site or at another approved location in the City, the Tree Removal Permit grantee shall pay into the City Tree Fund, which fund is hereby created, an amount of money approximately the value as defined by this subchapter, of the replacement trees that would otherwise be required by this subchapter. The City shall use the City Tree Fund for the purpose of producing, maintaining and preserving wooded areas and heritage trees, and for planting trees within the City.

A. The City Tree Fund shall be used to offer trees at low cost on a first-come, first-serve basis to any Type A Permit grantee who requests a tree and registers with the City Tree Fund.

B. In addition, and as funds allow, the City Tree Fund shall provide educational materials to assist with tree planting, mitigation, and relocation.

Response: Trees are proposed to be replaced on-site. Therefore, these standards are not applicable.

(.07) <u>Exception</u>. Tree replacement may not be required for applicants in circumstances where the Director determines that there is good cause to not so require. Good cause shall be based on a consideration of preservation of natural resources, including preservation of mature trees and diversity of ages of trees. Other criteria shall include consideration of terrain, difficulty of replacement and impact on adjacent property.

Response: It is understood that the Director has the authority to determine cases when tree replacement may not be required. An exception to tree replacement standards is not proposed as part of this application.

Section 4.620.10. Tree Protection During Construction

(.01) Where tree protection is required by a condition of development under Chapter 4 or by a Tree Maintenance and Protection Plan approved under this subchapter, the following standards apply:

A. All trees required to be protected must be clearly labeled as such.

Response: Trees designated for protection are indicated in the Tree Removal and Protection Plans by green labels (Exhibit A, Sheets 25-28). Therefore, this standard is met.

B. Placing Construction Materials Near Tree. No person may conduct any construction activity likely to be injurious to a tree designated to remain, including, but not limited to, placing solvents, building material, construction equipment, or depositing soil, or placing irrigated landscaping, within the drip line, unless a plan for such construction activity has been approved by the Planning Director or Development Review Board based upon the recommendations of an arborist.

C. Attachments to Trees During Construction. Notwithstanding the requirement of WC 4.620.10(1)(A), no person shall attach any device or wire to any protected tree unless needed for tree protection.

D. Protective Barrier. Before development, land clearing, filling or any land alteration for which a Tree Removal Permit is required, the developer shall erect and maintain suitable barriers as identified by an arborist to protect remaining trees. Protective barriers shall remain in place until the City authorizes their removal or issues a final certificate of occupancy, whichever occurs first. Barriers shall be sufficiently substantial to withstand nearby construction activities. Plastic tape or similar forms of markers do not constitute "barriers." The most appropriate and protective barrier shall be utilized. Barriers are required for all trees designated to remain, except in the following cases:

1. Right-of-Ways and Easements. Street right-of-way and utility easements may be cordoned by placing stakes a minimum of fifty (50) feet apart and tying ribbon, plastic tape, rope, etc., from stake to stake along the outside perimeters of areas to be cleared.

2. Any property area separate from the construction or land clearing area onto which no equipment will venture may also be cordoned off as described in paragraph (D) of this subsection, or by other reasonable means as approved by the reviewing authority.

Response: Construction materials will not be placed within tree drip lines and nothing will be attached to protected trees during construction. Protective barriers will be provided during construction consistent with recommendations in the Arborist Report (Exhibit N) and as shown noted in the Tree Removal and Protection Plans in Exhibit A, Sheets 25-28.

EXHIBITS

Exhibit A: Plan Set (Under Separate Cover)

Exhibit B: Lower Site Overlooks Presentation

Exhibit C: Willamette River Water Treatment Plant 2017 Master Plan Update (February 2018) [excerpts]

Exhibit D: Significant Resources Impact Report (Abbreviated)

Exhibit E: U.S. Army Corps of Engineers Permit and Oregon Department of State Lands Permit

Exhibit F: U.S. Army Corps of Engineers/Oregon Department of State Lands Joint Permit Application (June 2017) [excerpts]

Exhibit G: Wetland Delineation Report (September 2015)

Exhibit H: Oregon Department of State Lands Concurrence Report

WD # 2016-0249, Wetland Delineation Report for Proposed Improvements for the Willamette River Water Treatment Plant (August 31, 2016)

Exhibit I: Construction Management Plan

Exhibit J: Preliminary Stormwater Report

Exhibit K: Lighting Exhibit

Exhibit L: Willamette Water Supply System Biological Assessment (April 2017) [excerpts]

Exhibit M: Geotechnical Design Report (April 2, 2019)

Exhibit N: Arborist Report/Tree Survey

Exhibit O: No Rise Documentation

Exhibit P: Traffic Study Waiver Request

Exhibit Q: Hauler Coordination Documentation

Exhibit R: Materials Board (Upper Site) (Under Separate Cover)

Exhibit S: Tualatin Valley Water District Water Master Plan (December 2018) [excerpts]

Exhibit T: Willamette Water Supply Program Water Supply Program Formulation Summary (October 31, 2018)

Exhibit U: Original Land Use Application (Casefile 00DB18) [excerpts]

Exhibit V: Acoustical Analysis (January 24, 2019)

Exhibit W: Pre-Application Conference Notes from City of Wilsonville Staff

Exhibit X: Willamette Water Supply Program Facility On-Site Alternatives Analysis Memorandum (September 27, 2018)

Exhibit A: Plan Set

(Under Separate Cover)

Exhibit B: Lower Site Overlooks Presentation

July 2019

Lower Site Overlooks

BUILDING A WORLD OF DIFFERENCE®

Willamette Water Supply
Our Reliable Water

GREENWORKS

BLACK & VEATCH

Overlook Replacement Goals

- Enable an immersive experience in the mature riverbank forest, with wide filtered views of the Willamette River

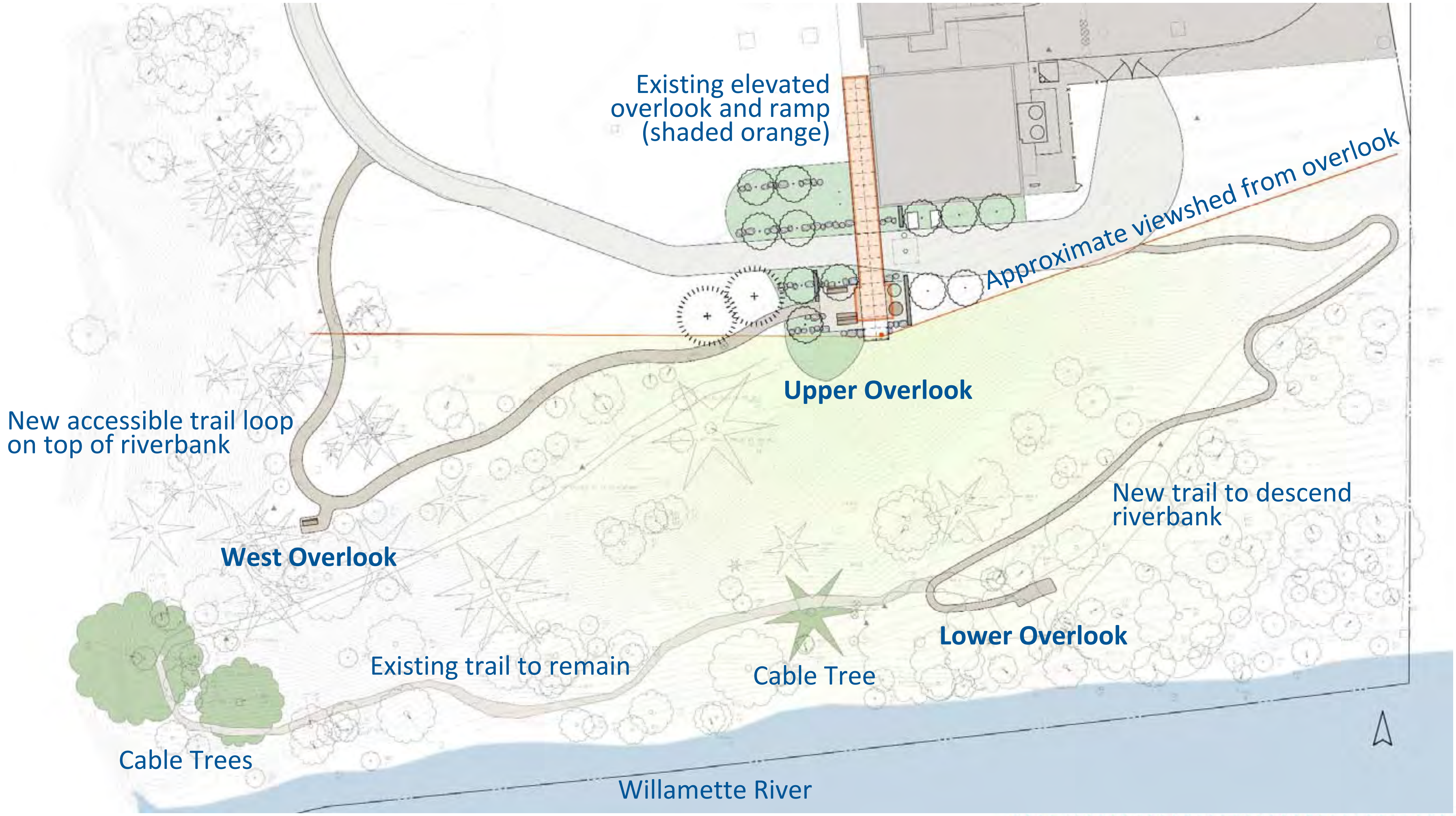
- Relate the new upper overlook to the award-winning design of the existing facility’s screening wall and water feature:
    - Cylindrical water feature at WWTP conference room
    - Sequence of pools separated by lines of boulders running east-west
    - Series of screening walls running north-south between the park and process facilities
    - Basalt stone veneer used both in the screening walls and walls in the water feature

- Create two new overlooks as destinations for new trails on the riverbank

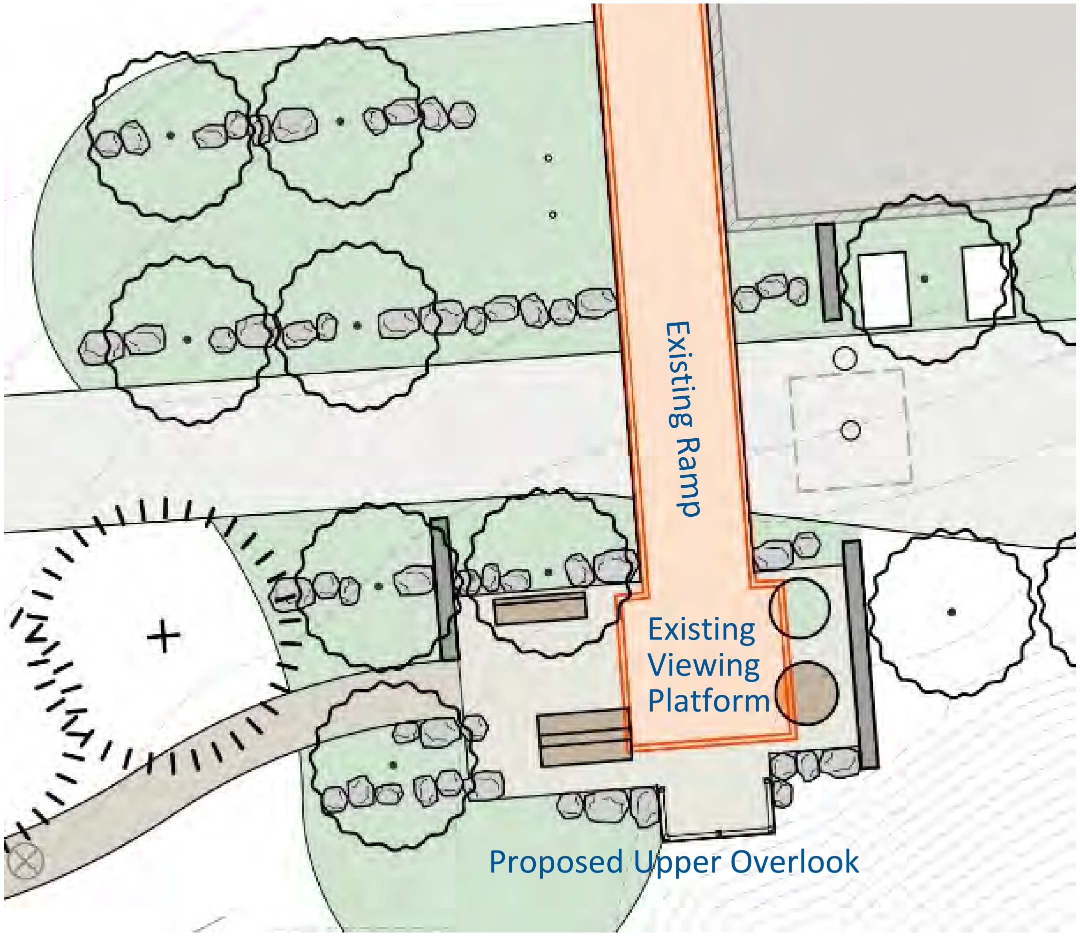
- Reveal hidden functions of the water treatment and conveyance systems, and link to the rest of the Willamette Water Supply Program

- Promote and inspire public and staff use of site

Lower Site Plan



Existing Overlook vs. Proposed Upper Overlook



206 sf:	Existing overlook viewing platform (orange), not including elevated ramp
645 sf:	Proposed Upper Overlook

Upper Overlook Precedent Images

Upper Overlook Perspective

View from Existing Overlook

View from Proposed Upper Overlook, After 2 Years

View from Proposed Upper Overlook, After 10 Years

Viewing Area of the New Upper Overlook

According to a survey, the existing overlook viewing area is 14 feet by 15 feet, at the end of a long 10-foot-wide elevated ramp. The proposed overlook will be 34 feet wide overall and an average of 19 feet deep, and the 31-foot-wide viewing area along the south edge includes multiple options for the user. The new viewing area will be about 8 feet closer to the river than existing.

The most dramatic view will be from the new 10-foot-wide center platform, which will be surrounded by a cable guardrail since it sits at the top of the steep riverbank. The two seated viewing areas on either side will be 8 feet and 13 feet wide. Since they are set back from the edge of the riverbank they have somewhat less panoramic views but do not need guardrails in front of them.

As a comparison, the existing overlook (ramp and viewing platform) is 1,046 square feet in size and the new overlook (viewing area plus new path to replace existing ramp) will be 1,475 square feet.

Viewshed of the New Upper Overlook

The view from the existing overlook is blocked in most directions by existing vegetation, and the river is hardly visible at all. In the winter, after leaves have fallen, the river is more present but only as a filtered view, and evergreen trees close to the viewing platform still block the view in multiple directions.

The trees removed for construction will leave an open area around the new overlook, but the tall, dense riparian forest on the lower half of the bank will remain. Therefore, from the new overlook the views will be into the interior of the forest canopy, looking up and out at the trunks and layers of canopy. The river will be more visible than it currently is, but still as a filtered view through the trees. After the trees are removed, the view of the river will be evaluated and strategic limbing will be considered to enhance the views, but only if it will not significantly alter the character of the forest.

In order to minimize future vegetation from blocking the views from the overlook (as is the case now), the riverbank restoration planting is designed to remain low within the primary field of view. In the area below the new overlook, the restoration planting mix will be relatively low shrubby native species and no trees. To either side, planting will include taller shrubs and trees. This will preserve the opening around the overlook for some time, but volunteer trees will eventually find their way in. In 20 years or so, it may make sense to do some pruning or thinning to open up the views again. The ornamental planting near the overlook, on top of the bank, will also be low so as to not block views.

The design intent for the overlook is to strategically constrain and then open the views. Approaching the overlook from the north, the view to the west of the water feature and park is open, while the process yard to the east is blocked by the existing row of screening walls. As one passes the existing pump station building, a new grove of dogwood trees will narrow the focus to the new planting, boulders, and walls surrounding the overlook, with a narrow view of the riparian forest beyond. Entering the overlook, the view opens up again but is mainly of the forest in front of the overlook. When the visitor reaches the viewing area at the front of the overlook, the reward will be a wide panoramic view into the layers of riparian forest, the steep riverbank below, and slices of the river and south bank beyond.

This sequence sets up anticipation and then the satisfaction of the wide view. The other goal of constraining the view is to screen the new access drive and the process yard to the east, which will be out of sight from most of the overlook. The 5-foot-tall stone wall on the east edge of the overlook provides much of this screening, similar to the existing screening walls to the north.

West Overlook

Lower Overlook

Exhibit C: Willamette River Water Treatment 2017 Master Plan Update (February 2018) [excerpts]

City of Wilsonville

Willamette River Water Treatment Plant 2017 Master Plan Update

2017 MASTER PLAN UPDATE

FINAL DRAFT | February 2018

City of Wilsonville
Willamette River Water Treatment Plant

2017 MASTER PLAN UPDATE

Jude D. Grounds,
February 5, 2018,
State of Oregon,
P.E. No. 74678

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Abbreviations

%	percent
2015 MPU	2015 WRWTP Master Plan Update
AACE	American Association of Cost Engineers
BRP	Blue Ribbon Panel
C	Celsius
Caisson	Raw Water Intake Pump Station Caisson
CECs	Contaminants of Emerging Concern
CECs	contaminants of emerging concern
CFD	computational fluid dynamic
City	City of Wilsonville
COW	cost of work
DBP	disinfection by-product
EBMUD	East Bay Municipal Utility District
ENR	Engineering News Record
EPA	Environmental Protection Agency
ESA	Endangered Species Act
EWEB	Eugene Water and Electric Board
FERC	Federal Energy Regulatory Commission
ft	feet
GAC	granular activated carbon
HABs	harmful algal blooms
IBC	International Building Code
JWC	Joint Water Commission
LOS	level of service
LOX	liquid oxygen
MCC	motor control centers
MCL	maximum contaminant level
mg/L	milligrams per liter
mgd	million gallons per day
MM	million
MPU	Master Plan Update
MWh	megawatt hours
NAVD	North American Vertical Datum
NCOD	National Contaminant Occurrence Database
nm	nanometers
NMFS	National Marine Fisheries Service

NTU	Nephelometric turbidity units
OAR	Oregon Administrative Rule
ODFW	Oregon Department of Fish and Wildlife
OHA	Oregon Health Authority
ORP	Oregon Resilience Plan
ORS	Oregon Revised Statutes
OPCC	opinion-of-probable construction-cost
OSSAC	Oregon Seismic Safety Advisory Committee
OSSC	State of Oregon Structural Specialty and Fire and Life Safety Code
OWUC	Oregon Water Utility Council
PGE	Portland General Electric
PNW	Pacific Northwest
PPCPs	pharmaceuticals and personal care products
ppd	pounds per day
PWB	Portland Water Bureau
RM	Richter scale magnitude
RWF	Raw Water Facility
SCADA	supervisory control and data acquisition
SCM	streaming current monitor
SDWA	Safe Drinking Water Act
the Act	Oregon Drinking Water Quality Act
TOC	total organic carbon
TVWD	Tualatin Valley Water District
UBC	Uniform Building Code
UCM	Unregulated Contaminant Monitoring
UCMR	Unregulated Contaminant Monitoring Rule
USGS	United States Geological Survey
WRWTP	Willamette River Water Treatment Plant
WWSA	Willamette River Water Supply Agency
WWSP	Willamette Water Supply Program
µg/L	micrograms per liter

EXECUTIVE SUMMARY

ES.1 Introduction

The 2017 Willamette River Water Treatment Plant Master Plan Update (2017 MPU) for the cities of Wilsonville and Sherwood defines the strategy to meet future demands, boost supply resiliency and reliability, and support responsible growth.

Commissioned in 2002, the Willamette River Water Treatment Plant (WRWTP) has a treatment capacity of 15 mgd. Of this capacity, Wilsonville owns 10 mgd, and the Tualatin Valley Water District (District) initially owned 5 mgd. The District invested in the plant's construction, oversizing many of its facilities to enable expansion for its own future water needs.

The existing property along the Willamette River in Wilsonville is irregularly shaped, creating two semi-contiguous parcels called the Lower Site and the Upper Site. During original design, the Lower Site, home to the existing treatment plant, would allow for an expansion of up to 60 mgd. The Upper Site was identified for future development in the *Willamette River Water Treatment Plant Master Plan* (MWH, 2006), which demonstrated enough space for at least 100 mgd additional capacity. Combined, both sites have a 160 mgd potential total capacity.

Since the 2006 Master Plan was published, several actions occurred that affect both construction and operational planning for expanding the WRWTP:

- In 2012, the District sold its 5 mgd of plant capacity to the City of Sherwood.
- In 2013, the District and the City of Hillsboro named the mid-Willamette supply alternative as their preferred supplemental supply, which laid the foundation for the Willamette Water Supply Program (WWSP).
- In 2014, the city of Wilsonville led a coalition of utilities that petitioned the Oregon Health Authority (OHA) for the right to recognize the disinfection benefits from intermediate ozonation.
- In 2015, the City and WWSP stakeholders updated the WRWTP Master Plan (MWH, 2006) in the 2015 MPU (Carollo, 2016) to outline how the existing plant could be expanded to meet future demand.
- As of 2017, the WRWTP is expected to supply Wilsonville and Sherwood exclusively. However, the oversized river intake and raw water pumping station will be expanded to supply raw water to both the WRWTP and the proposed WWSP treatment facilities.

The 2017 MPU updates the 2015 WRWTP MPU and addresses these changes. The 2017 MPU has the following key objectives.

1. To define the steps for expanding the existing WRWTP infrastructure to maximize the return on previous investments.
2. To optimize process selection and layout to meet capacity and water quality goals at the expanded WRWTP.
3. To strategize near- and long-term plant expansion for a 20-year planning horizon and cash-flow to guide future financial planning.
4. To ensure that WWSP-related facilities, including raw water pumping, surge protection, and standby power infrastructure, do not prevent the cities of Wilsonville and Sherwood from meeting their ultimate build-out demands for the existing WRWTP on the current site.

ES.2 Plant Expansion and Level of Service Goals

In addition to these objectives, levels of service (LOS) goals were used to plan the preliminary site and estimate its construction and operations costs.

Municipal utilities in the United States and elsewhere commonly use LOS goals to evaluate systems and operations. LOS goals can be defined in terms of the customer's experience of utility service and/or technical standards based on professional expertise of utility staff.

LOS goals can guide investments in maintenance, repair, and replacement. For new assets, they can be used to set design criteria and prioritize needs. Using a structured decision-making process that incorporates LOS goals helps a utility reach desired service objectives and minimize life-cycle costs.

The LOS goals address only the facilities required to operate the expanded WRWTP and do not apply to City infrastructure outside of the WTP fence line. The goals were first developed with participants of the 2015 MPU during a project workshop and adopted by the participants' governing bodies. These LOS goals, which were revisited and re-confirmed during a 2017 MPU workshop, are shown in Table ES.1.

Table ES.1 Cities of Wilsonville and Sherwood Treatment LOS Goals

LOS Goal	Regional Event (Seismic)	Local Event (Non-Seismic)
"Following a W catastrophic event ...	2,500 year	Per occurrence
...within X days/weeks of the event...	48 hours	14 days
...deliver Y % of average day demand...	50% of nameplate capacity	100% of nameplate capacity
...with Z water quality."	Potable (at minimum regulatory requirement)	Potable (at plant's intended treatment processes and procedures)

As stated in Table ES.1, 48 hours after a 2,500-year regional (seismic) event, 50 percent of the nameplate treatment plant production capacity will be available, with potable water quality that meets minimum regulatory requirements. Within 14 days of a local (non-seismic) event, 100 percent of the nameplate production capacity will be available with potable water quality at the plant's intended treatment processes and procedures.

The costs for achieving these LOS goals were developed and confirmed to fall within the cities' affordability and risk tolerances. We recommend these LOS goals continue to guide the WRWTP planning efforts.

ES.3 Existing Facilities and Operational Performance

When the 2006 WRWTP Master Plan was completed approximately four years after plant start-up, the City of Wilsonville was the only consumer of WRWTP finished water. In mid-2012, the City of Sherwood started using finished water from the WRWTP as its primary supply. To meet the demands of both cities, the plant went from operating on a daily start/stop basis for 8 to 16 hours per day depending on demand to operating 24 hours per day, year-round. Since the hours of operation impact plant operations and the expanded plant will continue to operate continuously, the plant performance data evaluated for this Master Plan Update was limited to 2012 through 2014, as included in the 2015 MPU. No additional plant performance data was analyzed as part of this 2017 MPU.

The 2015 MPU review of plant performance data demonstrates exceptional operational performance for turbidity removal, disinfection levels, total organic carbon (TOC) removal, and low disinfection by-product (DBP) formation. The extremely narrow range between the 5 and 95 percentile value for key water quality parameters such as turbidity, pH, and chlorine residual is a testament to the plant's robust design and its operators' attention to continuous optimal performance.

ES.4 Historical Raw and Finished Water Quality

Raw water quality data from May 2006 through 2014 was collected, reviewed, and compared to the data in the 2006 Master Plan and 2015 MPU. The trace-level contaminants detected in the raw water have not been detected in the finished water and were therefore assumed to be removed through the treatment processes.

The historical finished water quality data confirms that the plant consistently surpasses existing finished water regulatory requirements. The high-quality source water and robust treatment process result in excellent finished water quality delivered to customers. With only minor modifications, the current treatment processes are expected to continue to meet future regulatory requirements.

ES.5 Existing Infrastructure

The 2017 MPU offers additional electrical, seismic, and life-safety assessment for the WRWTP.

ES.5.1 Electrical Supply and Distribution CIP

To meet the 2022 site capacity of nominally 20 mgd, the plant's electrical supply and distribution system will need significant upgrades. Preliminary engineering for the capacity expansion will require detailed analysis of electrical supply alternatives, including backup power requirements. Improving the "backbone" of electrical and standby power is recommended in parallel with the expansion project.

ES.5.2 Seismic Evaluation CIP

The preliminary structural analysis identified both structural and non-structural vulnerabilities that may affect plant performance in a regional catastrophic seismic event. This 2017 MPU recommends including seismic retrofits to minimize infrastructure downtime and ensure plant performance after a catastrophic event.

ES.5.3 Life-Safety Evaluation CIP

The preliminary life-safety analysis identified issues about building code compliance and structural improvements. This 2017 MPU recommends modifications to support worker safety after a catastrophic seismic event.

ES.6 WRWTP Expansion CIP

Projected demand was submitted by the cities of Wilsonville and Sherwood based on each city's planning studies. To meet the cities' combined day demand of 30 mgd by 2036 as shown in Figure ES.1, this 2017 MPU recommends the following expansion and phasing:

- Preliminary design of the near-term expansion will likely begin in 2019 to bring WRWTP capacity from 15 mgd to 20 mgd by 2022.
- Total raw water intake capacity for both WRWTP and WWSP will be between 80 mgd and 84 mgd by 2026.
- Preliminary design of the 30 mgd expansion will likely begin in 2032 to bring the nameplate capacity of the WRWTP from 20 mgd to 30 mgd by 2036.
- Capacity expansion projects should be completed two years before the capacity is needed to allow flexibility. The 20 mgd capacity expansion will be completed in 2022 and the 30 mgd capacity expansion in 2036.

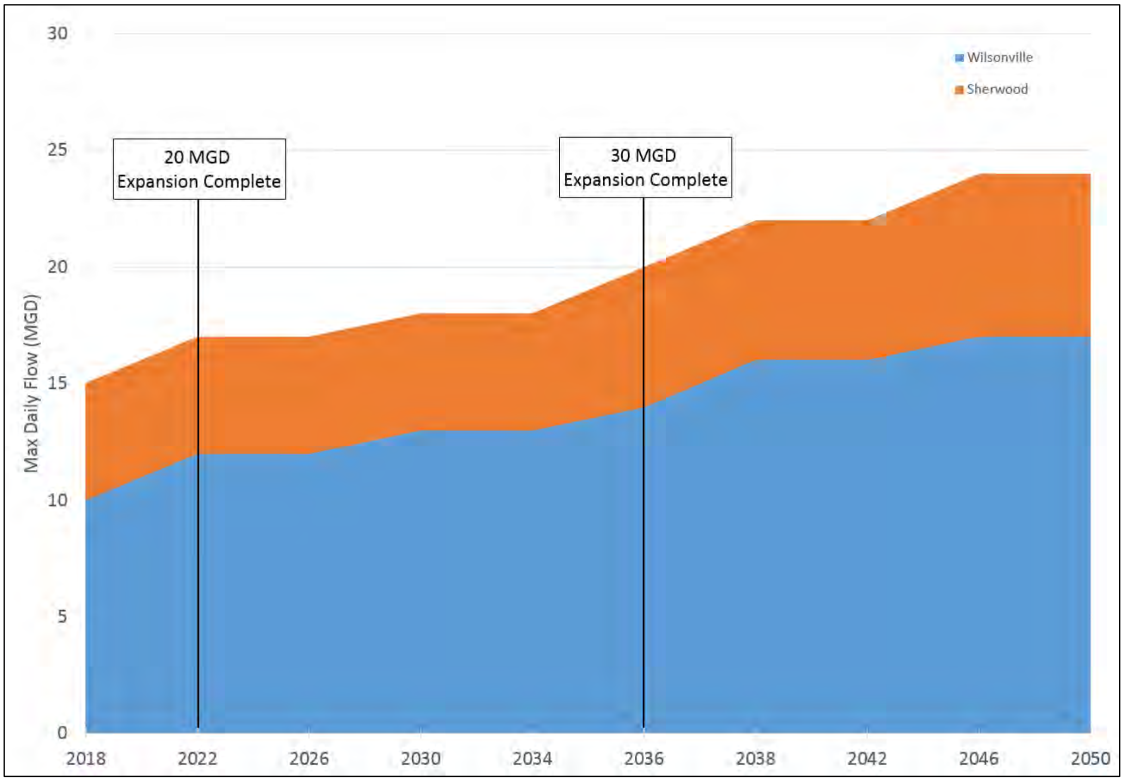

Figure ES.1 WRWTP Capacity Projections and Recommended Expansion Phasing

ES.6.1 20-MGD Expansion CIP

As outlined in the 2015 MPU, rather than constructing additional basins, the existing treatment processes will be uprated for the 20 mgd WRWTP expansion. For the primary treatment processes, the uprating will include the following.

- Increasing the Actiflo® flow rate from 7.5 mgd per basin to 10 mgd per basin.
- Increasing the ozonation basin flow rate from 7.5 mgd per basin to 10 mgd per basin. This will decrease the ozone contact time from 15 to 11 minutes, which still allows sufficient contact time for 1-log *Cryptosporidium* inactivation, provided increased levels of ozone can be dosed in the contactor.
- Increasing the filtration rate to a nominal rate of 5.7 gpm/sf and a maximum rate of 7.5 gpm/sf when one filter is off-line, and to a nominal rate of 7.5 gpm/sf and a maximum

rate of 10 gpm/sf when one basin is offline. This increased filtration rate will require approval from OHA prior to increasing plant capacity. To support OHA approval, a full-scale pilot study should be conducted in which the filtration rate is gradually increased and water quality is closely monitored.

Figure ES.2 depicts the site layout following completion of the 20-mgd capacity expansion.

ES.6.2 30-MGD Expansion CIP

The following two alternatives were considered for the 30 mgd expansion.

1. Install one additional process train: 1 Actiflo® basin, 1 ozone basin, and 2 filters.
2. Install two additional treatment process trains: 2 Actiflo® basins, 2 ozone basins, and 4 filters.

Both alternatives would need to meet the LOS goal after a regional seismic event. However, Alternative 1 would have limited treatment rates during equipment maintenance. For example, during filter backwash, the maximum filtration rate of 12 gpm/sf would limit finished water production to 8 mgd. Conversely, the capital and operating costs required for Alternative 2 make it undesirable because it raises rates for Wilsonville and Sherwood residents. Therefore, we recommend that the WRWTP construct Alternative 1 and identify an additional water supply to meet the LOS goal after a regional seismic event.

Using Alternative 1, the 30 mgd expansion requires the following major construction projects:

- One Actiflo® basin.
- One ozonation basin.
- Two filters.
- One 35-foot diameter gravity thickener.

Figure ES.3 depicts the site layout for the 30-mgd capacity expansion. As recommended in the 2015 MPU, space dedicated for future AOP processes (such as UV treatment) improves the ability of the expanded WRWTP to treat constituents of emerging concern.

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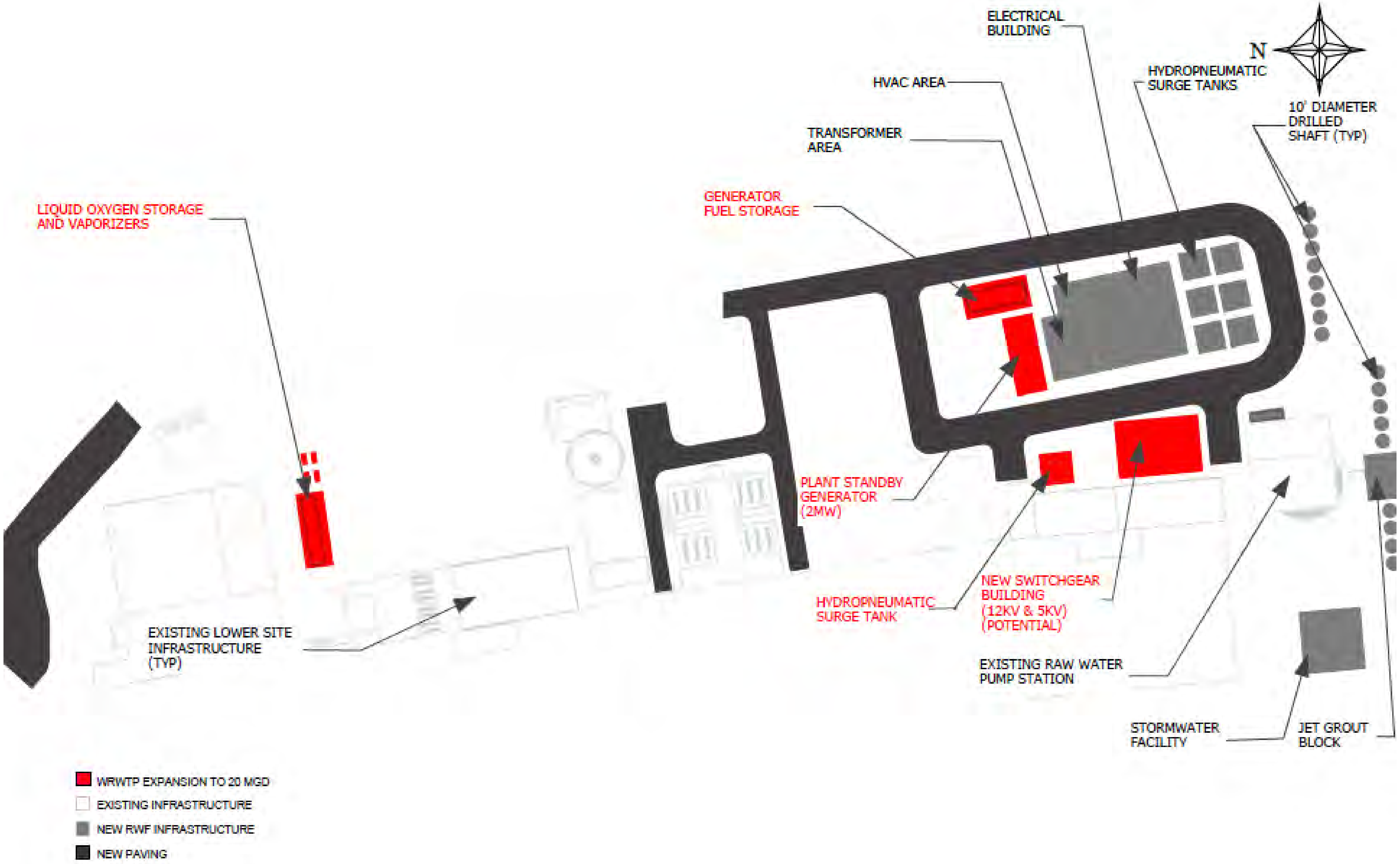

Figure ES.2 Site Plan – 20-MGD Capacity Expansion

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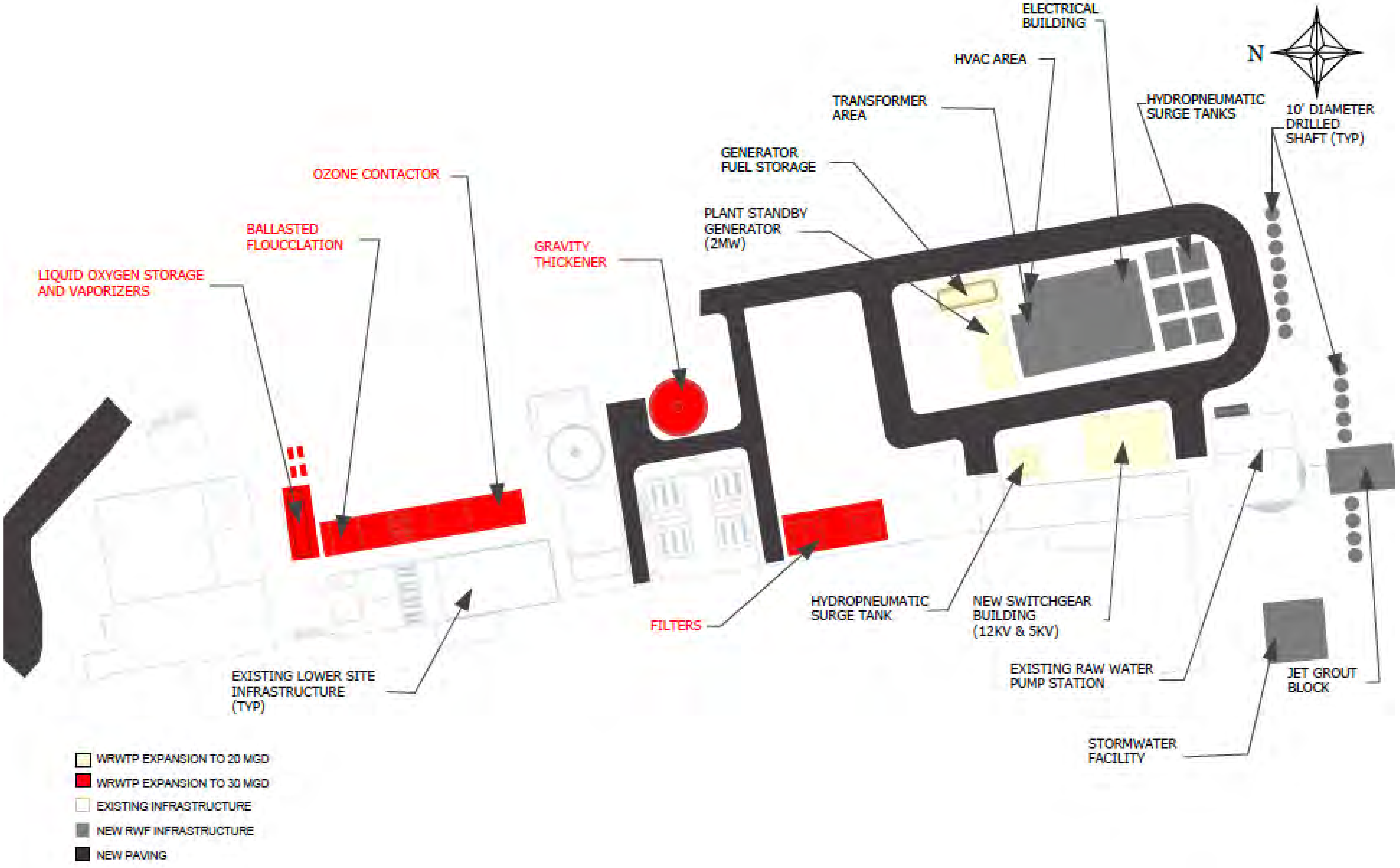

Figure ES.3 Site Plan – 30-MGD Capacity Expansion

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ES.6.3 Electrical Expansion CIP

The electrical system is loaded above 80 percent of listed capacity and is considered overloaded. Additionally, the existing emergency generator is not connected to all WRWTP equipment; for example, it is wired only to Actiflo® Basin 2. Furthermore, its capacity is sufficient only to power the 4 mgd raw and finished water pumps.

We recommend that the plant upgrade its existing electrical equipment that as part of the 20 mgd expansion to ensure that service is not interrupted by electrical fault. The following upgrades are recommended:

- **Replace switchgear** with 15-KV metering switchgear and 5 KV transformer, which should be sufficient to power the WRWTP through 60 MGD
- **Replace emergency generator** with a 2-MW generator wired directly to the 15-KV metering switchgear. This will allow all plant equipment run on the emergency generator.
- **Rewire plant** to connect all finished water pumps to the 5-V transformer/switchgear. This will leave sufficient capacity on the remaining transformers to power the rest of the plant.

ES.6.4 Repair and Replacement CIP

In addition to the seismic and life-safety CIP, the WRWTP requires ongoing maintenance/repair and replacement (R&R) of its existing infrastructure to meet service goals. This 2017 MPU summarizes repair and replacement projects for the next 20 years.

ES.7 CIP Approach and Schedule

The existing WRWTP must be expanded to 20 mgd by 2022 and to 30 mgd by 2036.

Table ES.2 breaks down the capital costs for the two expansions and related repair and replace projects, electrical equipment upgrades, life safety repairs, and seismic retrofits necessary to maintain plant operation. Table ES.3 details repair and replace projects by year and dollar amount. The CIP cost estimates are classified as American Association of Cost Engineers (AACE) Class 4 or Class 5 estimates. The Class 4 estimates have an expected level of accuracy of +50% to -30%. The Class 5 estimates have an expected level of accuracy of +100% to -50%. Figures ES.4 and ES.5 depict the near term and total CIP costs, respectively, as broken down by project.

Table ES.2 Estimated CIP Costs (2017 Dollars)

Project	Cost[(1)]	% Water Operations	% SDCs
20 mgd Expansion	$3,700,000	--	100%
30 mgd Expansion	$38,640,000	--	100%
Life Safety Repairs	$620,000	100%	--
Seismic Retrofits	$1,160,000	100%	--
Electrical Upgrades	$11,090,000	100%	--
Operations - Repair and Replace	$19,180,000	100%	--

Notes:
(1) Includes 15% design fee and 10% administrative cost.
(2) All costs are rounded up to nearest $10,000.

Table ES.3 Operations – Repair and Replace Estimated CIP Cost (2017 Dollars)

Repair and Replace Year	Cost(1)	% Water Operations	% SDCs
2019	$2,030,000	100%	--
2020	$1,430,000	100%	--
2021	$20,000	100%	--
2022	$4,490,000	100%	--
2023	$20,000	100%	--
2024	$20,000	100%	--
2025	$20,000	100%	--
2026	$20,000	100%	--
2027	$5,220,000	100%	--
2028	$20,000	100%	--
2029	$20,000	100%	--
2030	$20,000	100%	--
2031	$20,000	100%	--
2032	$2,480,000	100%	--
2033	$20,000	100%	--
2034	$20,000	100%	--
2035	$20,000	100%	--
2036	$3,400,000	100%	--

Notes:
(1) Includes 10% administrative cost.

To meet growing water demand from Wilsonville and Sherwood, the existing WRWTP will first be expanded to a capacity of 20 mgd, followed by an expansion to 30 mgd near the end of this planning horizon. Table ES.4 summarizes a preliminary and final design and construction schedule.

Table ES.4 WRWTP Expansion Design and Construction Schedule

Project	Approx. Service Year	Duration (Months)		Start Date
		Design	Construction	
20 MGD Capacity Expansion	2022	12	18	2019
Electrical Upgrades	2022	12	12	2019
Life Safety Repairs	2022	6	6	2020
Seismic Retrofits	2022	6	6	2020
30 MGD Capacity Expansion	2036	12	24	2033
Operations – Repair and Replace				
Year 1	2018	0	0	--
Year 2	2019	0	6	2018

Table ES.4 WRWTP Expansion Design and Construction Schedule (Continued)

Project	Approx. Service Year	Duration (Months)		Start Date
		Design	Construction	
Year 3	2020	0	6	2019
Year 4	2021	0	3	2021
Year 5	2022	6	9	2020
Year 6	2023	0	3	2023
Year 7	2024	0	3	2024
Year 8	2025	0	3	2025
Year 9	2026	0	3	2026
Year 10	2027	0	9	2026
Year 11	2028	0	3	2028
Year 12	2029	0	3	2029
Year 13	2030	0	3	2030
Year 14	2031	0	3	2031
Year 15	2032	0	9	2032
Year 16	2033	0	3	2033
Year 17	2034	0	3	2034
Year 18	2035	0	3	2035
Year 19	2036	0	12	2035

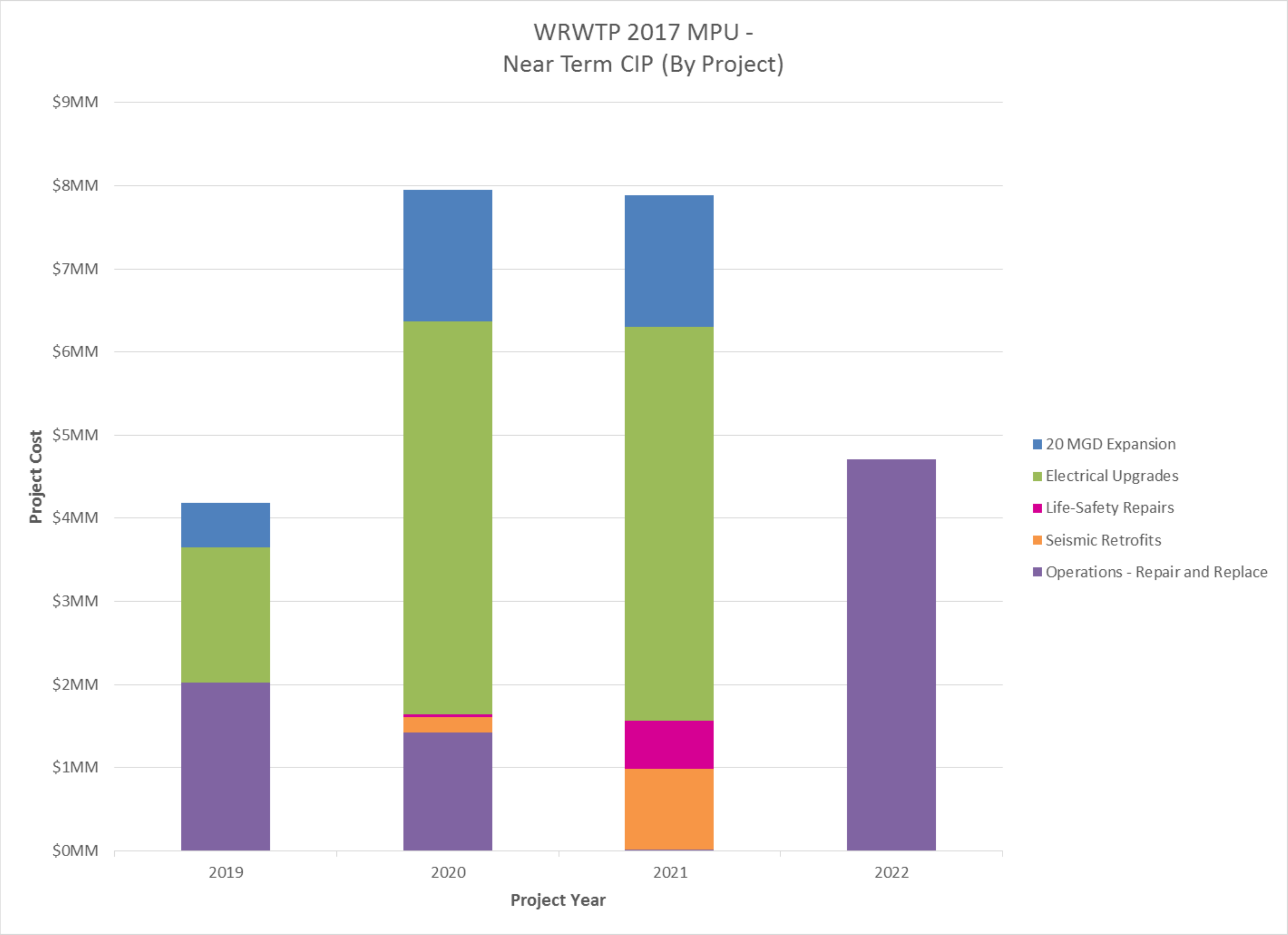

Figure ES.4 RWTP Near-Term CIP Costs by Project (2017 Dollars)

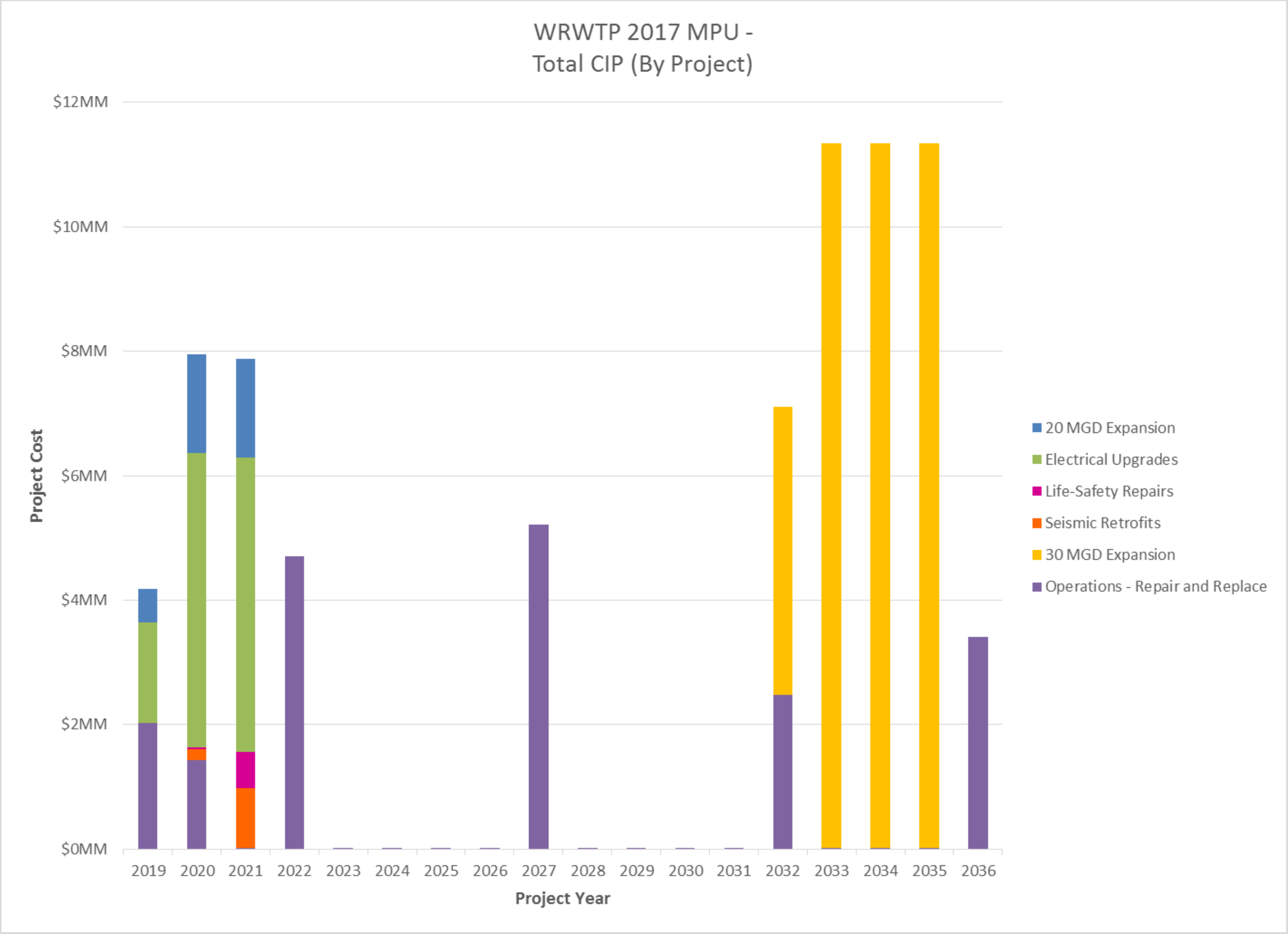

Figure ES.5 WRWTP Total CIP Costs by Project (2017 Dollars)

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Chapter 1

INTRODUCTION

The Willamette River is a source of high-quality and plentiful drinking water. In 1997, several Portland area agencies formed the Willamette River Water Supply Agency (WWSA) to assess the feasibility of using the Willamette River as a regional source. Extensive pilot testing and water quality sampling verified the supply's quality and treatability. The group developed preliminary engineering plans for facilities, estimated associated costs, and identified potential governance and financing options to fund and manage the system. Members of the WWSA compared this information to other options for regional water supply and developed long-term strategic plans to best meet the region's needs.

At about the same time, the City of Wilsonville (City) placed a city-wide moratorium on new construction. The City’s groundwater supply was over-drafted, and an additional drinking water supply was needed. Working with the Tualatin Valley Water District (TVWD), the City built a new drinking water treatment plant on the Willamette River.

The resulting Willamette River Water Treatment Plant (WRWTP), commissioned in 2002, has a treatment capacity of 15 mgd. The City contracted with Veolia to operate the plant. Of the 15 mgd original capacity, the City owns 10 mgd. TVWD owned 5 mgd of plant capacity, which it sold to the city of Sherwood in 2012. With an eye to accommodating future drinking water needs of its own, TVWD had invested in the plant's construction, oversizing many plant facilities to enable expansion.

In 2017, the WRWTP owners (the cities of Wilsonville and Sherwood) collaborated to update the 2015 WRWTP Master Plan Update (2015 MPU). This 2017 Update describes the strategy for the following:

- Meeting future demands.
- Increasing supply resiliency and reliability.
- Coordinating with the upcoming requirement to pump raw water to the Willamette Water Supply Program (WWSP) treatment plant in Sherwood.
- Facilitating responsible growth within existing urban growth boundaries.

1.1 WRWTP AND SOURCE BACKGROUND

The original plant's key objectives were to:

1. Produce consistently high-quality drinking water using a multi-barrier treatment process.
2. Exceed 2002 regulatory treatment and water quality standards to enhance consumer confidence.
3. Minimize the plant footprint, thereby providing space for public amenities.
4. Incorporate flexibility for cost-effective future plant capacity expansions.
5. Operate quietly, respectfully, and without negative impact on the neighborhood.

6. Complete design and construction in less than three years to meet the City's 2002 startup target.
7. Meet "critical facility" seismic and structural criteria.

The plant employed four innovative and robust treatment technologies: 1) high-rate clarification (ballasted flocculation); 2) intermediate ozonation; 3) deep-bed granular activated carbon (GAC)/sand filtration, and; 4) mechanical dewatering (centrifuges). When it was commissioned in 2002, the WRWTP was the first in the Pacific Northwest to use all four advanced technologies for drinking water treatment.

The existing WRWTP property along the river is irregularly shaped, creating Lower and Upper Sites. Home to the existing treatment plant, the Lower Site was designed for future expansion of up to 60 mgd of total capacity. The Upper Site, owned by TVWD, was not master-planned until after the District-led WRWTP Master Plan (MWH, 2006) was completed. The 2006 Master Plan showed the Upper Site could accommodate at least 100 mgd in additional capacity. Therefore, the combined WRWTP production capacity that could be constructed on the Upper and Lower sites is as high as 160 mgd.

Since then, several events have unfolded that affect construction and operational decision-making for expanding the plant, requiring an update to the 2006 Master Plan:

- In 2012, the City of Sherwood began purchasing WRWTP finished water. The plant, which had historically been operated in "start/stop" mode to meet Wilsonville's daily demands alone, is now operated 24 hours per day, seven days a week.
- In 2013, the District and the City of Hillsboro identified the mid-Willamette Supply alternative as its preferred supplemental supply option, which laid the foundation for the WWSP.
- Because of the WRWTP Tracer Study (MWH, 2014), the City led a coalition of Oregon's current and potential ozone users to petition the Oregon Health Authority (OHA) to give disinfection credit for intermediate ozonation. This credit would eliminate the requirement for costly chlorine contact basins or UV treatment for WRWTP expansions, a possibility considered when plant expansion scenarios were developed. At the time of this publication, the OHA had not yet issued a decision.
- In 2015, the City and WWSP stakeholders updated the WRWTP Master Plan (MWH, 2006) to explore expanding the plant to meet future demands of all stakeholders. Although the WRWTP Master Plan 2015 Update (Carollo, 2016) succeeded in evaluating these possibilities, it was later decided that the WWSP treatment facilities would be optimized at an alternative location in Sherwood, several miles north of the WRWTP. The WRWTP is now expected to supply Wilsonville and Sherwood exclusively. However, the oversized river intake and raw water pumping station will be expanded to supply raw water to both the WRWTP and the proposed WWSP treatment facility.

The 2015 Master Plan Update (2015 MPU) documented future water needs, level of service (LOS) goals, regulatory requirements, reliability and resiliency of the distribution system, and preliminary seismic evaluation of shared WRWTP and WWSP facilities. The goal of the 2017 Master Plan Update (2017 MPU) is to supplement and expand on the parts of the 2015 Master Plan Update that apply to the WRWTP facilities. The resulting stand-alone document details how increased water demand in Wilsonville and Sherwood can be accommodated in coordination with the future WWSP treatment facility.

1.2 MASTER PLAN UPDATE OBJECTIVES AND ORGANIZATION

This 2017 Master Plan Update (MPU) describes the WRWTP expansion to meet long-term water supply needs of Wilsonville, Sherwood, and potential future partners. It gives options for expanding the facilities and recommends a treatment and implementation plan to meet Wilsonville's and Sherwood's planning objectives:

Objective #1: Maintain water supply by completing the WRWTP 20 mgd and 30 mgd expansion projects by 2020 and 2034, respectively.

Objective #2: Define process selection and layout to meet capacity and water quality goals at the expanded WRWTP.

Objective #3: Chart the course for expanding existing WRWTP infrastructure to make the most of previous investments.

The primary purposes for this planning document are to:

- Develop treated water quality goals.
- Evaluate preliminary process requirements to meet water quality goals.
- Identify preliminary capacity requirements to meet long-term water supply needs.
- Verify space requirements at site facilities.
- Develop planning-level cost estimates.
- Develop preliminary implementation schedule.

The Master Plan Update is organized into the following chapters.

- Chapter 1 – Introduction
- Chapter 2 – Plant Expansion and Level of Service Goals
- Chapter 3 – Existing Facilities and Operational Performance
- Chapter 4 – Historical Water Quality and Regulatory Compliance
- Chapter 5 – Existing Infrastructure
- Chapter 6 – Expansion Alternatives Analysis
- Chapter 7 – CIP Approach and Schedule

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Chapter 2

PLANT EXPANSION AND LEVEL OF SERVICE GOALS

2.1 Introduction

This Chapter establishes the guiding principles for developing, evaluating, and comparing alternatives throughout the 2017 MPU and summarizes the current water supply demands and strategies for expansion phasing. This Chapter also reviews three alternative treatment procedures developed from workshops with the Participants for the 2015 MPU. With this review, the Chapter describes the methodology for evaluating the alternatives and summarizes the level of service (LOS) goals for the plant's expansion.

2.2 Water Demands and Expansion Strategy

Prepared in 1999, the Willamette River Water Supply System (WRWSS) Plan identified the potential need to withdraw up to 120 mgd from the existing Willamette River Water Treatment Plant (WRWTP) site based on combined projected demands from potential member agencies. The WRWSS Plan was updated in 2004, increasing the ultimate demand projection to 158 mgd. Following this, the 2006 WRWTP Master Plan bracketed the ultimate demand projection between 103 mgd and 156 mgd.

Under the original project, Wilsonville partnered with the Tualatin Valley Water District (TVWD) to fund oversized infrastructure that would better accommodate future WRWTP plant expansion(s) and meet the needs of the combined communities. In 2015, Wilsonville, along with other stakeholders, updated the WRWTP Master Plan (MWH, 2006) to determine how the existing plant could be expanded to meet future demands of the emerging Willamette Water Supply Program (WWSP); this effort culminated in the WRWTP 2015 Master Plan Update (2015 MPU) (Carollo, 2016).

However, after completing the 2015 MPU, the decision was made to construct the WWSP treatment facilities at an alternate site located several miles north of the existing WRWTP in the City of Sherwood. The raw water intake and pump station for this alternate WWSS WTP will be co-located/shared with the existing WRWTP, which requires careful coordination between both sites.

Adjustments to the 2015 MPU's projected demand/capacity requirements and the timing of the capacity needs affect the planning of the expanded WRWTP site. This 2017 MPU summarizes these efforts in subsequent subsections.

2.2.1 Demand Projections and Hydraulic Requirements

Two water agencies will continue using the expanded WRWTP as their primary source of drinking water supply: the City of Wilsonville and the City of Sherwood.

Figure 2.1 presents the two cities' respective projected annual peak daily demands through 2050 as well as the combined ultimate build-out demand projection for 2050. It also shows a phased expansion strategy, which is detailed in the following subsections.

Figure 2.2 presents the projected annual peak demand for the WRWTP and the proposed WWSP treatment facility. Projected WWSP demands were developed based on the agency's planning project and are separate from this Master Plan Update. However, as described in subsequent sections, the demands are relevant to upgrading some shared WRWTP facilities.

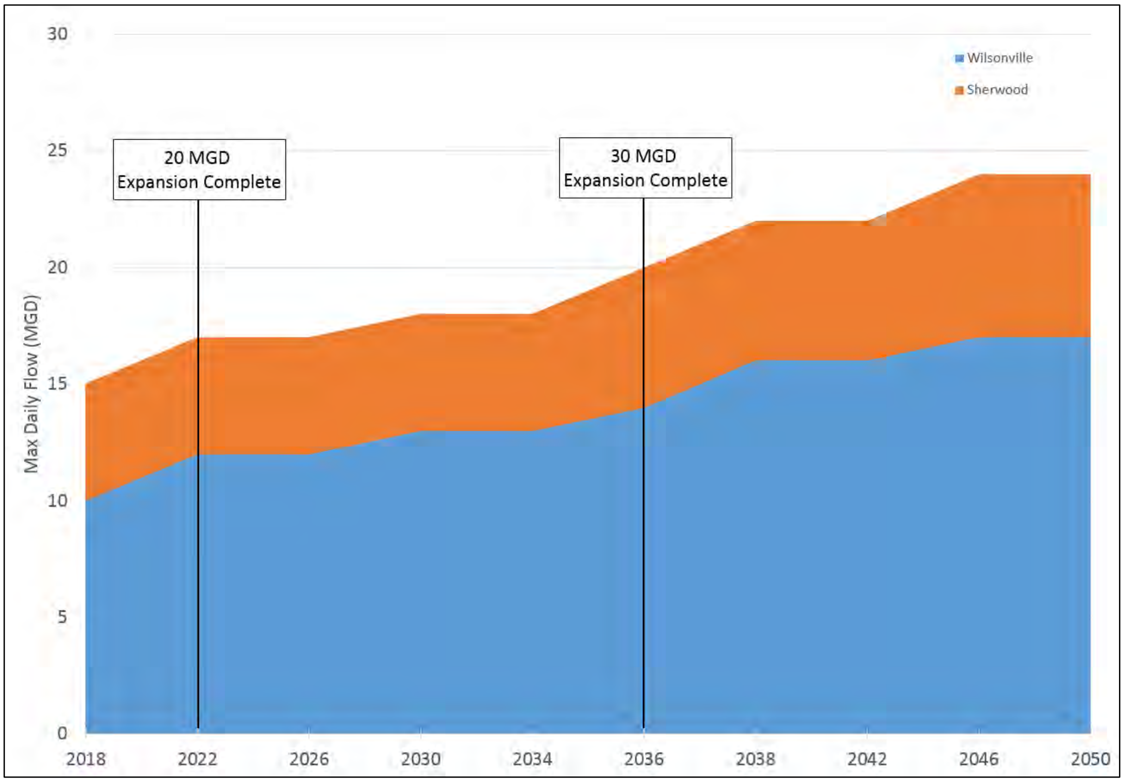

Figure 2.1 WRWTP Capacity Projections and Recommended Expansion Phasing

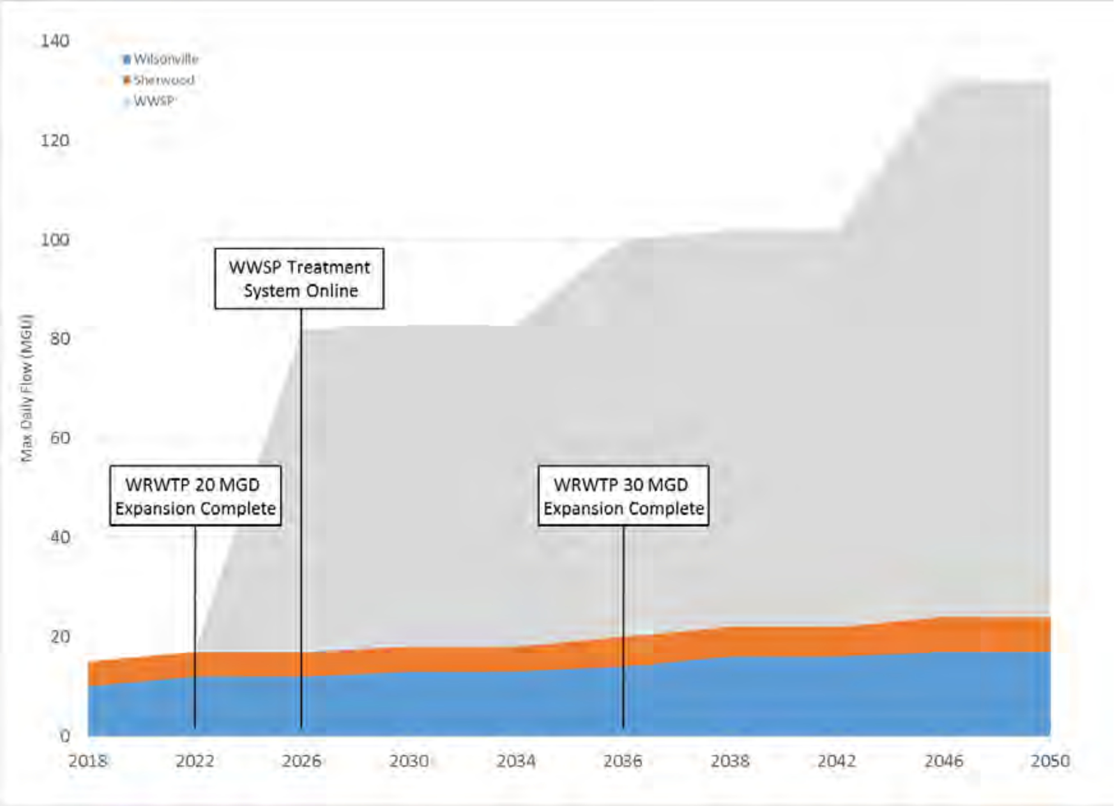

Figure 2.2 WRWTP and WWSP Water Demand Projections

Table 2.1 summarizes the anticipated demands and the hydraulic elevation that each City will likely require to serve its respective system.

Table 2.1 Hydraulic and Capacity Requirements of the WRWTP Participants

Participant	Hydraulic Elevation (ft)	2026 Max Day Demand (mgd)	2036 Max Day Demand (mgd)	2046 Max Day Demand (mgd)	Future Max Day Demand (mgd)
Wilsonville	400	12	14	17	30
Sherwood	380	5	6	7	13
Total		**17**	**20**	**24**	**43**

Notes:
(1) Projected demands obtained from independent City planning exercises.

2.2.2 Capacity Expansion and Phasing Strategy

Figures 2.1 and 2.2 present the projected WRWTP plant production capacity and total raw water withdrawals, respectively. Highlights of these projections are as follows:

- An initial expansion of the existing WRWTP required to meet combined demands for the Cities of Wilsonville and Sherwood: this expansion will increase WRWTP capacity to 20 mgd in 2020, two years before the capacity is required in 2022.
- Construction to support the WWSP Raw Water Facility (RWF) connection to the WRWTP intake structure and Raw Water Pump Station: this modification is expected to be completed by 2024, two years before the capacity is required in 2026.

- A subsequent expansion of the existing WRWTP to meet combined demands from the Cities of Wilsonville and Sherwood: this expansion will increase WRWTP capacity to 30 mgd in 2034, two years before the capacity is required in 2036.
- Capacity expansion projects: these projects are expected to be completed two years before the capacity is required, allowing flexibility for future unknowns.
- Ongoing repair and replacement projects: These R&R projects address aging infrastructure that has exceeded its service life or has become unreliable, but remain crucial to operations and must be integrated into the overall expansion plan.
- Seismic retrofits: These additions reflect changes in the seismic design criteria since the WRWTP was constructed in 2002. Given the changes in the USGS data between 2002 and 2008, projected ground accelerations in the region have increased up to 28 percent, significantly adding to the structural design requirements.
- Life safety upgrades: These improvements are necessary to protect the operations staff and maintain compliance with safety and building code requirements.

Based on capital, operational, and technical evaluations performed during the 2015 MPU, the WRWTP 20 mgd capacity expansion will be achieved by uprating major process trains and by providing installed redundancy wherever feasible. No additional basins will be constructed under this expansion. The details of this evaluation are summarized in Chapters 2 and 6 of the 2015 MPU.

Furthermore, evaluations of the 30 mgd capacity expansion include a discussion of pre- and post-regional seismic event resiliency to determine the scope of the expansion. Chapter 6 of this 2017 MPU describes the WRWTP expansions falling within the 20-year planning horizon and summarizes an evaluation of them.

2.3 Hazard Analysis and Associated Level of Service Goals

This section describes the methodology used to identify hazards and to develop corresponding LOS goal recommendations for the WRWTP expansion. For the 2015 MPU planning process, preliminary LOS goals were used to establish the preliminary site plans and associated construction and operations cost estimates. After confirming that these preliminary results were consistent with those of the Cities of Wilsonville and Sherwood, this report recommends adopting these LOS goals for the 2017 MPU.

LOS goals address only the facilities required to operate the WRWTP and do not apply to facilities outside of the WTP fence line, such as the piping for the transmission and distribution systems. The goals herein were developed during the 2015 MPU and confirmed with the Cities during a 2017 MPU project workshop.

2.3.1 LOS Goal Objective

LOS goals are typically stated as follows:

"Following a W catastrophic event, within X days/weeks of the event, the WTP will deliver Y percent of average day demand with Z water quality."

This policy-level statement addresses how facilities will be recovered after a catastrophic event, in terms of water quality, quantity, and recovery time. Thus, the goal of this section is to first identify the various types of catastrophic events that may occur and then develop LOS goals that correspond to each event.

2.3.2 Catastrophic Event

To guide the selection of LOS goals after a catastrophic event, the Clackamas County Natural Hazards Mitigation Plan (December 2012) was reviewed for hazards of concern to the County. Additional hazards were also identified based on similar work performed by Ballantyne Consulting LLC. Potential WTP impacts were also considered for the 2015 MPU, although they may differ from those that could affect the County overall. Table 2.2 presents the identified hazards and the potential impacts on the Lower Site, which includes the WRWTP and WWSP raw water intake and pumping facilities.

Table 2.2 Catastrophic Hazards Events and Potential Impact on the WRWTP Lower Site

Hazard	Potential WTP Impacts
Seismic – Geotechnical	• Liquefaction at site causes differential settlement that compromises facilities. • Lateral spreading/landslide at river bank compromises slope stability and RW Intake.
Seismic – Structural	• Causes raw Water Pump Station structural damage. • Leads to High Service Pump Station / Clearwell structural damage. • Compromises connections of process piping and electrical duct banks at process facilities due to shearing.
Flood	• Erodes river bank. • Plugs or damages raw water intake.
Volcano	• Ash fall or water-transported debris compromises ability of plant to treat water.
Spills/Contaminants in River	• Raw sewage discharge from upstream communities compromises ability of plant to treat water. • Oil spill compromises ability of plant to treat water. • Other chemical spill compromises ability of plant to treat water.
Wild Fire	• Decreases water quality of Willamette River watershed. • Impact on river bank compromises raw water pump station.
Wind, Ice, Snow	• Local or regional power outage compromises plants' abilities to treat water. • Reduces staff availability.
Terrorism/Cyber Attack	• Reduces IT security and operational control. • Compromises control over finished-water quality.

Of these hazards, seismic hazards (geotechnical and structural) are expected to also affect other water supply facilities serving the region. The remaining hazards are expected to affect only the WRWTP, with exception of two possibly far-reaching hazards: volcanic ash and regional power disruption.

Volcanic ash fall could affect the City of Portland, City of Lake Oswego/Tigard, and Joint Water Commission (JWC) surface water supplies, depending on which volcano erupts and the wind direction at the time surrounding the eruption(s). Table 2.3 shows the relative likelihood of volcanic ash from an eruption of Three Sisters, Mount Hood, or Mount St. Helens, which would affect the surrounding four regional supply watersheds with the predominant southwest prevailing wind. As Table 2.3 shows, a volcanic event would likely not affect all four regional supplies.

Table 2.3 Likelihood of Volcanic Ash Having Substantial Impact on Watersheds with a Southwest Wind

River/Volcano	Three Sisters	Mount Hood	Mount St. Helens
Willamette River	High	Low	Low
Clackamas River	Moderate	High	Moderate
Bull Run River	Moderate	High	Moderate
Tualatin River	Low	Low	Low

A wind or ice storm could affect the regional power supply if it downs multiple high-voltage circuits crossing the Cascades. This hazard would be categorized as similar to seismic hazards. Based on this understanding, seismic hazards affecting all the regional water supply facilities shall be addressed separately from local hazards that would only affect the WRWTP Lower Site.

2.3.2.1 Hazards Affecting All Regional Facilities

A seismic hazard is typically discussed in terms of its likelihood of occurring in a 50-year period as well as its associated return period. This timeframe is used because it represents a building's typical life expectancy. Equipment has a life expectancy of approximately 20 years, and buried pipelines have a life expectancy of 100 years. For example, an earthquake with a 10 percent chance of occurring in 50 years has an approximately 500-year return period; one with a 5 percent chance has an approximately 1,000-year return period; and one with a 2 percent chance has an approximately 2,500-year return period.

On average, the Cascadia Subduction Zone earthquake occurs every 500 years. However, other earthquake sources also contribute to and heighten the probability of 500-year-return ground motions.

The Minimum Design Loads for Buildings and Other Structures (ASCE, 2010), which is a consensus-based standard, is used in conjunction with the International Building Code (IBC) to guide structural designs. Both start with a 2,500-year probabilistic ground motion, which are then multiplied by two-thirds. The resulting ground motion estimate is used to design most facilities and to achieve life safety for Category II facilities, such as residential and commercial structures.

ASCE 2010 assigns a risk category to various types of structures ranging from I to IV. Specifically, Risk Category II has an Importance Factor of 1.0, Risk Category III has an Importance Factor of 1.25, and Risk Category IV has an Importance Factor of 1.5. These factors are applied to the ground motion. With the Importance Factor applied, the IBC ensures that structures designed to Risk Categories III and IV will only require minor repairs before returning to operation (Category III) or remain operational after a 500-year return event. The IBC requires "qualifying" equipment used in Category IV to demonstrate their ability to remain operable after an earthquake.

The Importance Factors are based on building observations and engineering judgment. Water facilities, particularly water treatment plants, are complicated systems made up of many geotechnical considerations, structural and non-structural components, and systems that may be vulnerable to earthquakes. Applying an Importance Factor of 1.5 does not necessarily address all of these various elements and does not guarantee post-earthquake operation after a 500-year return earthquake. To increase the likelihood of post-earthquake operation, a detailed facility system seismic vulnerability analysis is recommended. At a minimum, it is recommended that this vulnerability analysis include unit processes, communications, staffing, supply logistics, inventory maintenance, and staff accommodations. This analysis should be relevant to all facilities on the WRWTP Lower Site and will need to include coordination with the WWSP.

To be more conservative, the owner may request to design for 2,500-year return ground motions. These are 1.5 times the ground motions used for most structures, the same as the Category IV 1.5 Importance Factor. Applying the same methodology as used for a base-level earthquake, 2,500-year ground motions should be used in conjunction with an Importance Factor of 1.5. Adding these factors of safety would result in a ground motion design of 1 + 0.5 + 0.5 = 2.0 multiplied by the base ground motion.

Because it only addresses the facilities' structural elements, this increase may not be enough to achieve post-earthquake facility functionality. To return to operations within days of a 2,500-year return event, a detailed facility system seismic vulnerability assessment is recommended. Furthermore, applying one 0.5 factor of safety (Importance Factor = 1.5), instead of applying both 0.5 factors of safety (Importance Factor = 2.0), is recommended.

The ground motion design, Importance Factor, and Facility System Seismic Analysis drive the Recovery Level, which represents the time it takes to get back in operation. The Recovery Level is the key parameter in determining a catastrophe's impact on a community. Table 2.4 shows the expected recovery level for combinations of ground motion design level, the Importance Factor, and a Facility System Seismic Analysis.

Table 2.4 Water Treatment Facility Recovery Levels for Various Earthquake Hazard Levels as Implied by Current Codes and Standards for New Construction

	Ground Motion Design Level					
	500-year	500-year	500-year	2,500-year	2,500-year	2,500-year
Importance Factor	1	1.5	1.5	1	1.5	1.5
Facility System Seismic Analysis	No	No	Yes	No	No	Yes
Subjected to:	**Resume Service in:**					
500-Year Return Period Earthquake	Months to Years	Days to Weeks	Days	Days to Weeks	Days	Days
2,500-Year Return Period Earthquake	Years	Months to Years	Months to Years	Months to Years	Days to Weeks	Days

In terms of the overall cost for the project, the difference of building new structures for Risk Category IV versus Risk Category III is nominal (estimated at 2 to 3 percent of total project cost to achieve Category IV for just the structures). The cost to conduct a detailed facility seismic vulnerability analysis is less than $100,000, plus mitigation of identified deficiencies. As a result, we recommend designing the future expanded WRWTP facilities to Category IV seismic design loading for a 500-year return event with no additional increase for 2,500-year ground motions. Chapter 5 of this 2017 MPU provides a detailed facility seismic vulnerability analysis of the existing facilities and summarizes Oregon's seismic requirements and standards put in place while the WRWTP was constructed.

As mentioned earlier, the IBC requires "qualifying" equipment in facilities designed to Risk Category IV. This means that the equipment used must be tested to ensure that it remains functional after the prescribed earthquake loading. Some standard WTP equipment, such as motor control centers, was previously qualified. This equipment must be identified and located in the facilities.

In case of earthquakes and potential wind and ice events, loss of regional power is expected to affect all the regional supplies. Although some of the other regional supply facilities have backup power, these may be damaged in an earthquake. Therefore, the existing backup power facilities at the WRWTP must be expanded to meet the desired LOS goals.

2.3.2.2 Hazards Only Affecting the WRWTP

As discussed briefly in 2.3.2, flood, volcanic debris flow, water quality events, wild fire, wind/ice/snow storms (excluding regional power outage), and terrorism/cyber-attacks are expected to affect only the WRWTP. These local hazards have the largest impact on the intake (raw water quality) and finished water quality.

Unlike seismic events, where the shaking intensity increases for an event with a longer return period (lower probability), local hazards such as chemical spills or terrorist attacks do not have different intensities depending on different return periods. Therefore, we recommend not attaching a return period to this group of hazards. These events do, however, have a reasonable likelihood of occurring during the life of the WRWTP.

2.3.3 Regional Precedents

This section reviews the regional precedence for large regional water supply systems, which guides the selection of seismic LOS goals.

2.3.3.1 East Bay Municipal Utility District (Oakland, California)

A thought leader in seismic reliability, the East Bay Municipal Utility District (EBMUD) in Oakland, California, established LOS goals for a probable and maximum earthquake event. These goals apply to an existing system that includes supply, treatment, and distribution. Table 2.5 presents these LOS goals.

Table 2.5 East Bay Municipal Utility District Level of Service Goals

Category	Probable Earthquake	Maximum Earthquake
General	All water introduced into the distribution system are fully treated, but minimally disinfected.	All water introduced into the distribution system are fully treated, but minimally disinfected.
Fire Service	Service to all hydrants within 20 days.	Service to all hydrants within 100 days.
Hospitals and Disaster Collection Centers	Minimum service to affected area within 1 day (water available via backbone distribution system near each facility).	Minimum service via distribution system or truck within 3 days.

Table 2.5 East Bay Municipal Utility District Level of Service Goals (Continued)

Category	Probable Earthquake	Maximum Earthquake
Domestic Users	Potable water via distribution system or truck within 1 day.	Impaired service within 30 days (water available via distribution system to each facility, possibly at reduced pressures).
Commercial, Industrial, and Other Users	Impaired service to affected area within 3 days (water available via distribution system to each commercial or industrial user, possibly at reduced pressures).	Potable water at central locations for pick up within 1 week. Minimum service to 70% of customers within 10 days. Impaired service to 90% of customers within 30 days.

2.3.3.2 Oregon Resiliency Plan

The Oregon Seismic Safety Advisory Committee (OSSAC) developed the Oregon Resilience Plan (ORP) per the Oregon State Legislature's request. The ORP includes goals for specific functions of water systems, as shown in Table 2. 6. For WTPs, the ORP recommends that 20 to 30 percent of the potable supply be available within 24 hours of the event and be at near-full restoration within 1 to 2 weeks.

Table 2.6 Oregon Resilience Plan Recommended LOS Goals for Water Systems

System Function	Event Occurs							
	0-24 hours	1-3 days	3-7 days	1-2 weeks	2-4 weeks	1-3 months	3-6 months	6-12 months
Potable water available at supply source	🔺	🟡		🟩			✖	
Main transmission facilities, pipes, pump stations, and reservoirs operational	🟩					✖		
Water supply to critical facilities available	🟡	🟩				✖		
Water for fire suppression at key supply points	🟩		✖					
Water for fire suppression at fire hydrants			🔺	🟡	🟩			✖
Water available at community distribution centers/points		🟡	🟩	✖				
Distribution system operational		🔺	🟡	🟩				✖

Notes:
(1) 🟩 Desired time to restore component to 80-90% operational.
(2) 🟡 Desired time to restore component to 50-60% operational.
(3) 🔺 Desired time to restore component to 20-30% operational.
(4) ✖ Current state (90% operational).

2.3.3.3 Joint Water Commission (JWC) (Hillsboro, Oregon)

The JWC developed LOS goals for its existing WTP (originally constructed in 1976) for three earthquake return periods (72, 475, and 2,475 years) with goals for immediate and short-term capacity, as well as short-term restoration. In all cases, the water quality produced was intended to be potable. For the JWC WTP, the expected performance of various unit processes during a seismic event governed the capacities. Table 2.7 shows the JWC's LOS goals.

Table 2.7 Joint Water Commission WTP LOS Goals

Seismic Events	Immediate Capacity mgd	Short-Term Capacity mgd	Short-Term Restoration Time days	Water Quality
72 Year Event	42(1)	42(1)	0	Potable
475 Year Event	0	24	1	Potable
2,475 Year Event	0	12	3	Potable
		28(2)	7 to 14	
		42(1)	60 to 90	

Notes:
(1) Average Day Demand is 42 mgd.
(2) Average Winter Demand is 28 mgd.

2.3.4 Recommended Preliminary LOS Goals for WRWTP Expansion

Two categories of preliminary LOS goals are recommended for the expanded WRWTP: 1) a regional seismic event that potentially affects all regional supplies where Participants rely on the WRWTP and 2) local events that affect only the WRWTP supply (i.e., other regional supplies remain on-line) and allow Participants to rely on other regional supplies.

Recommended LOS goals in this section were developed in a workshop setting that included the technical advisory committee (TAC). Because the expansion is for a regional facility, LOS goals must be verified with each agency during the design phase for compatibility with their own distribution and storage LOS goals. LOS goals developed as part of the 2015 MPU were adopted by the governing bodies of both Wilsonville and Sherwood.

Hazard Return Period

To prepare for a regional event, new facilities should be designed and upgraded for 2,500-year return period ground motions, in accordance with the IBC Risk Category IV. When available, pre-qualified equipment should also be specified.

To prepare for local hazard events, no return periods should be attached to them, but scenarios for each event type should be considered.

WTP Outage Time

For the regional event, the region will depend on the WRWTP. The plant should be operable within 48 hours after the event.

For local hazard events, the Cities of Wilsonville and Sherwood will rely on their existing groundwater supplies for short-term use, while potential interties with other regional water purveyors will be considered for long-term use. The WRWTP should be returned to operation within 14 days of the event.

Delivery Capacity Percentage

For a regional event, the WTP should be able to deliver 50 percent of its full capacity. This number controls the amount of backup power required and the size of chemical storage facilities.

For a local hazard event, the WTP should be at full capacity when service resumes.

Water Quality

Whenever operational, the WTP should produce potable water for both the regional and local hazard events.

Table 2.8 summarizes the final LOS goals recommended for the expanded WRWTP facilities.

Table 2.8 Adopted LOS Goals for the WRWTP

LOS Goal	Regional Event (Seismic)	Local Event (Non-Seismic)
"Following a W catastrophic event ...	2,500 year	Per occurrence
...within X days/weeks of the event...	48 hours	14 days
...deliver Y % of average day demand...	50% of nameplate	100% of nameplate
...with Z water quality."	Potable (at minimum regulatory requirement)	Potable (at plant treatment processes and procedures)

Exhibit D: Significant Resource Impact Report (Abbreviated)

City of Wilsonville
Significant Resources Impact Report

Willamette Water Supply Program
Work Package RWF_1.0

Prepared for:

Willamette Water Supply Program
1850 SW 170th Ave
Beaverton, OR 97003

Prepared by:

David Evans and Associates, Inc.
2100 SW River Parkway
Portland, Oregon 97201

November 2019

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List of Acronyms

DBH = Diameter at breast height

Project Participants = Tualatin Valley Water District and the City of Hillsboro

RWF = Raw Water Facilities

SRIR = Significant Resource Impact Report

SROZ = Significant Resource Overlay Zone

TVWD = Tualatin Valley Water District

UGMFP = Urban Growth Management Functional Plan

WDC = Wilsonville Development Code

WIF = Willamette Intake Facilities

WRWTP = Willamette River Water Treatment Plant

WWSP = Willamette Water Supply Program

WWSS = Willamette Water Supply System

1 INTRODUCTION

Tualatin Valley Water District (TVWD) and the City of Hillsboro, collectively referred to as the Project Participants, have partnered to form the Willamette Water Supply Program (WWSP or Program) and to build the Willamette Water Supply System (WWSS). The WWSS will provide a resilient and redundant water supply for the TVWD-Hillsboro service area and partnering urban areas. The WWSP will also include improvements to the existing Willamette Intake Facilities (WIF); in addition to the Project Participants, the WIF Partners include the cities of Wilsonville, Beaverton, Sherwood, and Tigard. When complete, the WWSS will be one of Oregon’s most seismically resilient water systems, built to better withstand natural disasters, protect public health, and speed regional economic recovery through restoring critical services more quickly than existing systems.

This abbreviated Significant Resources Impact Report (SRIR) addresses natural resource features regulated by the City of Wilsonville (City) that may be impacted by the proposed new Raw Water Facilities (RWF_1.0) that will be part of the WWSS. Portions of the project are located within a Significant Resource Overlay Zone (SROZ). This report provides resource boundaries and analyzes the impacts of development within SROZ and 25-foot Impact Area based upon requirements of Section 4.139.06.01 (Abbreviated SRIR Requirements), as part of a Site Development Permit Application for the WWSS and WIF.

The RWF_1.0 facilities will be located at the existing Willamette River Water Treatment Plant site (WRWTP) (tax lot IDs 31W23B1800 and 1900) located in Wilsonville. It includes a portion of raw water pipeline that will cross Arrowhead Creek onto an adjacent property (tax lot ID 31W23B01700). A vicinity map is provided in Figure 1 of Appendix A.

1.1 PROJECT DESCRIPTION

The proposed raw water facilities consist of constructing new facilities at the WRWTP site, as well as improvements to the Willamette Intake Facilities (WIF) to include seismic improvements to protect the WIF during a seismic event, and replacing the fish screens to enlarge withdrawal capacity. The WWSS will source its water from the Willamette River. The RWF_1.0 will be located at the site of the existing WRWTP in Wilsonville. From there, raw water will be pumped offsite through a new raw water pipeline to a new state-of-the-art water filtration plant in Sherwood’s Tonquin Employment Area, where multiple treatment processes will produce high quality drinking water. Drinking water will be pumped to the Reservoir Facilities on Cooper Mountain and then will be gravity-fed to the existing distribution systems serving users. The project also includes seismic stability improvements, including caissons and jet grout bank stabilization, which have been designed to provide seismic resiliency for the new WWSS facilities and the WIF.

The project will cross through a SROZ, as described below in Section 5. Construction of the new system is planned to be completed by 2026. Other water providers in the region are considering participating in the WWSP.

2 RELEVANT CODE SECTIONS

Based on guidance from the City (Kerry Rappold, personal communication, December 4, 2018) this SRIR has been prepared using the abbreviated SRIR requirements listed below in italics. A brief response, in non-italic font, after each code requirement describes how the requirement is addressed in this report.

Section 4.139.06 Significant Resource Impact Report (SRIR) and Review Criteria

(.01) Abbreviated SRIR Requirements.

[…]

B. Outline of any existing features including, but not limited to, structures, decks, areas previously disturbed and existing utility locations;*

This information is provided on Figure 2 of Appendix A.

C. Location of any wetlands or water bodies on the site and the location of the stream centerline and top-of-bank;

This information is provided on Figure 2 of Appendix A. The memo in Appendix B documents the mapping methods and provides descriptions for these features.

D. Within the area proposed to be disturbed, the location, size and species of all trees that are more than six (6) inches in diameter at breast height (DBH). Trees outside the area proposed to be disturbed may be individually shown or shown as drip line with an indication of species type or types;

This information is provided on Figure 2 of Appendix A, and in the RWF_1.0 arborist report (Harrity 2019).

E. The location of the SROZ and Impact Area boundaries;*

This information is provided in Figure 2 of Appendix A, which identifies the SROZ for the entire RWF_1.0 work area, including adjacent areas. The SROZ was previously mapped for most of this area and the City preliminarily concurred with the boundary on March 9, 2016 (Appendix B). However, since the time of the City's preliminary concurrence, the crossing of Arrowhead Creek has shifted to the west side of the bridge to improve constructability and separation from existing City infrastructure. The north side of this new crossing now extends onto a new parcel (tax lot ID 31W23B01700) that had not been included in the preliminary concurrence by the City. The SROZ has since been mapped in this area following the same methods outlined in the concurred memo provided in Appendix B.

F. A minimum of three slope cross-section measurements transecting the site, equally spaced at no more than 100-foot increments. The measurements should be made perpendicular to the stream;*

Slope measurements were reviewed during the creation of the SROZ mapping noted in Appendix B. Slope breaks used to define Metro Urban Growth Management Functional Plan (UGMFP) Title 3 areas are very distinct in all mapped SROZ areas (i.e. bank of Willamette River, unnamed tributary to the Willamette River situated in a steep ravine, and Arrowhead Creek situated in a deep ravine). Steep slopes (>=25%) lead up from these water resource features to a relatively level terrace.

*G. A map that delineates the Metro UGMFP Title 3 Water Quality Resource Area boundary (using Metro Title 3 field observed standards)****;**

This resource has been previously mapped by DEA and documented in a memo that received preliminary concurrence by the City (Appendix B). This same mapping was extended onto the parcel on the north side of Arrowhead Creek. The updated mapping is reflected in the figures provided in Appendix A.

*H. Current photos of site conditions shall be provided to supplement the above information******.

This information is provided in Appendix C.

*I. A narrative describing the possible and probable impacts to natural resources and a plan to mitigate for such impacts**.*

Section 5 of this report describes anticipated project impacts to natural resources. These impacts are displayed in Drawings (DWG) F3 and F4 of Appendix A. Section 6 describes proposed mitigation for the proposed impacts. Proposed mitigation is depicted in DWG 4 of Appendix A.

3 METHODS

Methods for mapping and documenting the SROZ are provided in the memo included in Appendix B. Water resource features (i.e. wetlands and waterways) were delineated (DEA 2015) and received concurrence from the Oregon Department of State Lands (DSL ID#2016-0249). Trees within potential development areas were mapped by the project surveyor, with tree species, DBH, and other tree characteristics required by Wilsonville Development Code (WDC) Section 4.610.40 documented by the project arborist. SROZ impacts were determined by overlaying proposed project development footprints, including temporary construction areas, with the delineated SROZ boundaries. A similar analysis was conducted to determine tree impacts.

4 EXISTING CONDITIONS

The RWF_1.0 project site is situated on a high terrace along the north bank of the Willamette River. Throughout the project site the terrace gradually slopes downward from the northern end to the southern end of the site, then steepens considerably along a forested bluff that leads to the Willamette River. The site is described in this SRIR as two areas: an Upper Site (roughly the northern third, lots 1700 and 1800) and a Lower Site (the southern two-thirds including lots 1800 and 1900).

The Upper Site consists of a former hazelnut orchard, maintained lawn areas near Arrowhead Creek Lane, and areas of fill covered in lawn grasses. Arrowhead Creek flows from west to east through the north end of the property and is situated in a forested ravine. Two wetlands were delineated within the narrow Arrowhead Creek floodplain. The RWF_1.0 project extends slightly north of Upper Site a short distance beyond the ravine sideslopes along the northern side of the Arrowhead Creek corridor onto a lot that consists of agricultural land growing ornamental trees and shrubs. This area north of the creek consists of the receiving shaft for the water pipeline that will be bored under Arrowhead Creek. The sections of pipe north of the receiving shaft are part of the PLM_1.1 work package, which is being permitted separately from the RWF_1.0.

The Lower Site contains an intermittent drainage feature, including a small wetland, which is situated in a steep, generally forested ravine that drains to the Willamette River. Developed areas of the Lower Site include the existing WRWTP facility and a community park area containing lawn, paved trails, ornamental plantings and a water feature. A water storage tank (clearwell) is located belowground, under a portion of the lawn area. The south end of the WRWTP facility contains a raw water pump station and a pedestrian overlook deck. The WIF are located in the south side of the Lower Site beneath the ground surface, including the caisson and a water intake pipe situated within the steep forested bluff that leads down to the Willamette River.

Areas mapped as SROZ are located along the north, west, and south sides of the RWF_1.0 project area. At the Upper Site SROZ surrounds the Arrowhead Creek corridor. SROZ also extends along the western edge of the Lower Site surrounding an intermittent drainage and wetland. Additional SROZ is located at the forested bluff above the Willamette River. Figure 2 in Appendix A depicts the location of SROZ within the project site.

For additional description of the wetlands, waterways, and adjacent riparian areas noted above, see the Results section of the memo provided in Appendix B.

5 PROPOSED ALTERATIONS

DWG F3-0 to F3-3 (Appendix A) show proposed impacts during construction, while DWG F4-0 to F4-3 (Appendix A) show the final developed conditions and highlight where permanent and temporary SROZ impacts will occur, as well as proposed mitigation. DWG F5-0 (Appendix A) provides cross-sections along the bluff adjacent to the Willamette River, with pre- and post-construction grading conditions shown.

On the Upper Site a pipeline will be installed underneath the Arrowhead Creek corridor using trenchless technology to reduce impacts. However, a small number of trees will be removed from the north side of the SROZ where the receiving shaft work area will be located. This area consists of a small group of trees located along the level terrace, beyond the steep slopes of the ravine.

Within the Lower Site, a construction corridor is proposed to run along the SROZ Impact Area located along the western side of the site, adjacent to an unnamed intermittent drainage. Along this western side, several trees will be removed in the SROZ in this area and no permanent impacts to the SROZ will occur other than that associated with minor widening of the existing path and installation of vaults associated with a new electrical conduit and fiber optic line. The electrical conduit and fiber optic line will result in temporary impacts within the SROZ, located primarily within the footprint of the path or within the lawn area to the east of the path. The path widening occurs in an area that is currently maintained lawn.

Proposed project components along the south side of the Lower Site will impact the SROZ where the raw water pipeline and a new path and pedestrian overlook will be placed. The existing pedestrian overlook will be removed. This work will include staging areas, grading, and seismic stability improvements. Seismic slope stabilization improvements will alter the substrate of the bank to provide seismic resiliency for the new WWSS facilities and the WIF. Vegetation removal and grading will occur in this area, and the seismic slope stabilization improvements will cause a change in the soil profile, making it difficult for large trees to grow back in this location. The tree layer in the SROZ will be permanently impacted because the seismic stabilization may prevent deep rooting trees from becoming established, however this area will be replanted with a native shrub community.

Permanent and temporary SROZ impact acreages are provided in Table 1. Proposed tree removal quantities are provided in Table 2 and include trees to be removed within and outside of the SROZ.

All impacts to the SROZ within the project area will be mitigated for in a section of land abutting the existing SROZ surrounding the Arrowhead Creek corridor on the Upper Site (DWG F4-0 and F4-3). This mitigation will include removing existing weedy vegetation and replanting with native forest species.

Table 1 Proposed Permanaent and Temporary SROZ Impacts

	Permanent Impact (acres)	**Temporary Impact (acres)**
SROZ Impacts	0.209	0.522

Table 2 Tree Impacts

	SROZ	**Non-SROZ**	**Total**
Total number of trees impacted	**73**	**18**	**91**

6 PROPOSED SITE RESTORATION AND MITIGATION

Site restoration and mitigation plans have been developed collaboratively with the City over a series of meetings and site visits throughout 2018 and early 2019. When construction of the project has been completed, temporary impact areas will be restored similar to existing grade except for allowance of a new trail along the Willamette River bluff (Appendix A DWG F4-2 and F5-0). All impacts to the SROZ will be mitigated for on a section of the Upper Site that abuts the Arrowhead Creek riparian corridor SROZ. Mitigation in this area will include the removal of existing weedy vegetation followed by replanting with native forest species. Appendix A DWG F4-3 shows the proposed mitigation area footprint and also provides a list of proposed species to be planted in both the mitigation area and for site restoration in temporarily disturbed areas along the Willamette River bluff (note tree species may not be planted along the river bluff due to conflicts with the seismic bank stabilization improvements).

Appendix A, and Figures DWG F4-1 and F4-3 serve as preliminary site restoration plans for permanent and temporary impacts. Proposed mitigation planting plans are provided in Appendix A, figures DWG USL-08 to 09 and DWG USL-12 to 13. No impacts to the SROZ will occur prior to approval of the plans by the City. Only native plant materials will be used in SROZ areas, including within temporary impact areas and the proposed mitigation site. Plant material type and size are shown on figure DWG USL-12. Permanent irrigation is not proposed; however, mitigation plantings will be irrigated for two years after planting to encourage plant establishment. The WWSP proposes a three-year monitoring and maintenance period to cover initial plant establishment. This will include a total tree and shrub count along with an assessment of encroachment by non-native invasive species (e.g. Himalayan blackberry) that could impede overall plant establishment success. The WWSP proposes a success criterion of 80 percent survival of trees and shrubs at the end of the three year period. This is a typical success criterion for plantings in a natural setting. Percent survival shall be based on the number of live plants counted at the time of monitoring divided by the initial tree and shrub planting totals from the planting plans. Monitoring shall occur annually and trees and shrubs replanted as needed to meet the success criterion. Long term monitoring and maintenance will occur as part of overall WRWTP, WIF, and WWSP RWF facility maintenance activities per agreements between the cooperating entities.

The WWSP has received permits from the U.S. Army Corps of Engineers (USACE) and Oregon Department of State Lands (DSL) that cover the entirety of the WWSP, including the RWF_1.0. No wetland or waterway impacts requiring mitigation will occur at RWF_1.0. The WWSP has purchased wetland mitigation bank credits for wetland impacts associated with other WWSP elements.

7 PREPARERS AND CONTRIBUTORS

Mr. Ethan Rosenthal, DEA Ecologist, performed the site assessment. Mr. Rosenthal and Valerie Thompson, DEA Ecologist, co-authored this report. Sarah Betz, DEA Biologist, provided quality assurance review. Shawna Hale, DEA Deputy Project Manager, provided editing assistance.

8 REFERENCES

David Evans and Associates, Inc. (DEA). 2015. Wetland Delineation Report, Willamette River Water Treatment Plant. September 2015.

Harrity Tree Specialists, Inc. (Harrity). 2019. Tree Maintenance and Protection Plan memo to David Evans and Associates, Inc. Prepared for Willamette Water Supply System work package RWF_1.0.

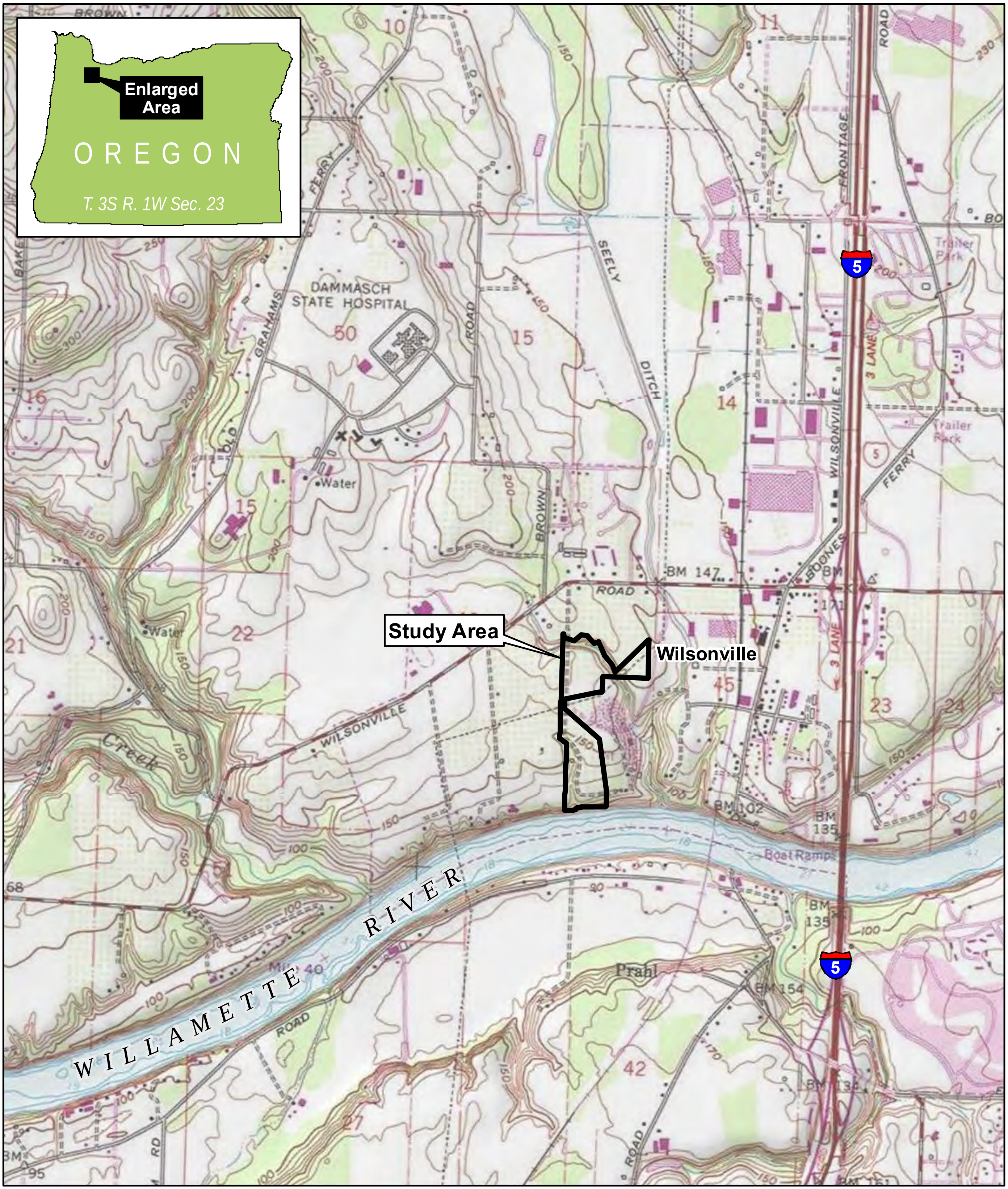
Kerry Rappold. City of Wilsonville. Personal Communication. December 4, 2018.

File Name: p:\t\tvwd00000008\0600info\0670reports\land use\rwf_1.0\significant resource impact report\report draft 5\2019-11-06_wwsp_rwf_srir.docx

9 APPENDICES

APPENDIX A: Figures

Figure 1. Vicinity Map
Figure 2. Existing Conditions
Figure 3. Temporary Construction Condition
Figure 4. Proposed Final Conditions
Figure 5. Willamette River Bank Cross-Section
Figure 6. Mitigation Site Planting Plans



ESRI, ArcGIS Online, USA Topographic Maps. 1961. Sherwood, Oregon.

Figure 1
Vicinity

GENERAL SHEET NOTES

1. TREE SURVEY INFORMATION PROVIDED ON F2-1, F2-2, AND F2-3.

LEGEND

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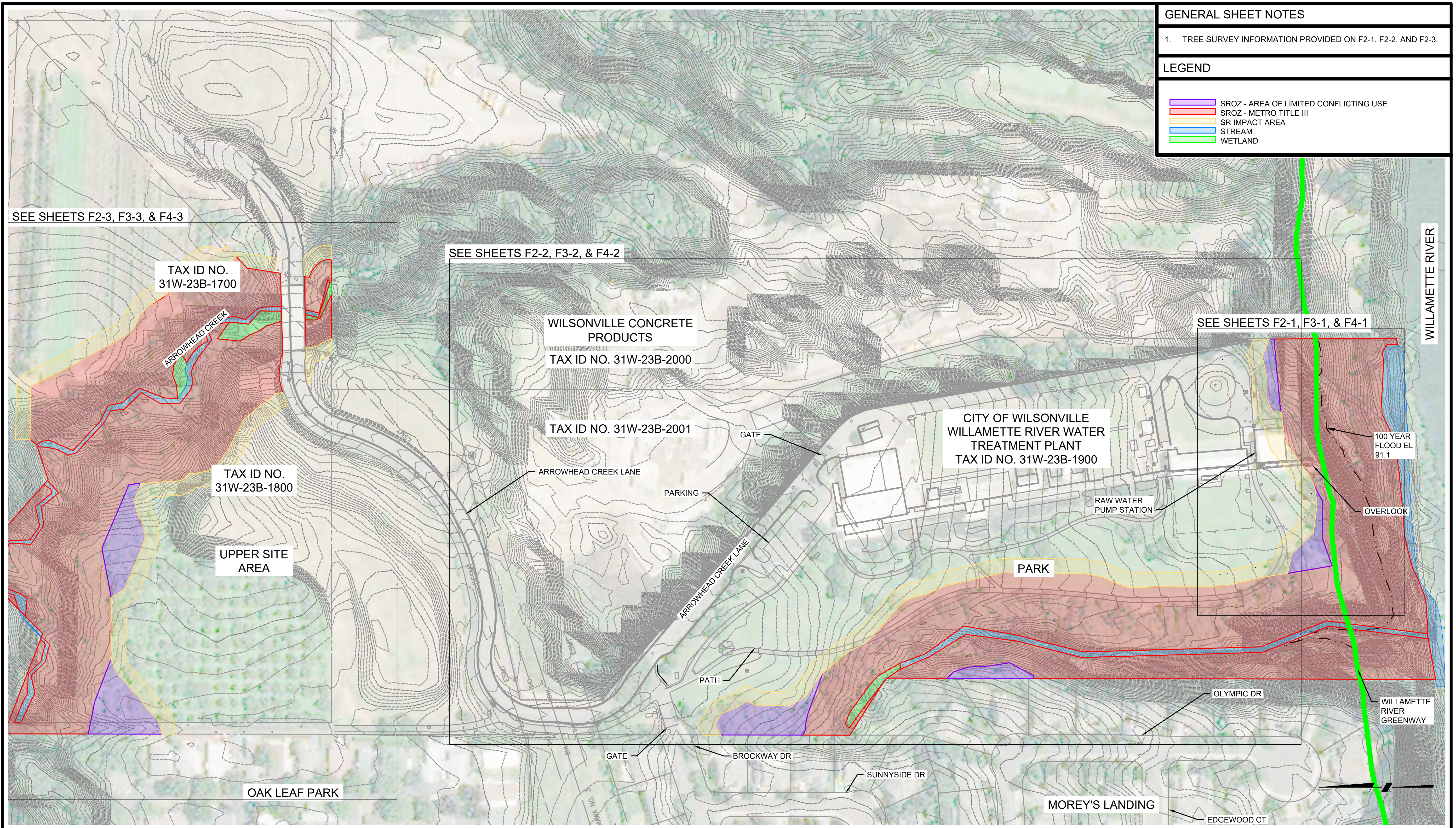
🟥	SROZ - METRO TITLE III
🟨	SR IMPACT AREA
🟦	STREAM
🟩	WETLAND



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CHK	P. KNEITZ					
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SRIR FIGURES
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SIGNIFICANT RESOURCE IMPACT REPORT
EXISTING CONDITIONS
OVERVIEW

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DATE	07/12/19
PROJ	196999

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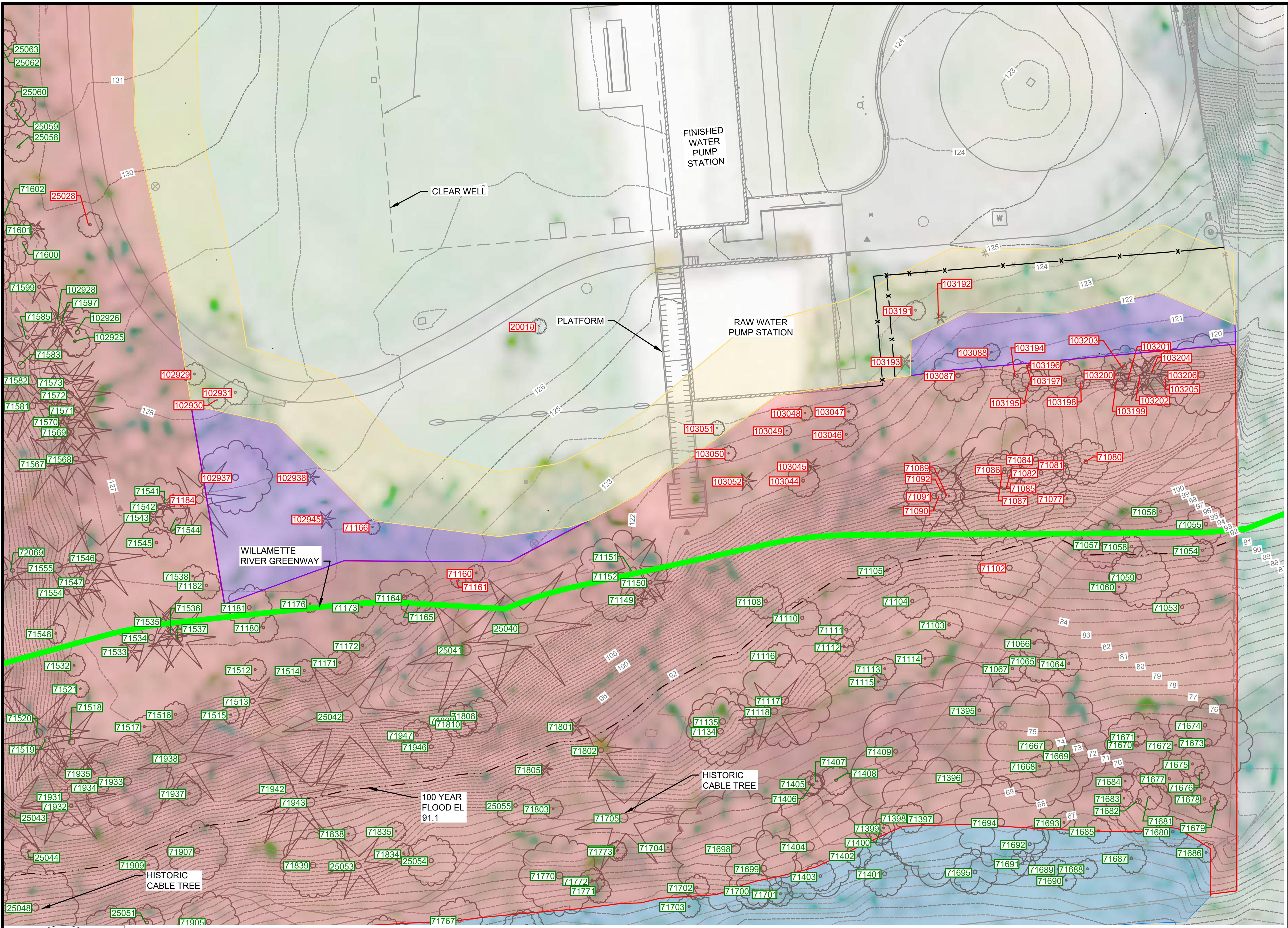

1 PLAN

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▨	SR IMPACT AREA
▨	STREAM
🟩	WETLAND
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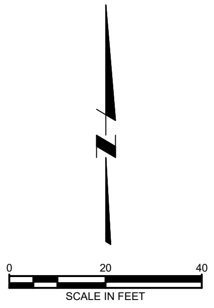
XXXX ⊙	TREE (REMOVE)



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SIGNIFICANT RESOURCE IMPACT REPORT
EXISTING CONDITIONS
RIVER BANK

SHEET	2
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DATE	11/5/19
PROJ	196999

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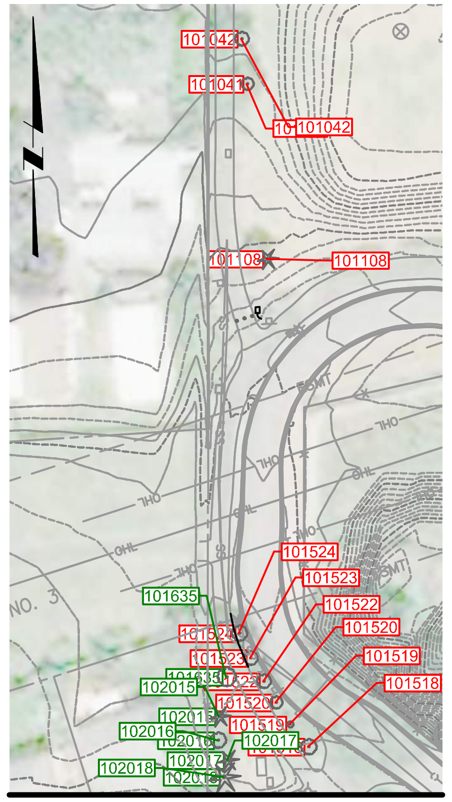

SEE OVERALL PLAN

INSET

LEGEND

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▨	SR IMPACT AREA
▨	STREAM
🟩	WETLAND
XXXX	TREE (PROTECT)
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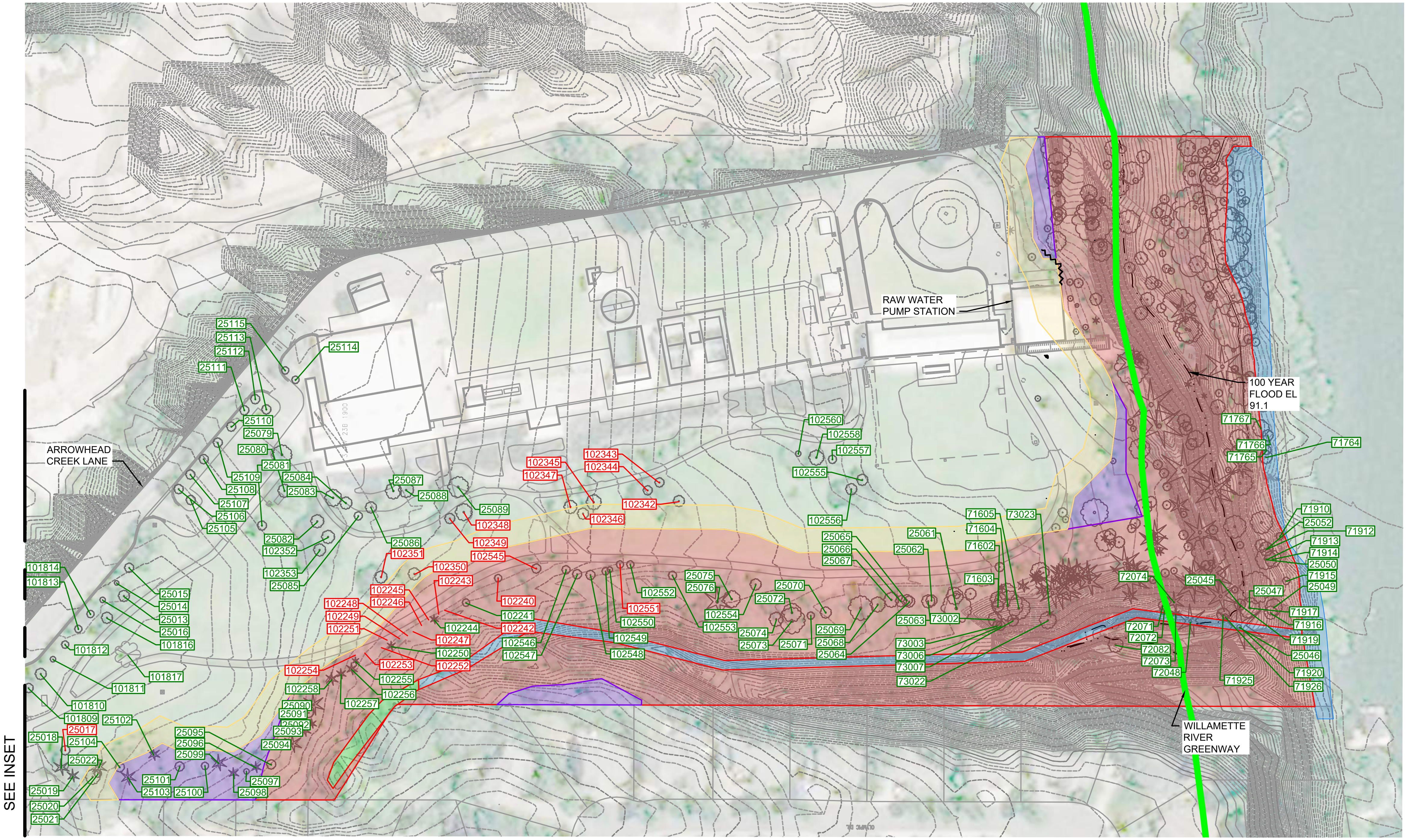

OVERALL PLAN

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DR	C.J. COGLIANESE
CHK	P. KNEITZ
APVD	J. MCMULLEN

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SRIR FIGURES
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SIGNIFICANT RESOURCE IMPACT REPORT
EXISTING CONDITIONS
PARK

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PROJ	196999

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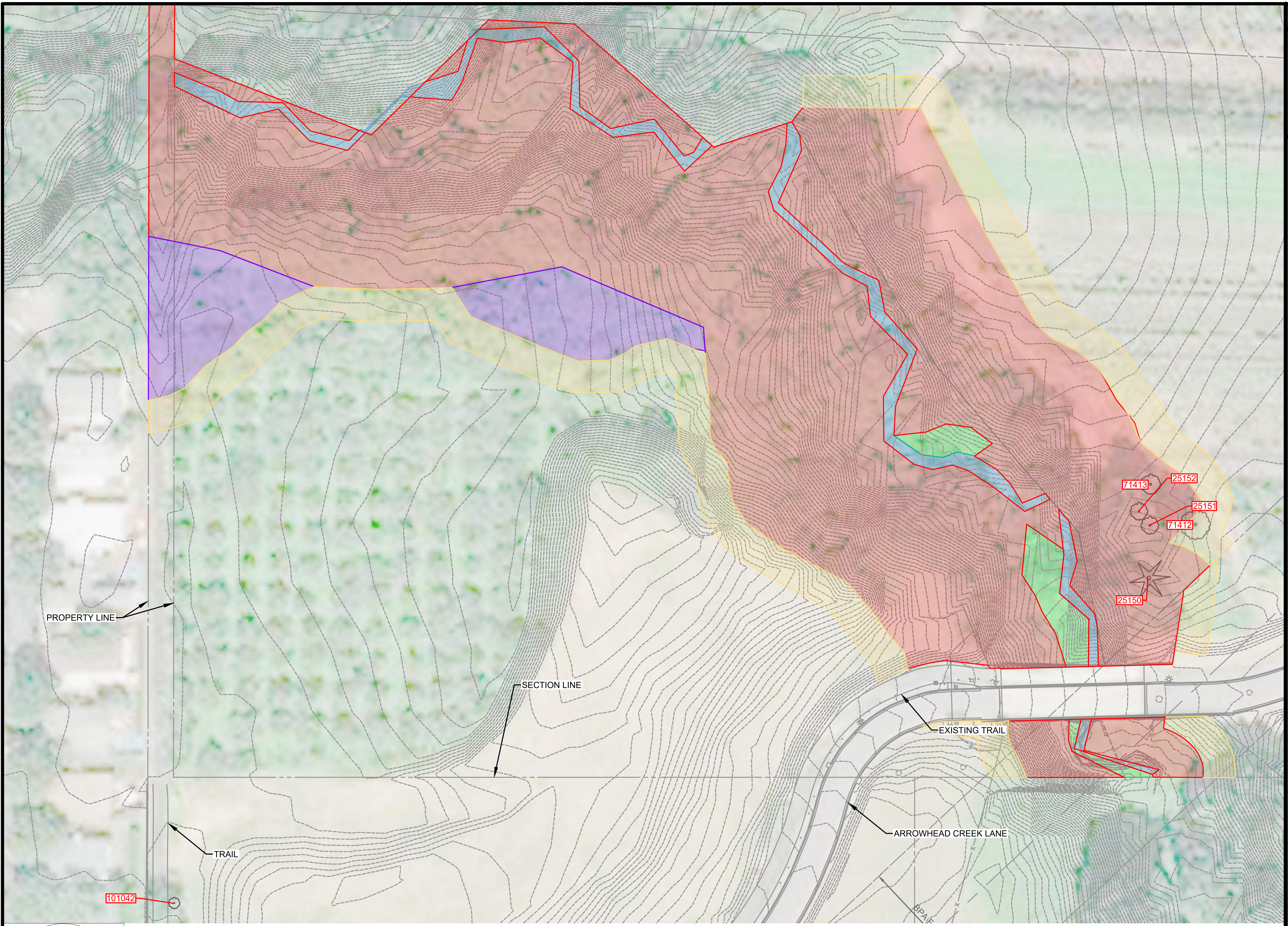

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- ▨ STREAM
- ▨ WETLAND
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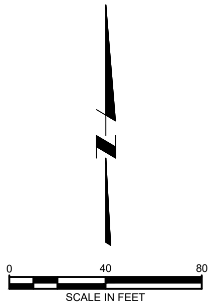
- XXXX ⊙ TREE (REMOVE)



1 SITE YARD PIPING PLAN

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SRIR FIGURES
(NOT FOR CONSTRUCTION)

SIGNIFICANT RESOURCE IMPACT REPORT
EXISTING CONDITIONS
UPPER SITE

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GENERAL SHEET NOTES

1. TREE SURVEY INFORMATION PROVIDED ON F3-1, F3-2, AND F3-3.

LEGEND

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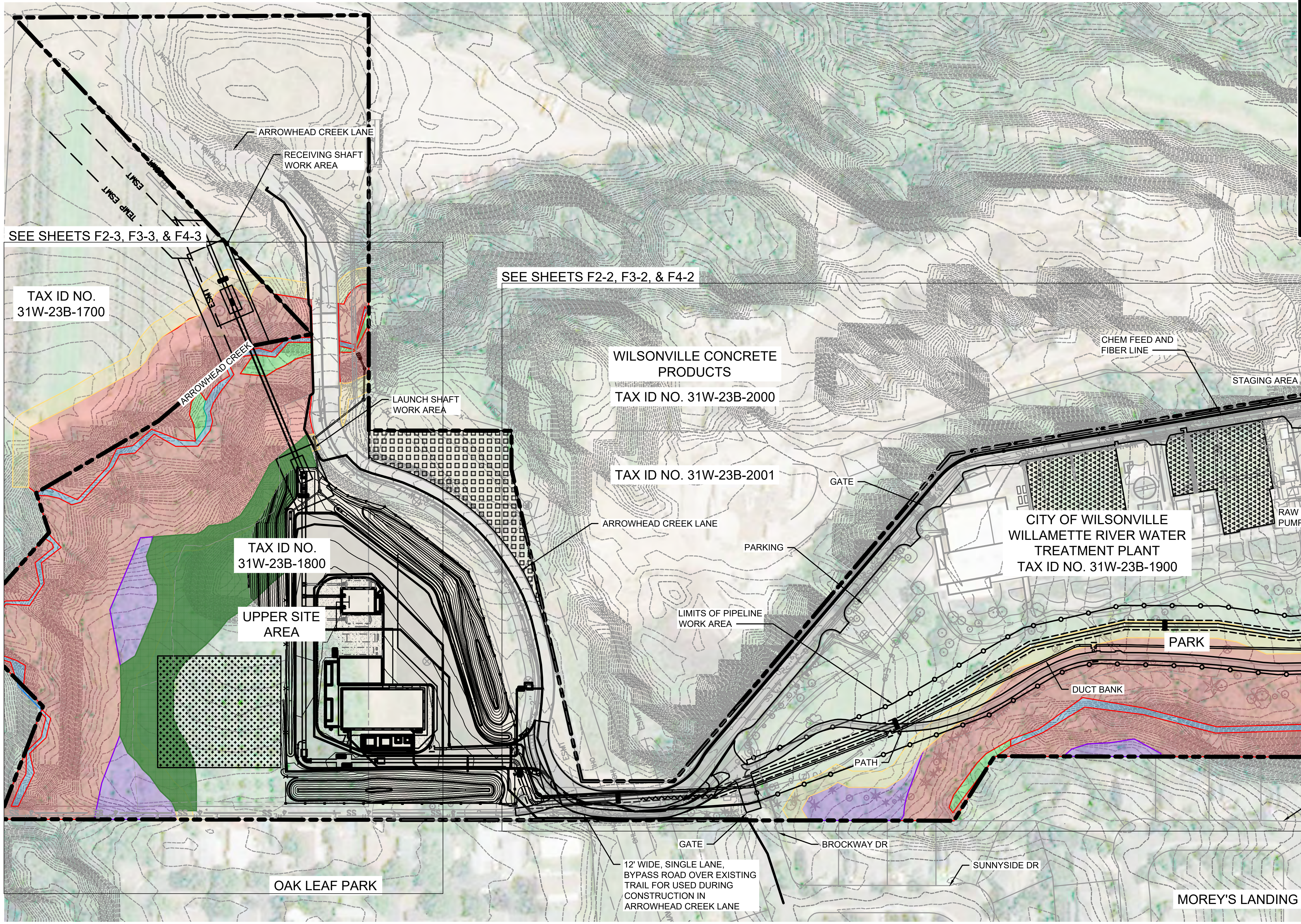
- 🟥 SROZ - METRO TITLE III
- 🟨 SR IMPACT AREA
- 🟦 STREAM
- 🟩 WETLAND
- ▨ PROPOSED SROZ MITIGATION AREA
- ▦ UNLIMITED USE STAGING AREA
- ▦ USE WITH PLANT APPROVAL STAGING AREA
- ▩ TEMPORARY STAGING AREA FOR CM/GC AND WWSP CONSTRUCTION TRAILERS AND CONSTRUCTION WATER MANAGEMENT
- ━━ PIPELINE
- ━ ━ LIMITS OF CONSTRUCTION
- - - - LIMITS OF TRENCH



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PRELIMINARY, SUBJECT TO CHANGE

SRIR FIGURES
(NOT FOR CONSTRUCTION)

SIGNIFICANT RESOURCE IMPACT REPORT
TEMPORARY CONDITIONS
OVERVIEW

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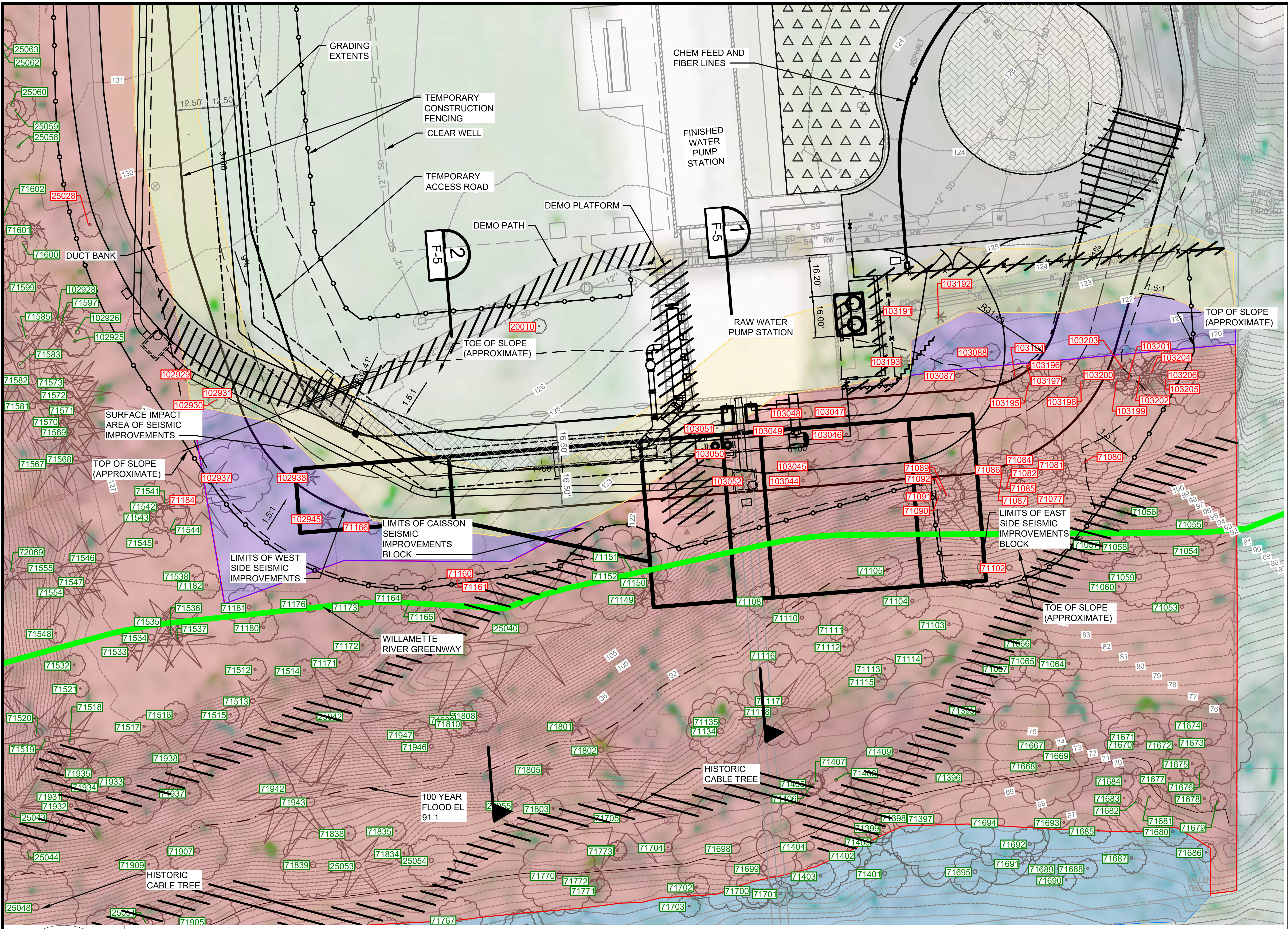

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- 🟩 WETLAND
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- △△△ USE WITH PLANT APPROVAL STATING AREA
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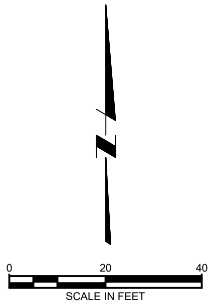
- XXXX TREE (REMOVE)



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RWF_1.0

SIGNIFICANT RESOURCE IMPACT REPORT
TEMPORARY CONDITIONS
RIVER BANK

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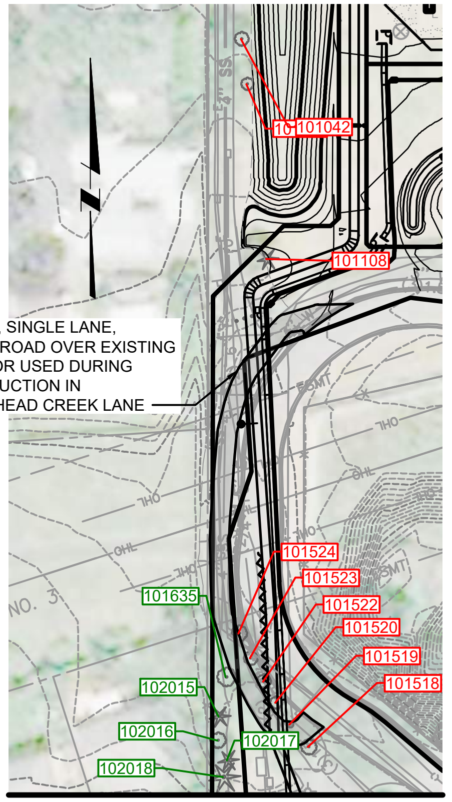
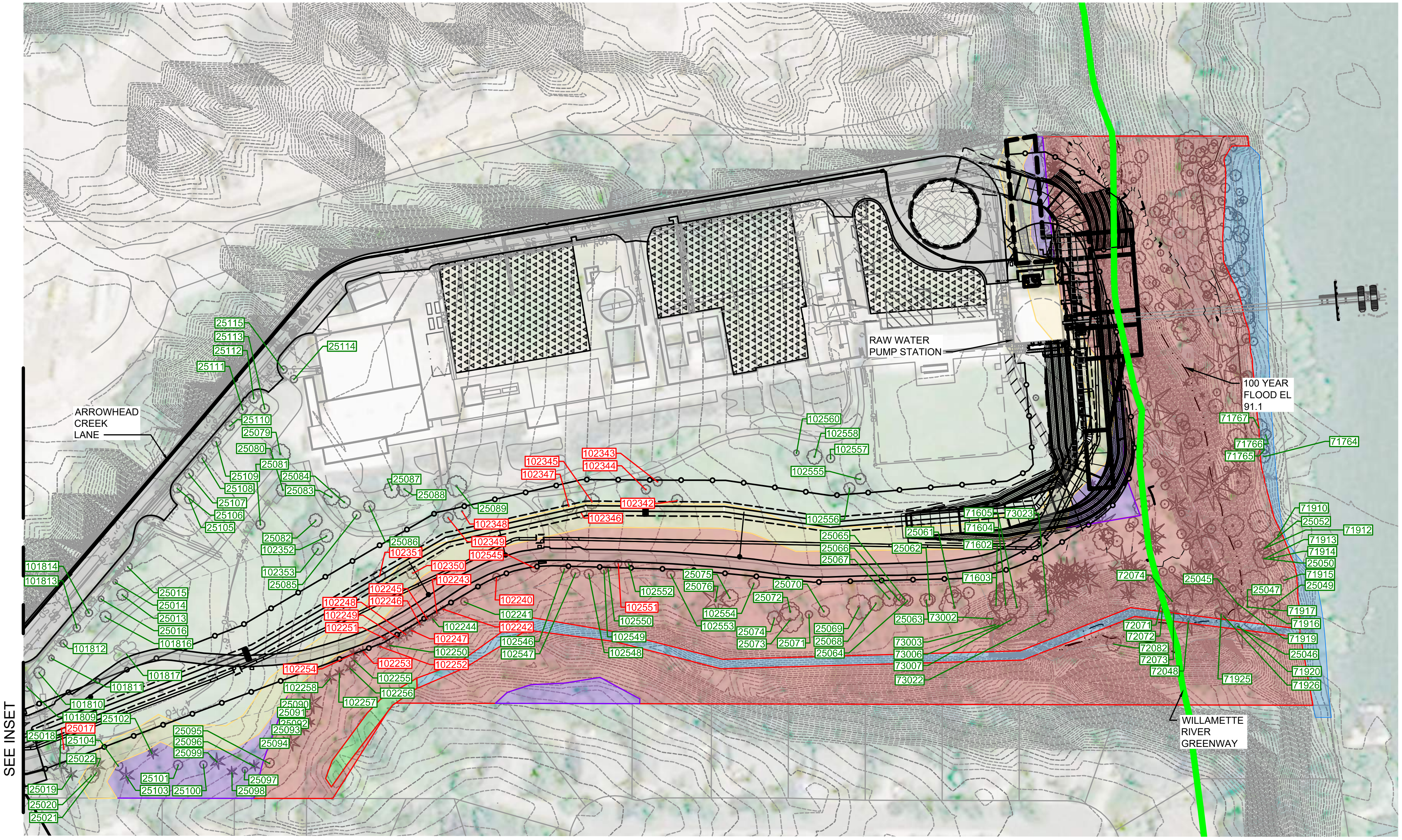


SEE OVERALL PLAN

INSET



OVERALL PLAN

LEGEND

▨	SROZ - AREA OF LIMITED CONFLICTING USE
▨	SROZ - METRO TITLE III
▨	SR IMPACT AREA
▨	STREAM
▨	WETLAND
🟩	PROPOSED SROZ MITIGATION AREA
▨	UNLIMITED USE STAGING AREA
▨	USE WITH PLANT APPROVAL STAGING AREA
XXXX	TREE (PROTECT)
XXXX	TREE (REMOVE)
—	PIPELINE
— — —	LIMITS OF CONSTRUCTION
- - - -	LIMITS OF TRENCH

		NO.	DATE	REVISION	BY	APVD
DSGN	M. CARLSON					
DR	C.J. COGLIANESE					
CHK	P. KNEITZ					
APVD	J. MCMULLEN					

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.

0 1"

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

BLACK & VEATCH

SAFELY DELIVERED

Willamette Water Supply
Our Reliable Water

WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

PRELIMINARY, SUBJECT TO CHANGE

SRIR FIGURES
(NOT FOR CONSTRUCTION)

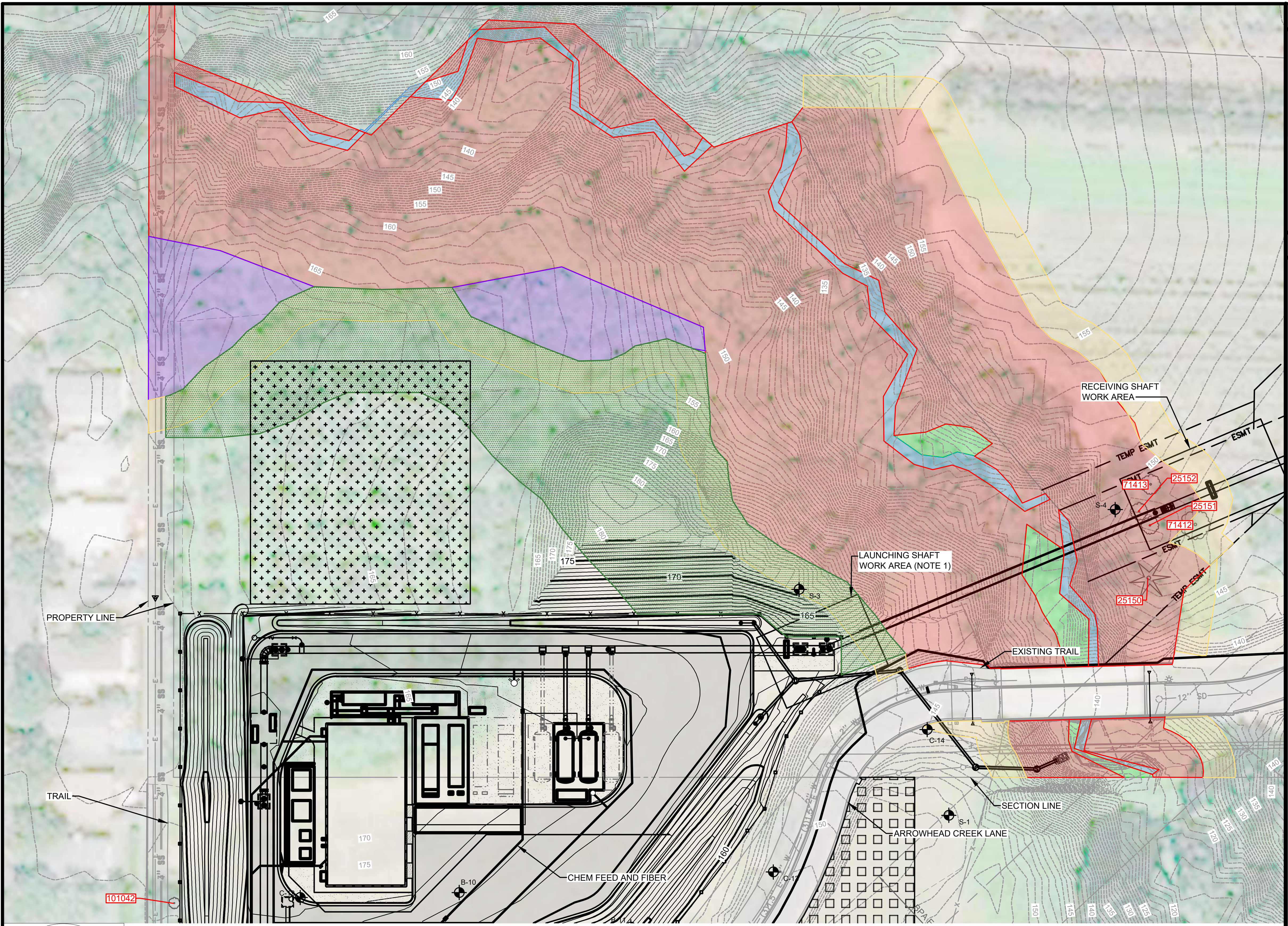
SIGNIFICANT RESOURCE IMPACT REPORT

TEMPORARY CONDITIONS
PARK

SHEET	7
DWG	F3-2
DATE	11/5/19
PROJ	196999

FILENAME: RWF_1.0 GEG-03.DWG

PLOT DATE AND TIME: 11/5/2019 3:42:35 PM



1 SITE YARD PIPING PLAN

LEGEND

- ▨ SROZ - AREA OF LIMITED CONFLICTING USE
- ▨ SROZ - METRO TITLE III
- ▨ SR IMPACT AREA
- ▨ STREAM
- ▨ WETLAND
- ▨ PROPOSED SROZ MITIGATION ZONE
- ▨ UNLIMITED USE STAGING AREA
- ▨ USE WITH PLANT APPROVAL STAGING AREA
- ▨ TEMPORARY STAGING AREA FOR CM/GC AND WWSP CONSTRUCTION TRAILERS AND CONSTRUCTION WATER MANAGEMENT
- XXXX TREE (PROTECT)
- XXXX TREE (REMOVE)

NOTES

1. ALL SURFACE DISTURBANCE TO OCCUR ABOVE BREAK IN RAVINE SLOPE.

0 40 80
SCALE IN FEET

Oregon 811
UTILITY NOTIFICATION CENTER

DSGN M. CARLSON						VERIFY SCALE
DR C.J. COGLIANESE						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.
CHK P. KNEITZ						
APVD J. MCMULLEN	NO.	DATE	REVISION	BY	APVD	

BLACK & VEATCH

SAFELY DELIVERED

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WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

PRELIMINARY, SUBJECT TO CHANGE

SRIR FIGURES
(NOT FOR CONSTRUCTION)

SIGNIFICANT RESOURCE IMPACT REPORT
TEMPORARY CONDITIONS
UPPER SITE

SHEET	8
DWG	F3-3
DATE	11/5/19
PROJ	196999

FILENAME: RWF_1.0 USC-03.DWG PLOT DATE AND TIME: 11/5/2019 3:16:30 PM

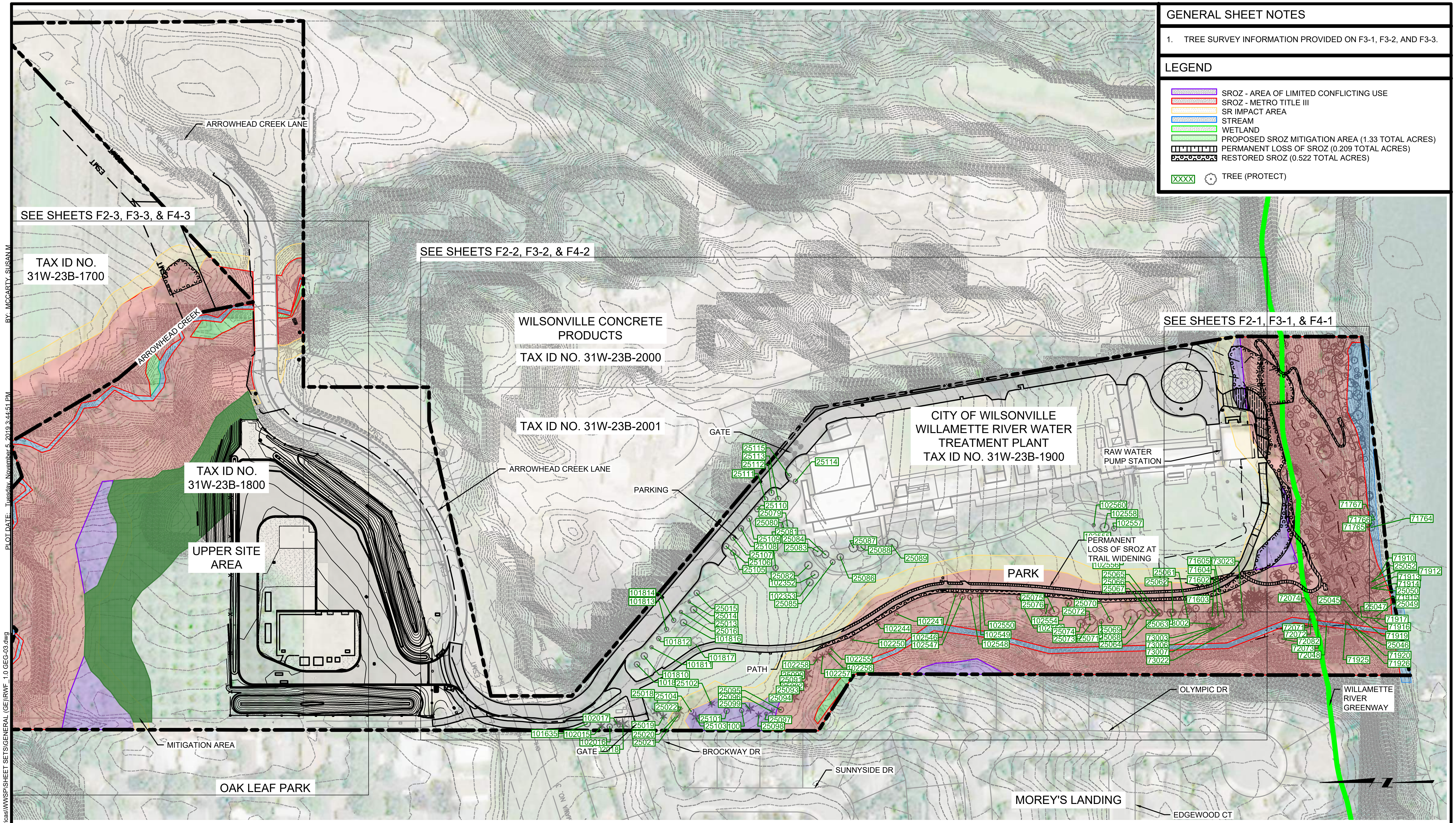
DWG FILE: C:\pw_working\bvw_americas\WWSP\SHEET SETS\UPPER SITE POWER BUILDING (US)\RWF_1.0 USC-03.dwg PLOT DATE: Tuesday, November 5, 2019 3:16:30 PM BY: MCCARTY, SUSAN M

GENERAL SHEET NOTES

1. TREE SURVEY INFORMATION PROVIDED ON F3-1, F3-2, AND F3-3.

LEGEND

▨	SROZ - AREA OF LIMITED CONFLICTING USE
▨	SROZ - METRO TITLE III
▨	SR IMPACT AREA
▨	STREAM
▨	WETLAND
▨	PROPOSED SROZ MITIGATION AREA (1.33 TOTAL ACRES)
▨	PERMANENT LOSS OF SROZ (0.209 TOTAL ACRES)
▨	RESTORED SROZ (0.522 TOTAL ACRES)
XXXX ⊙	TREE (PROTECT)



0 80 160
SCALE IN FEET

DSGN M. CARLSON						
DR C.J. COGLIANESE						
CHK P. KNEITZ						
APVD J. MCMULLEN	NO.	DATE	REVISION	BY	APVD	

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 ▬ 1"
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PRELIMINARY, SUBJECT TO CHANGE

SRIR FIGURES
(NOT FOR CONSTRUCTION)

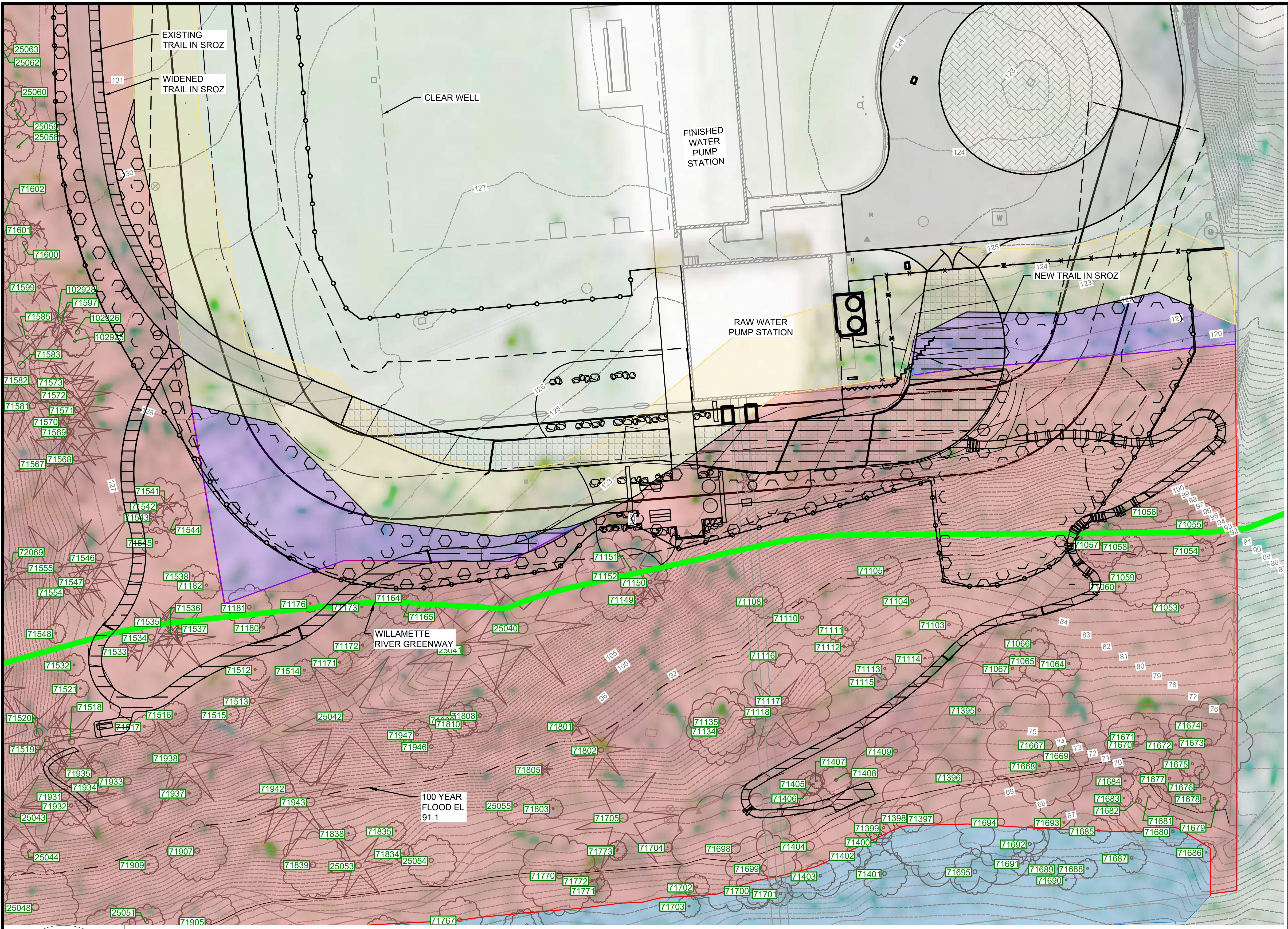
SIGNIFICANT RESOURCE IMPACT REPORT

FINAL CONDITIONS OVERVIEW (ABOVE GROUND FEATURES)

SHEET	9
DWG	F4-0
DATE	11/5/19
PROJ	196999

FILENAME: RWF_1.0 GEG-03.DWG PLOT DATE AND TIME: 11/5/2019 3:44:51 PM

DWG FILE: C:\pw_working\bvw_americas\WWSP\SHEET SETS\GENERAL (GE)\RWF_1.0 GEG-03.dwg PLOT DATE: Tuesday, November 5, 2019 3:44:51 PM BY: MCCARTY, SUSAN M



1 PLAN

LEGEND

🟪	SROZ - AREA OF LIMITED CONFLICTING USE
🟥	SROZ - METRO TITLE III
🟨	SR IMPACT AREA
🟦	STREAM
🟩	WETLAND
▤	PERMANENT LOSS OF SROZ (SEE F4-0 FOR ACREAGE)
▨	RESTORED SROZ (SEE F4-0 FOR ACREAGE)
XXXX ⊙	TREE (PROTECT)

RIVER BANK AREA PLANTING PLAN

TREES:

BIGLEAF MAPLE (ACER MACROPHYLLUM)
CASCARA (RHAMNUS PURSHIANA)
DOUGLAS FIR (PSEUDOTSUGA MENZIESII)
GRAND FIR (ABIES GRANDIS)
PACIFIC DOGWOOD (CORNUS NUTTALLI)
RED ALDER (ALNUS RUBRA)
WESTERN HEMLOCK (TSUGA HETEROPHYLLA)
WESTERN REDCEDAR (THUJA PLICATA)

LARGE SHRUBS:

BLUE ELDERBERRY (SAMBUCUS CERULEA)
RED FLOWERING CURRANT (RIBES SANGUINEUM)
THIMBLEBERRY (RUBUS PARVIFLORUS)
VINE MAPLE (ACER CIRCINATUM)
WESTERN SERVICEBERRY (AMELANCHIER ALINFOLIA)

MEDIUM AND SMALL SHRUBS:

BALDHIP ROSE (ROSA GYMNOCARPA)
CREEPING OREGON GRAPE (MAHONIA REPENS)
DWARF OREGON GRAPE (MAHONIA NERVOSA)
EVERGREEN HUCKLEBERRY (VACCINIUM OVATUM)
INDIAN PLUM (OEMLERIA CERAIFORMIS)
NOOKTA ROSE (ROSA NUTKANA)
RED HUCKLEBERRY (VACCINIUM PARVIFLORUM)
SALAL (GAULTHERIA SHALLON)
SNOWBERRY (SYMPHORICARPOS ALBA)
SWORD FERN (POLYSTICHUM MUNITUM)
TALL OREGON GRAPE (MAHONIA AQUIFOLIUM)

0 20 40
SCALE IN FEET

Oregon811
UTILITY NOTIFICATION CENTER

BY: COGLIANESE, CHRISTOPHER J.   PLOT DATE: Tuesday, November 5, 2019 3:58:20 PM   DWG FILE: C:\pw_working\bvw_americas\WWSP\SHEET SETS\SEISMIC MODIFICATIONS (SM)\RWF_1.0 SMC-01.dwg

DSGN M. CARLSON						
DR C.J. COGLIANESE						
CHK P. KNEITZ						
APVD J. MCMULLEN	NO.	DATE	REVISION	BY	APVD	

VERIFY SCALE
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0 1"
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RWF_1.0

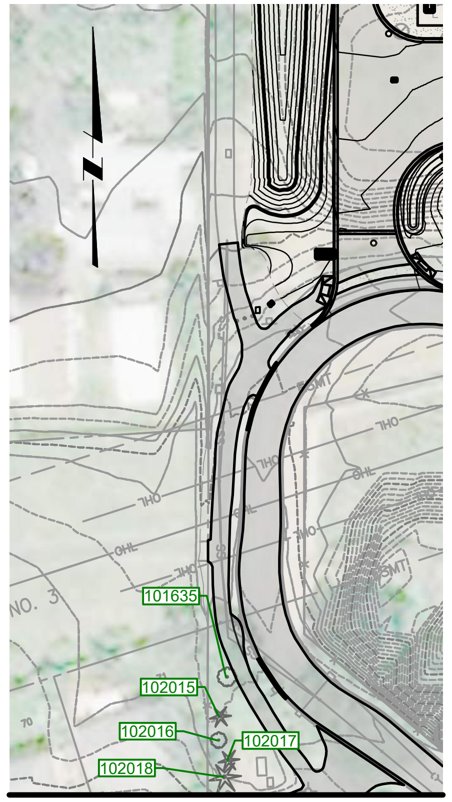
SIGNIFICANT RESOURCE IMPACT REPORT
FINAL CONDITIONS
RIVER BANK
(ABOVE GROUND FEATURES)

SHEET	10
DWG	F4-1
DATE	11/5/19
PROJ	196999

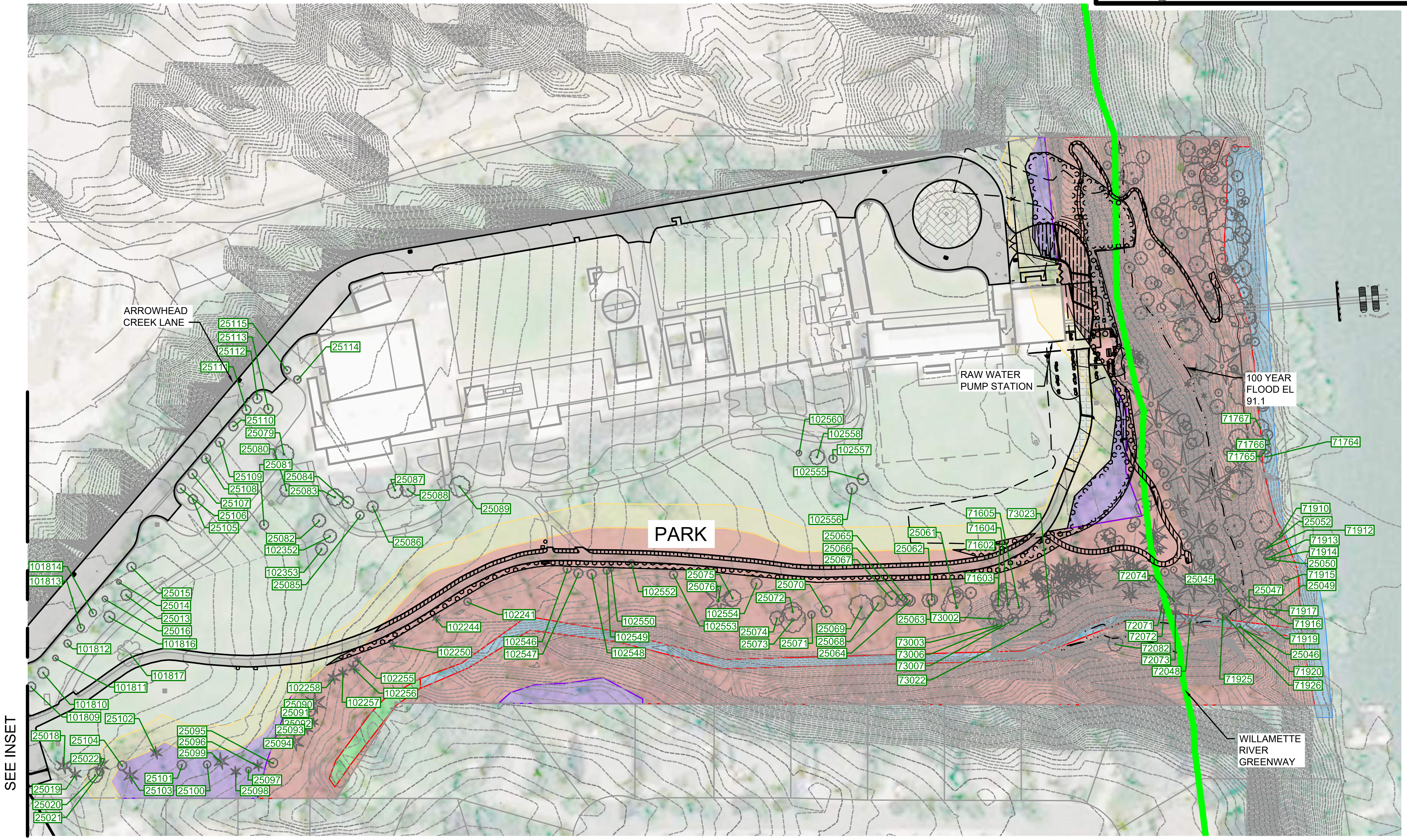
FILENAME: RWF_1.0 SMC-01.DWG   PLOT DATE AND TIME: 11/5/2019 3:58:19 PM

LEGEND

🟪	SROZ - AREA OF LIMITED CONFLICTING USE
🟥	SROZ - METRO TITLE III
🟨	SR IMPACT AREA
🟦	STREAM
🟩	WETLAND
▭	PERMANENT LOSS OF SROZ (SEE F4-0 FOR ACREAGE)
▭	RESTORED SROZ (SEE F4-0 FOR ACREAGE)
XXXX ○	TREE (PROTECT)



SEE OVERALL PLAN
INSET



OVERALL PLAN

DSGN M. CARLSON						VERIFY SCALE	
DR C.J. COGLIANESE						BAR IS ONE INCH ON ORIGINAL DRAWING. 0 ▬ 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.	
CHK P. KNEITZ							
APVD J. MCMULLEN	NO.	DATE	REVISION	BY	APVD		

BLACK & VEATCH

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RWF_1.0

PRELIMINARY, SUBJECT TO CHANGE

SRIR FIGURES (NOT FOR CONSTRUCTION)

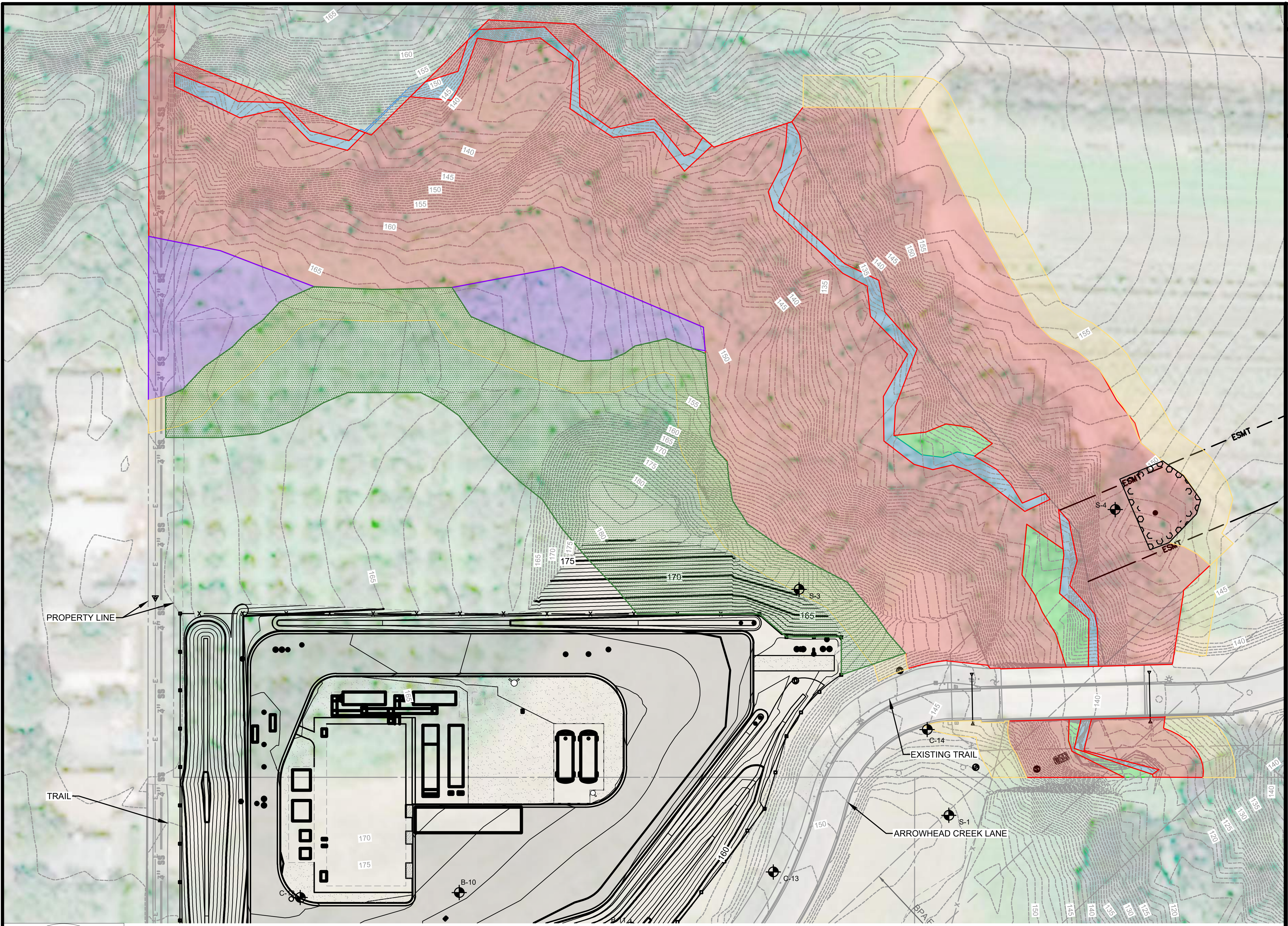
SIGNIFICANT RESOURCE IMPACT REPORT
FINAL CONDITIONS
PARK
(ABOVE GROUND FEATURES)

SHEET	11
DWG	F4-2
DATE	11/5/19
PROJ	196999

FILENAME: RWF_1.0 GEG-03.DWG PLOT DATE AND TIME: 11/5/2019 7:56:50 AM

DWG FILE: C:\pw_working\bvw_americas\WWSP\SHEET SETS\GENERAL (GE)\RWF_1.0 GEG-03.dwg PLOT DATE: Tuesday, November 5, 2019 7:56:50 AM BY: COGLIANESE, CHRISTOPHER J.

DWG FILE: C:\pw_working\bvw_americas\WWSP\SHEET SETS\UPPER SITE POWER BUILDING (US)\RWF_1.0 USC-03.dwg   PLOT DATE: Tuesday, November 5, 2019 3:11:39 PM   BY: MCCARTY, SUSAN M



LEGEND

- ▨ SROZ - AREA OF LIMITED CONFLICTING USE
- 🟥 SROZ - METRO TITLE III
- ▨ SR IMPACT AREA
- ▨ STREAM
- 🟩 WETLAND
- ▨ RESTORED SROZ (SEE F4-0 FOR ACREAGE)
- XXXX ⊙ TREE (PROTECT)

MITIGATION ZONE PLANTING PLAN

TREES:

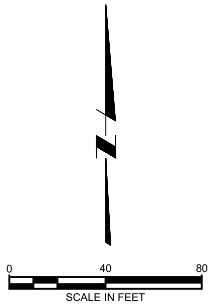
BIGLEAF MAPLE (ACER MACROPHYLLUM)
CASCARA (RHAMNUS PURSHIANA)
DOUGLAS FIR (PSEUDOTSUGA MENZIESII)
OREGON OAK (QUERCUS GARRYANA)
PACIFIC DOGWOOD (CORNUS NUTTALLI)

LARGE SHRUBS:

BLUE ELDERBERRY (SAMBUCUS CERULEA)
RED FLOWERING CURRANT (RIBES SANGUINEUM)
THIMBLEBERRY (RUBUS PARVIFLORUS)
VINE MAPLE (ACER CIRCINATUM)
WESTERN SERVICEBEDRRY (AMELANCHIER ALINFOLIA)

MEDIUM AND SMALL SHRUBS:

BALDHIP ROSE (ROSA GYMNOCARPA)
DWARF OREGON GRAPE (MAHONIA NERVOSA)
EVERGREEN HUCKLEBERRY (VACCINIUM OVATUM)
INDIAN PLUM (OEMLERIA CERAIFORMIS)
NOOKTA ROSE (ROSA NUTKANA)
RED HUCKLEBERRY (VACCINIUM PARVIFLORUM)
SALAL (GAULTHERIA SHALLON)
SNOWBERRY (SYMPHORICARPOS ALBA)
SWORD FERN (POLYSTICHUM MUNITUM)
TALL OREGON GRAPE (MAHONIA AQUIFOLIUM)



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UTILITY NOTIFICATION CENTER

DSGN	M. CARLSON					
DR	C.J. COGLIANESE					
CHK	P. KNEITZ					
APVD	J. MCMULLEN	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
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BLACK & VEATCH

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RWF_1.0

PRELIMINARY, SUBJECT TO CHANGE

SRIR FIGURES
(NOT FOR CONSTRUCTION)

SIGNIFICANT RESOURCE IMPACT REPORT
FINAL CONDITIONS
UPPER SITE
(ABOVE GRADE FEATURES)

SHEET	12
DWG	F4-3
DATE	11/5/19
PROJ	196999

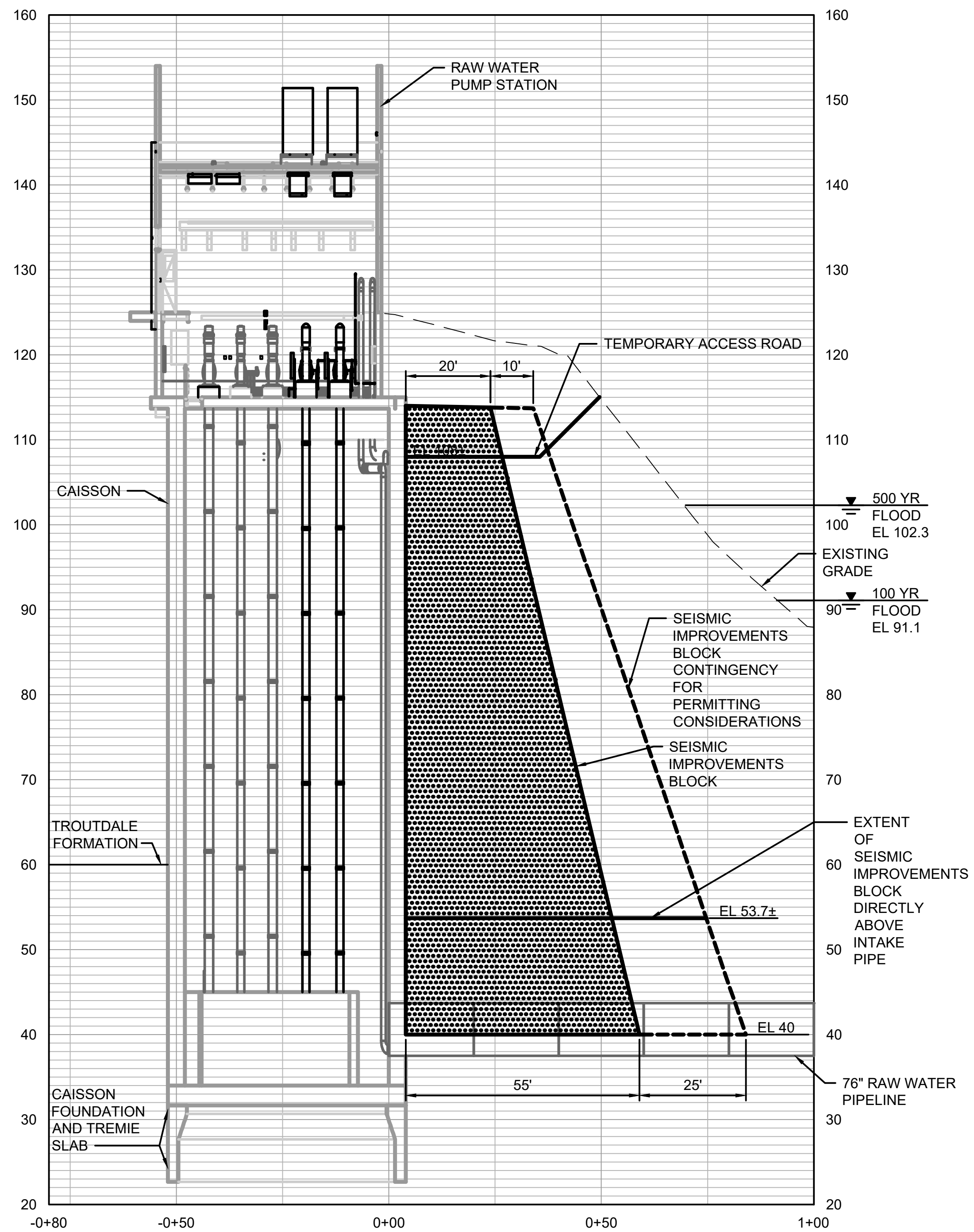
FILENAME: RWF_1.0 USC-03.DWG   PLOT DATE AND TIME: 11/5/2019 3:11:39 PM

GENERAL SHEET NOTES

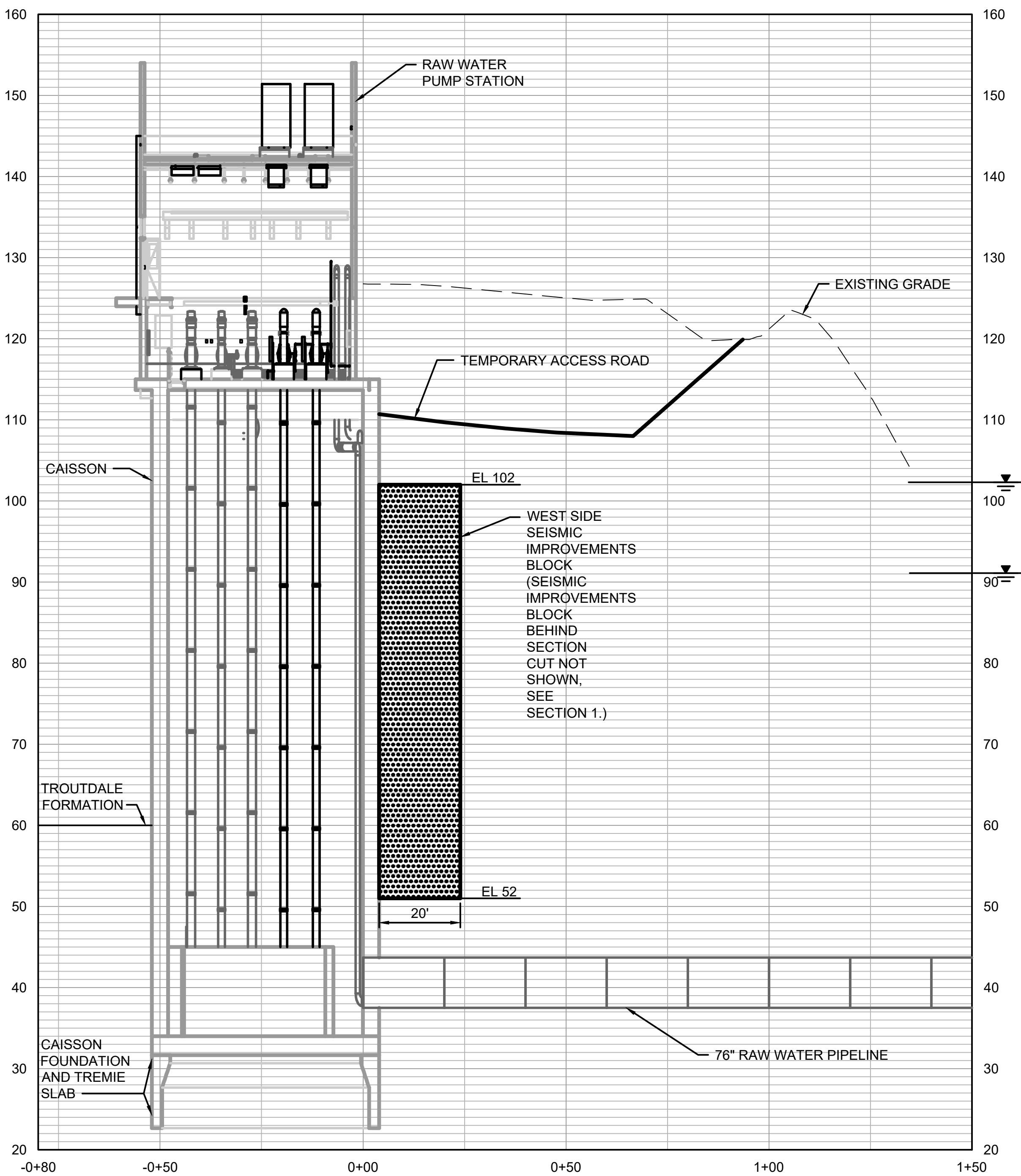
1. ALL ELEVATIONS ARE SHOWN IN NAVD 29.
2. NO OCCUPIED FACILITIES ARE CONSTRUCTED WITHIN THE 100 YEAR OR 500 YEAR FLOOD ZONE.
3. NO WORK RELATED TO THIS PROJECT IMPACTS THE 100 YEAR FLOOD PLAIN.

⎔ SHEET KEYNOTES

LEGEND



1 SECTION
F4-1



2 SECTION
F4-1

HORZ 0 20 40
VERT 0 10 20
SCALE IN FEET

UTILITY NOTIFICATION CENTER

DSGN	M. CARLSON					
DR	C.J. COGLIANESE					
CHK	P. KNEITZ					
APVD	J. MCMULLEN	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

BLACK & VEATCH

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WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

PRELIMINARY, SUBJECT TO CHANGE

SRIR FIGURES
(NOT FOR CONSTRUCTION)

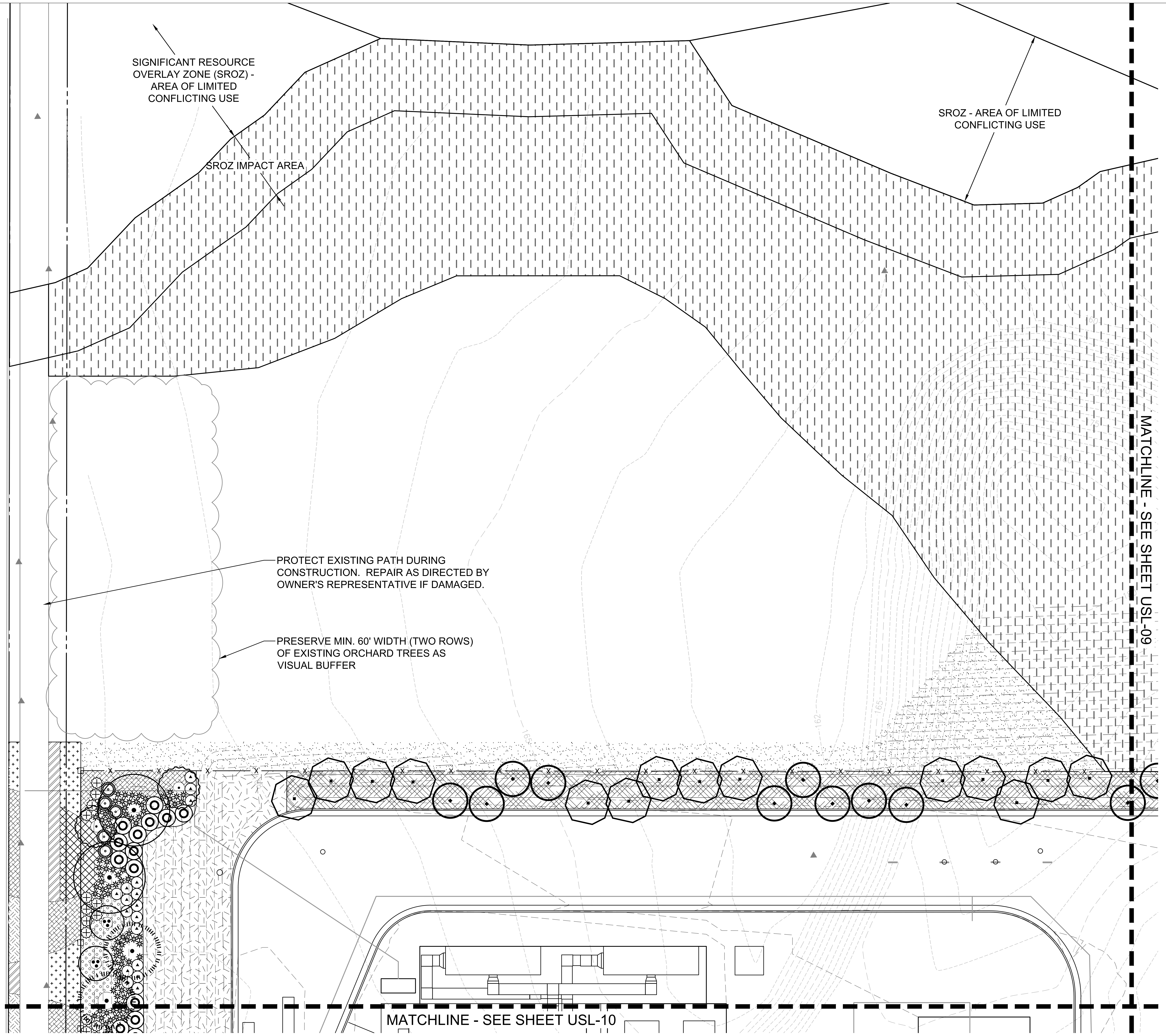
SIGNIFICANT RESOURCE IMPACT REPORT
WILLAMETE RIVER CROSS SECTION

SHEET	13
DWG	F5-0
DATE	07/12/19
PROJ	196999

FILENAME: RWF_1.0 SMC-05.DWG
PLOT DATE AND TIME: 7/10/2019 2:34:40 PM

DWG FILE: C:\pw_working\bvw_americas\WWSP\SHEET SETS\SEISMIC MODIFICATIONS (SM)\RWF_1.0 SMC-05.dwg
PLOT DATE: Wednesday, July 10, 2019 2:34:40 PM
BY: COGLIANESE, CHRISTOPHER J.

NOTE: SEE SHEET USL-12 FOR UPPER SITE PLANTING LEGEND AND NOTES; SEE SHEET USL-13 FOR PLANTING DETAILS



1 PLAN

0 20 40

SCALE: 1" = 20'-0"

DSGN	A. HOLDER				
DR	A. HOLDER				
CHK	D. WALTERS				
APVD	M. FAHA	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GREENWORKS

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Willamette Water Supply
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WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

90% DESIGN
(NOT FOR CONSTRUCTION)

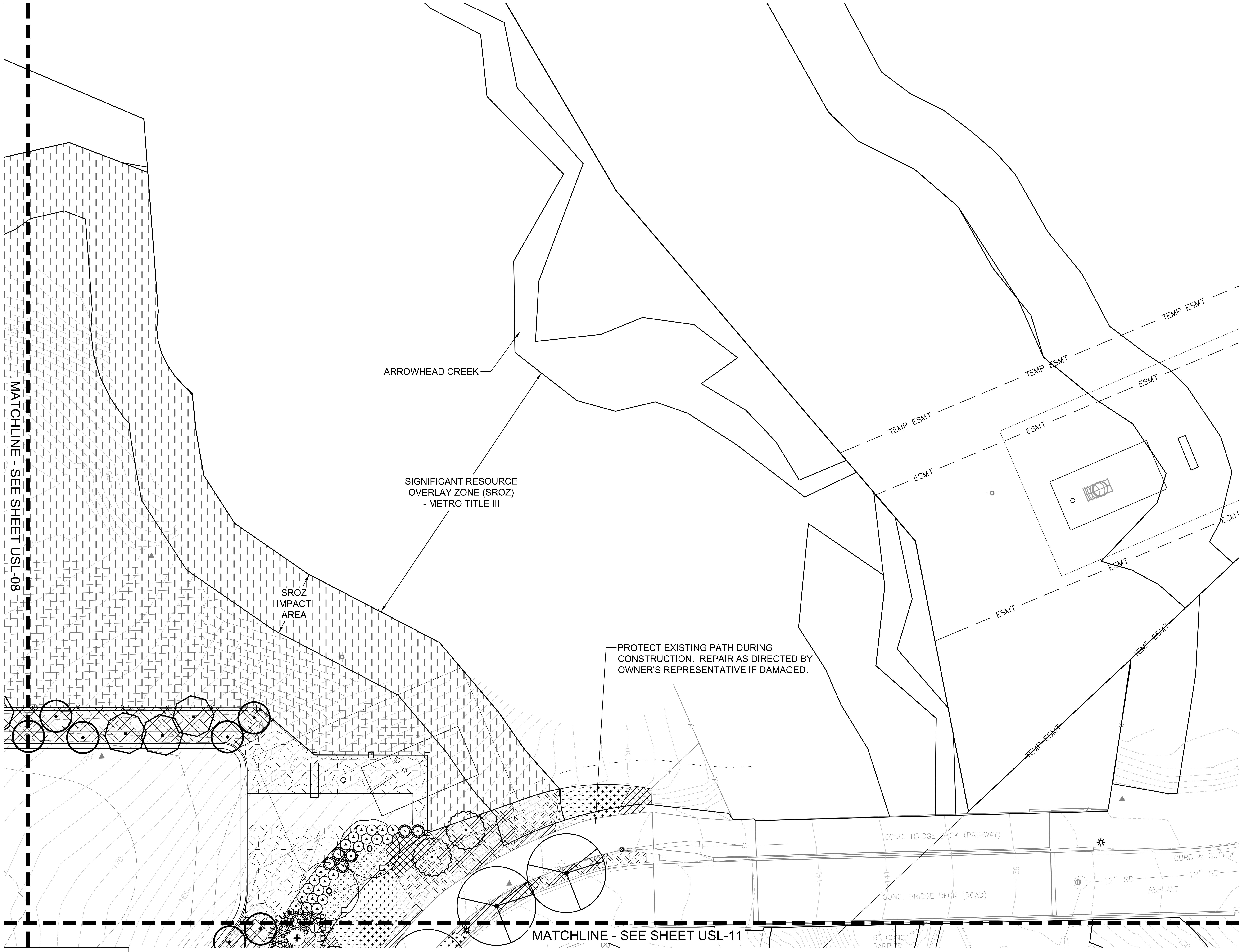
LANDSCAPE
UPPER SITE ELECTRICAL BUILDING
PLANTING PLAN 1

SHEET 191
DWG USL-08
DATE 09/10/19
PROJ 196999

FILENAME: 17111_PLNT.DWG

PLOT DATE AND TIME: 9/5/2019 7:20:10 PM

NOTE: SEE SHEET USL-12 FOR UPPER SITE PLANTING LEGEND AND NOTES; SEE SHEET USL-13 FOR PLANTING DETAILS



1 PLAN

0 20 40
SCALE: 1" = 20'-0"

DSGN A. HOLDER
DR A. HOLDER
CHK D. WALTERS
APVD M. FAHA

NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GREENWORKS

SAFELY DELIVERED

Willamette Water Supply
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WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

90% DESIGN
(NOT FOR CONSTRUCTION)

LANDSCAPE
UPPER SITE ELECTRICAL BUILDING
PLANTING PLAN 2

SHEET 192
DWG USL-09
DATE 09/10/19
PROJ 196999

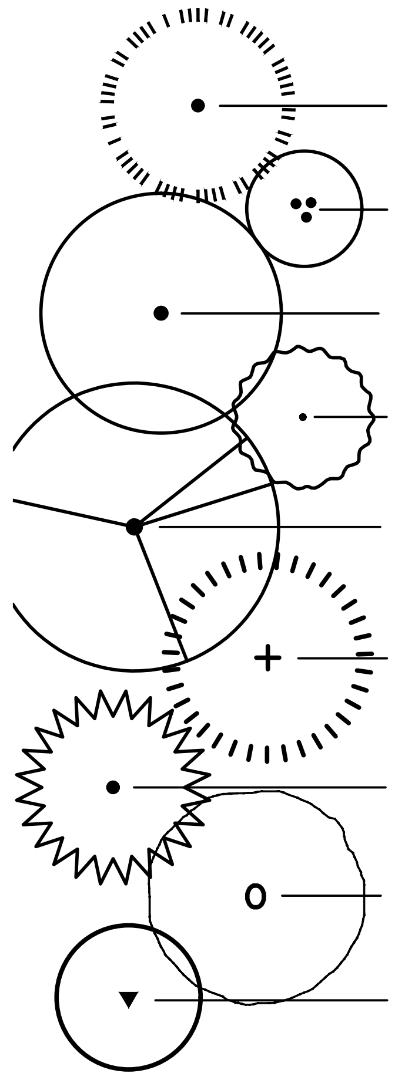
FILENAME: 17111_PLNT.DWG
PLOT DATE AND TIME: 9/5/2019 7:20:22 PM

UPPER SITE PLANTING LEGEND

EXISTING TREES TO BE PRESERVED

TREES

4 USL-13 | 5 USL-13 | 6 USL-13 | 7 USL-13



BOTANICAL NAME	COMMON NAME	SIZE & TYPE	SPACING	QTY.
ABIES GRANDIS	GRAND FIR	4'-6' HT., B&B	AS SHOWN	8
ACER CIRCINATUM	VINE MAPLE	4'-6' HT., B&B	AS SHOWN	8
ACER MACROPHYLLUM	BIGLEAF MAPLE	1.5" CAL., B&B	AS SHOWN	9
CORNUS NUTTALLI	PACIFIC DOGWOOD	1.5" CAL., B&B	AS SHOWN	14
OSTRYA VIRGINIANA	AMERICAN HOPHORNBEAM	2.5" CAL., B&B	AS SHOWN	27
PINUS PONDEROSA 'WILLAMETTENSIS'	WILLAMETTE VALLEY PONDEROSA PINE	4'-6' HT., B&B	AS SHOWN	10
PSEUDOTSUGA MENZIESII	DOUGLAS FIR	4'-6' HT., B&B	AS SHOWN	9
QUERCUS GARRYANA	OREGON WHITE OAK	1.5" CAL., B&B	AS SHOWN	8
RHAMNUS PURSHIANA	CASCARA	1.5" CAL., B&B	AS SHOWN	9

STORMWATER SWALE TREES

4 USL-13 | 5 USL-13

BOTANICAL NAME	COMMON NAME	SIZE & TYPE	SPACING	QTY.
ALNUS RUBRA	RED ALDER	1" CAL., B&B	AS SHOWN	36
MALUS FUSCA	PACIFIC CRABAPPLE	1" CAL., B&B	AS SHOWN	33

STORMWATER SWALE PLANTING

1 USL-13 | 2 USL-13 | 3 USL-13

BOTANICAL NAME	COMMON NAME	SIZE & TYPE	SPACING	QTY.
ZONE A - BELOW HIGH WATER MARK:				
CAMASSIA QUAMASH	COMMON CAMAS	4" CONT.	12" O.C.	600
CAREX OBNUPTA	SLOUGH SEDGE	4" CONT.	12" O.C.	1512
JUNCUS PATENS	SPREADING RUSH	4" CONT.	12" O.C.	1512
SPIRAEA BETULIFOLIA	BIRCH-LEAF SPIREA	1 GAL. CONT.	2.5' O.C	60
SPIRAEA DOUGLASII	DOUGLAS SPIREA	2 GAL. CONT.	5' O.C	101
SYMPHORICARPOS ALBUS	COMMON SNOWBERRY	1 GAL. CONT.	3' O.C	74
ZONE B - ABOVE HIGH WATER MARK:				
DESCHAMPSIA CAESPITOSA	TUFTED HAIRGRASS	4" CONT.	12" O.C.	3932
ELYMUS GLAUCUS	BLUE WILDRYE	4" CONT.	12" O.C.	3933
POLYSTICHUM MUNITUM	SWORD FERN	1 GAL. CONT.	2.5' O.C	137
RIBES SANGUINEUM	RED-FLOWERING CURRANT	2 GAL. CONT.	5' O.C	205
SYMPHORICARPOS ALBUS	COMMON SNOWBERRY	1 GAL. CONT.	3' O.C	137

SHRUBS AND HERBACEOUS

1 USL-13 | 2 USL-13 | 3 USL-13

	BOTANICAL NAME	COMMON NAME	SIZE & TYPE	SPACING	QTY.
▨	CORNUS SERICEA 'KELSEYI'	KELSEY DOGWOOD	1 GAL. CONT.	2' O.C.	858
◎	CORYLUS CORNUTA VAR. CALIFORNICA	WESTERN HAZEL	2 GAL. CONT.	6' O.C	71
▦	DESCHAMPSIA CAESPITOSA	TUFTED HAIRGRASS	1 GAL. CONT.	2' O.C	2,265
⊙	MAHONIA AQUIFOLIUM	TALL OREGON GRAPE	2 GAL. CONT.	4' O.C	142
▩	MAHONIA REPENS	CREEPING OREGON GRAPE	1 GAL. CONT.	2' O.C	5,615
⊕	PHILADELPHUS LEWISII 'BLIZZARD'	BLIZZARD MOCK ORANGE	2 GAL. CONT.	4' O.C	127
✲	POLYSTICHUM MUNITUM	SWORD FERN	1 GAL. CONT.	2.5' O.C	577
◉	RIBES SANGUINEUM 'KING EDWARD VII'	KING EDWARD VII RED-FLOWERING CURRANT	2 GAL. CONT.	5' O.C	91
▧	SEDUM 'AUTUMN JOY'	AUTUMN JOY SEDUM	1 GAL. CONT.	18" O.C	1,487
▩	SPIRAEA BETULIFOLIA VAR. LUCIDA	BIRCH-LEAF SPIREA	1 GAL. CONT.	2.5' O.C	824
▤	SYMPHORICARPOS ALBUS	COMMON SNOWBERRY	1 GAL. CONT.	3' O.C	458

OTHER GROUNDCOVER

SEEDED FINISH LAWN
(IRRIGATED)

SEEDED FIELD GRASS
ON ALL REMAINING AREAS DISTURBED BY CONSTRUCTION
(NON-IRRIGATED)

BARK MULCH ONLY
PROVIDE 3" DEPTH (PROVIDE EROSION CONTROL NETTING
BELOW MULCH ON SLOPES STEEPER THAN 3:1)

UPPER SITE RESTORATION PLANTING MIX

BOTANICAL NAME	COMMON NAME	SIZE & TYPE	SPACING	QTY.
TREES (4 USL-13, 5 USL-13, 6 USL-13, 7 USL-13)				
ACER MACROPHYLLUM	BIGLEAF MAPLE	1" CAL., B&B	30'	23
ALNUS RUBRA	RED ALDER	1" CAL., B&B	20'	16
CORNUS NUTTALLI	PACIFIC DOGWOOD	1" CAL., B&B	20'	18
PINUS PONDEROSA 'WILLAMETTENSIS'	WILLAMETTE VALLEY PONDEROSA PINE	3'-4' HT., B&B	25'	24
PRUNUS EMARGINATA	BITTER CHERRY	1" CAL., B&B	20'	19
PSEUDOTSUGA MENZIESII	DOUGLAS FIR	3'-4' HT., B&B	25'	23
RHAMNUS PURSHIANA	CASCARA	1" CAL., B&B	20'	18
LARGE SHRUBS (1 USL-13, 2 USL-13, 3 USL-13) INSTALL THE FOLLOWING PLANTS IN GROUPS OF 3 AND 5 - GROUPS TO BE EVENLY DISTRIBUTED THROUGHOUT PLANTING ZONE:				
ACER CIRCINATUM	VINE MAPLE	#1 CONT.	12'	55
AMELANCHIER ALNIFOLIA	WESTERN SERVICEBERRY	#1 CONT.	12'	55
CORYLUS CORNUTA V. CALIF.	WESTERN HAZEL	#1 CONT.	10'	46
RIBES SANGUINEUM	RED FLOWERING CURRANT	#1 CONT.	8'	69
RUBUS PARVIFLORUS	THIMBLEBERRY	#1 CONT.	8'	46
SAMBUCUS CERULEA	BLUE ELDERBERRY	#1 CONT.	10'	55
MEDIUM AND SMALL SHRUBS (1 USL-13, 2 USL-13, 3 USL-13) INSTALL THE FOLLOWING PLANTS IN GROUPS OF 5, 7, AND 9 - GROUPS TO BE EVENLY DISTRIBUTED THROUGHOUT PLANTING ZONE:				
GAULTHERIA SHALLON	SALAL	#1 CONT.	5'	69
MAHONIA AQUIFOLIUM	TALL OREGON GRAPE	#1 CONT.	5'	125
MAHONIA REPENS	CREEPING OREGON GRAPE	#1 CONT.	3'	92
POLYSTICHUM MUNITUM	SWORD FERN	#1 CONT.	3'	138
ROSA GYMNOCARPA	BALDHIP ROSE	#1 CONT.	5'	16
SYMPHORICARPOS ALBA	SNOWBERRY	#1 CONT.	4'	98
VACCINIUM OVATUM	EVERGREEN HUCKLEBERRY	#1 CONT.	6'	69
VACCINIUM PARVIFLORUM	RED HUCKLEBERRY	#1 CONT.	6'	55

PLANTING NOTES

1. CONTRACTOR SHALL PROVIDE PLANTING SOIL, SOIL AMENDMENTS, STORMWATER SWALE GROWING MEDIUM, AND MULCH TO THE COMPOSITION AND DEPTHS IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS OF THE CONTRACT DOCUMENTS.
2. PROVIDE 3" DEPTH ROCK MULCH IN STORMWATER SWALES, AND PROVIDE 3" DEPTH BARK MULCH IN ALL OTHER PLANTING AREAS.
3. ALL PLANTS SHALL BE INSTALLED IN ACCORDANCE WITH THE DRAWINGS AND THE SPECIFICATIONS PROVIDED AS PART OF THE CONTRACT DOCUMENTS.
4. QUANTITIES ARE LISTED FOR THE CONTRACTOR'S CONVENIENCE ONLY. ALL COUNTS MUST BE VERIFIED BY THE CONTRACTOR. IN THE CASE OF A DISCREPANCY BETWEEN THE LEGEND AND THE PLAN, PLANTS INDICATED ON THE PLAN SHALL SUPERCEDE QUANTITIES LISTED IN THE LEGEND.
5. UTILITY LOCATIONS SHOWN ON PLANS MAY DIFFER FROM FIELD CONDITIONS. CONTRACTOR TO FIELD VERIFY ALL UTILITIES BEFORE INSTALLATION. CONFLICTS BETWEEN ANY EXISTING AND PROPOSED UTILITIES ARE TO BE BROUGHT TO THE ATTENTION OF THE OWNERS' REPRESENTATIVE IMMEDIATELY.

DSGN	A. HOLDER
DR	A. HOLDER
CHK	D. WALTERS
APVD	M. FAHA

NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GREENWORKS

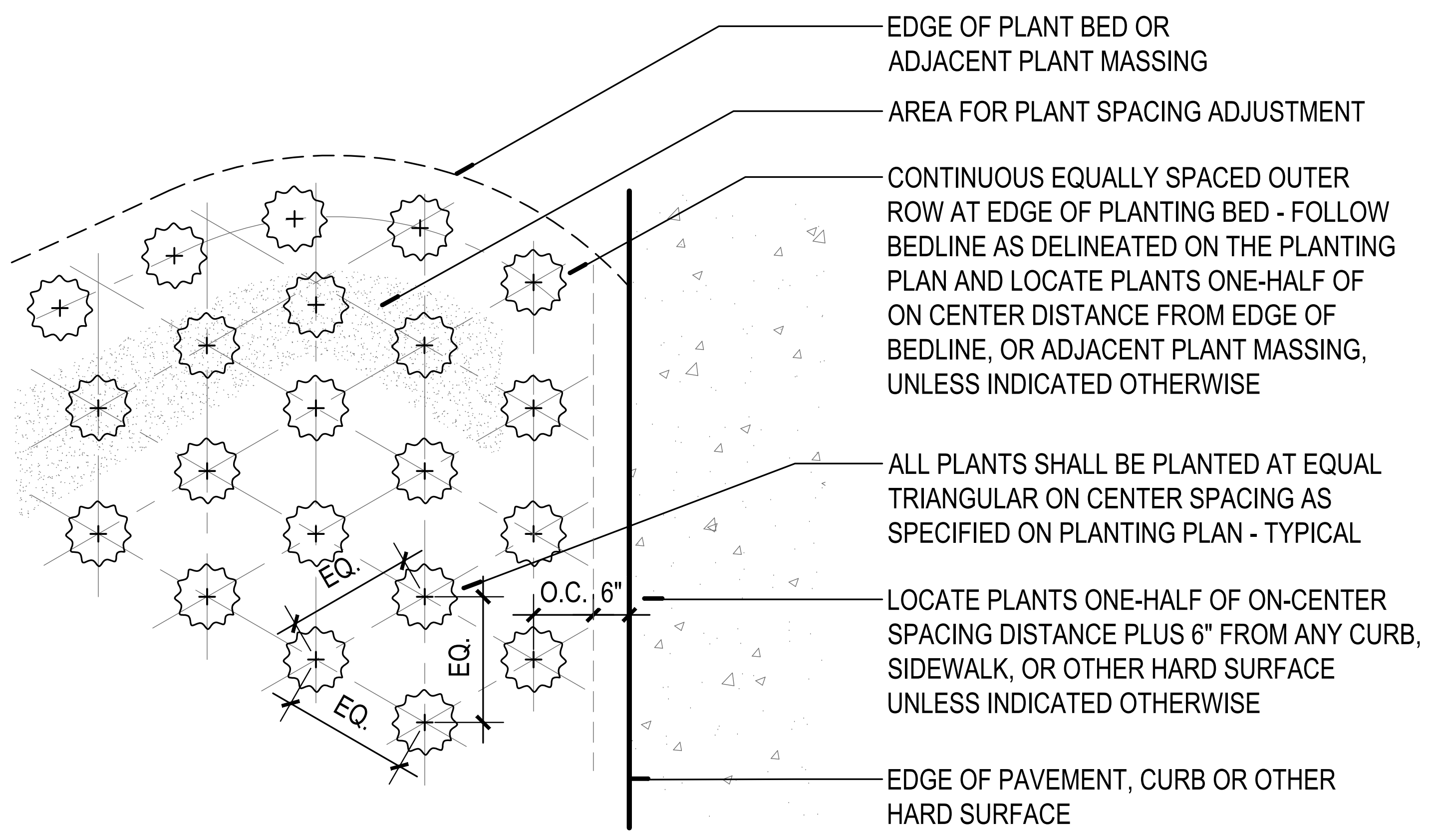
SAFELY DELIVERED
Willamette Water Supply
Our Reliable Water
WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

90% DESIGN
(NOT FOR CONSTRUCTION)

LANDSCAPE
UPPER SITE ELECTRICAL BUILDING
PLANTING LEGEND

SHEET	195
DWG	USL-12
DATE	09/10/19
PROJ	196999

FILENAME: 17111_PLNT.DWG
PLOT DATE AND TIME: 9/5/2019 7:20:55 PM

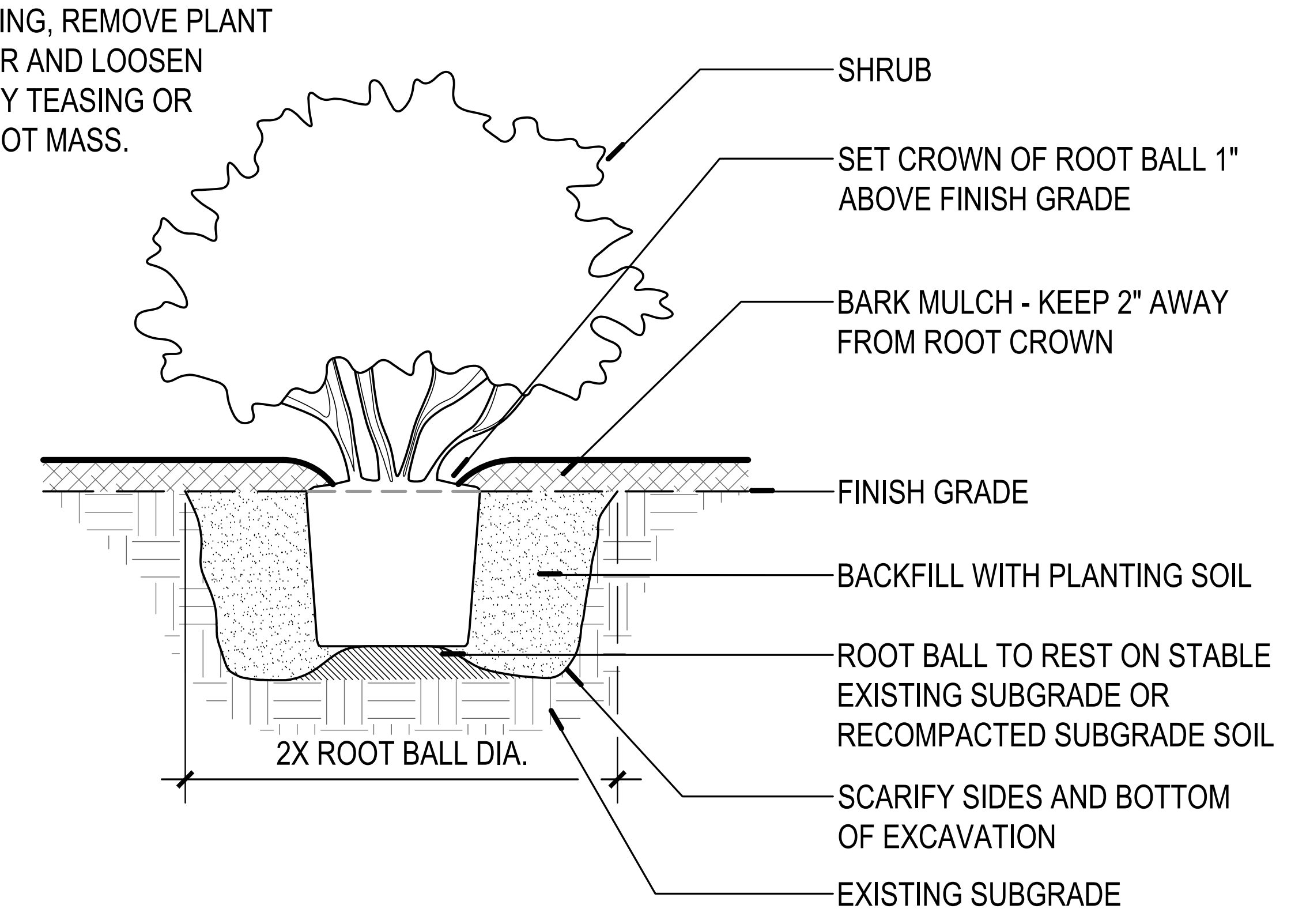


PLANT SPACING DIAGRAM

NTS

1
USL-13

NOTE:
1. PRIOR TO PLANTING, REMOVE PLANT FROM CONTAINER AND LOOSEN SIDES BY LIGHTLY TEASING OR SCRATCHING ROOT MASS.

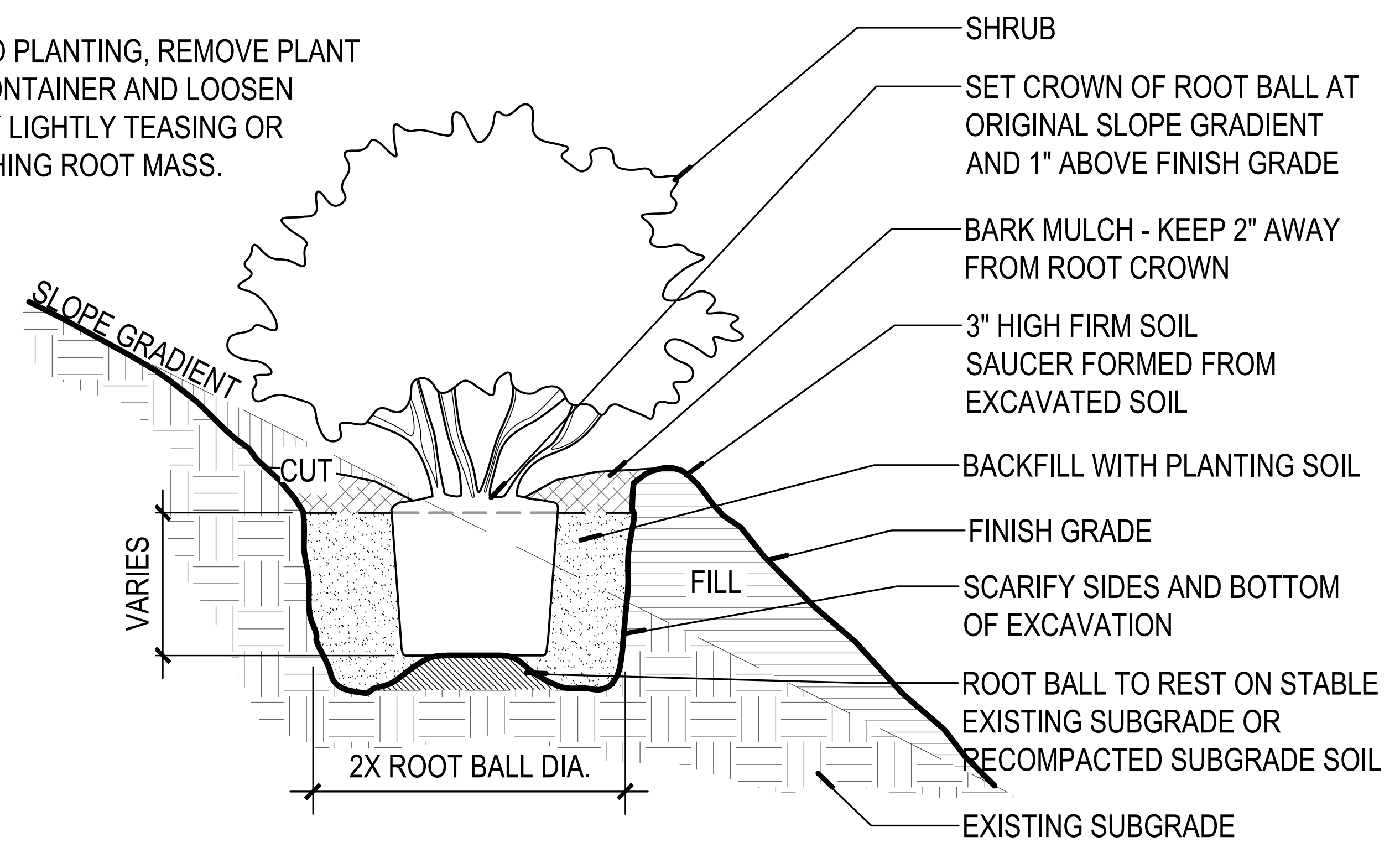


SHRUB CONTAINER PLANTING

NTS

2
USL-13

NOTE:
1. PRIOR TO PLANTING, REMOVE PLANT FROM CONTAINER AND LOOSEN SIDES BY LIGHTLY TEASING OR SCRATCHING ROOT MASS.



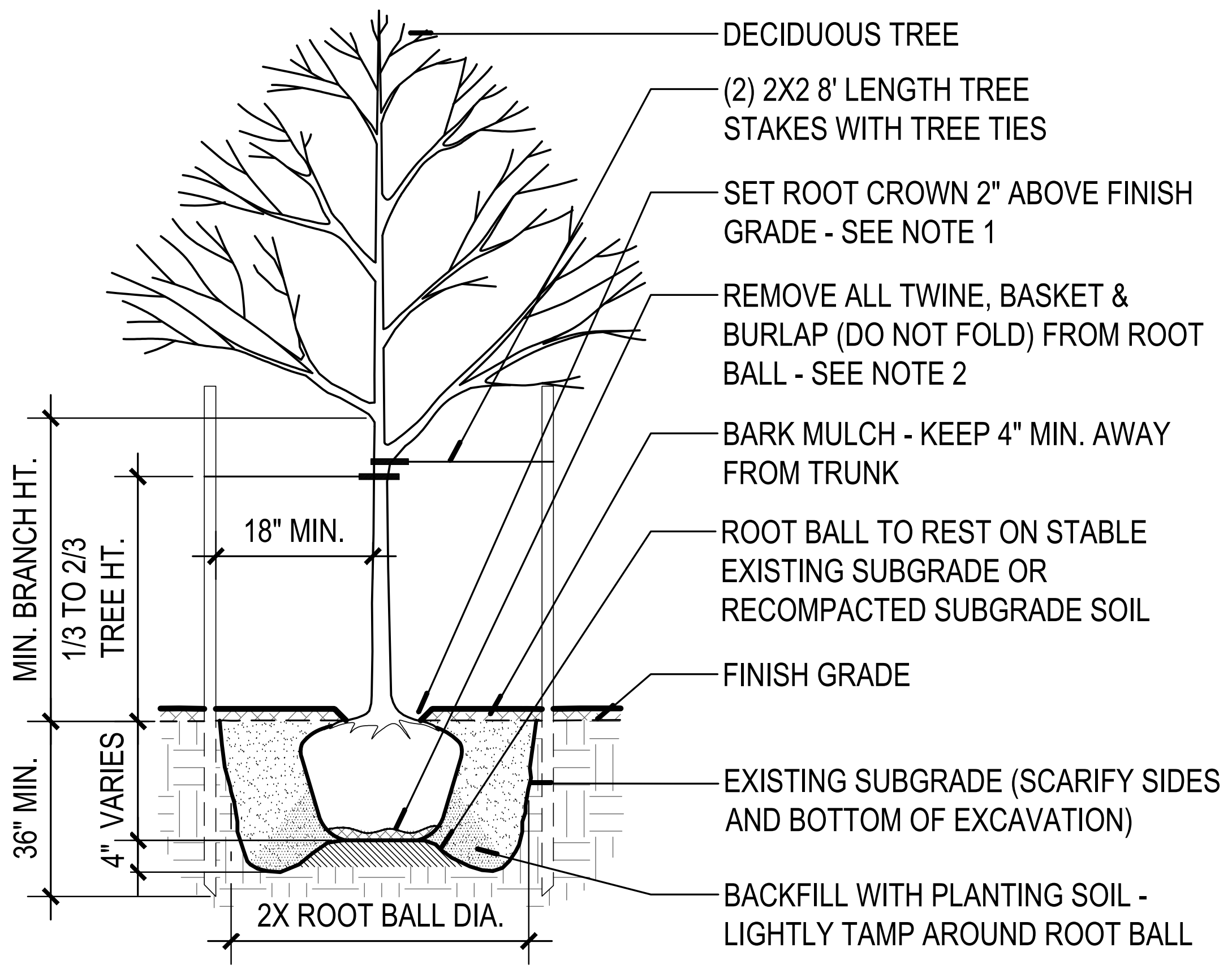
SHRUB CONTAINER PLANTING ON SLOPE

NTS

3
USL-13

NOTES:
1. ROOT CROWN TO BE VISIBLE BEFORE TREE IS SET. REMOVE TOP OF ROOT BALL MEDIA TO LOCATE IF NEEDED.

2. BURLAP, TWINE, & METAL BASKET TO BE CUT AND REMOVED ENTIRELY DOWN TO BASE OF ROOT BALL AFTER TREE IS SET (MATERIAL ON BOTTOM CAN REMAIN). IF ROOT BALL IS UNSTABLE OR BREAKING, ONLY REMOVE THE TOP 12" OF BURLAP.



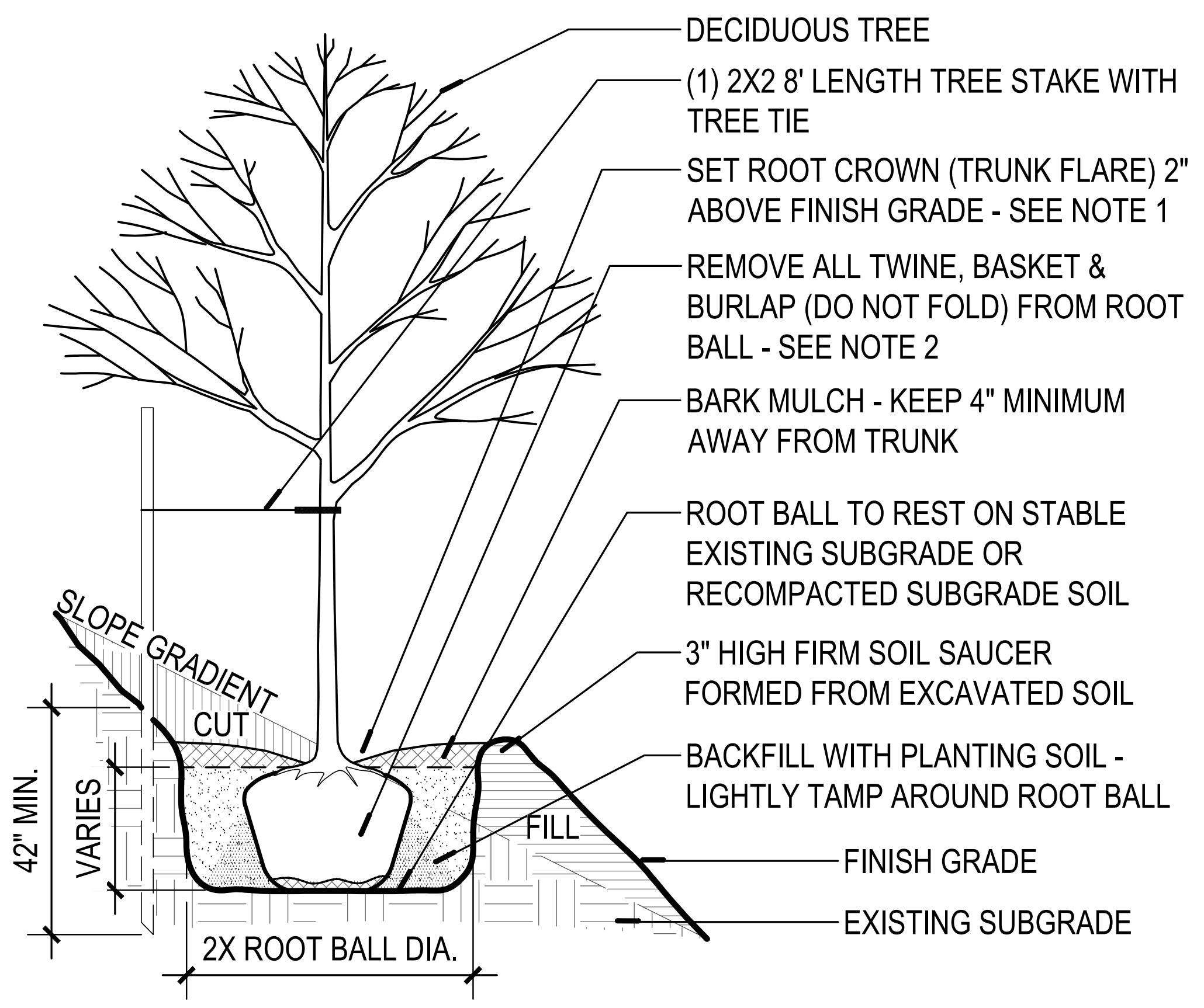
DECIDUOUS TREE PLANTING

NTS

4
USL-13

NOTES:
1. ROOT CROWN TO BE VISIBLE BEFORE TREE IS SET. REMOVE TOP OF ROOT BALL MEDIA TO LOCATE IF NEEDED.

2. BURLAP, TWINE, & METAL BASKET TO BE CUT AND REMOVED ENTIRELY DOWN TO BASE OF ROOT BALL AFTER TREE IS SET (MATERIAL ON BOTTOM CAN REMAIN). IF ROOT BALL IS UNSTABLE OR BREAKING, ONLY REMOVE THE TOP 12" OF BURLAP.



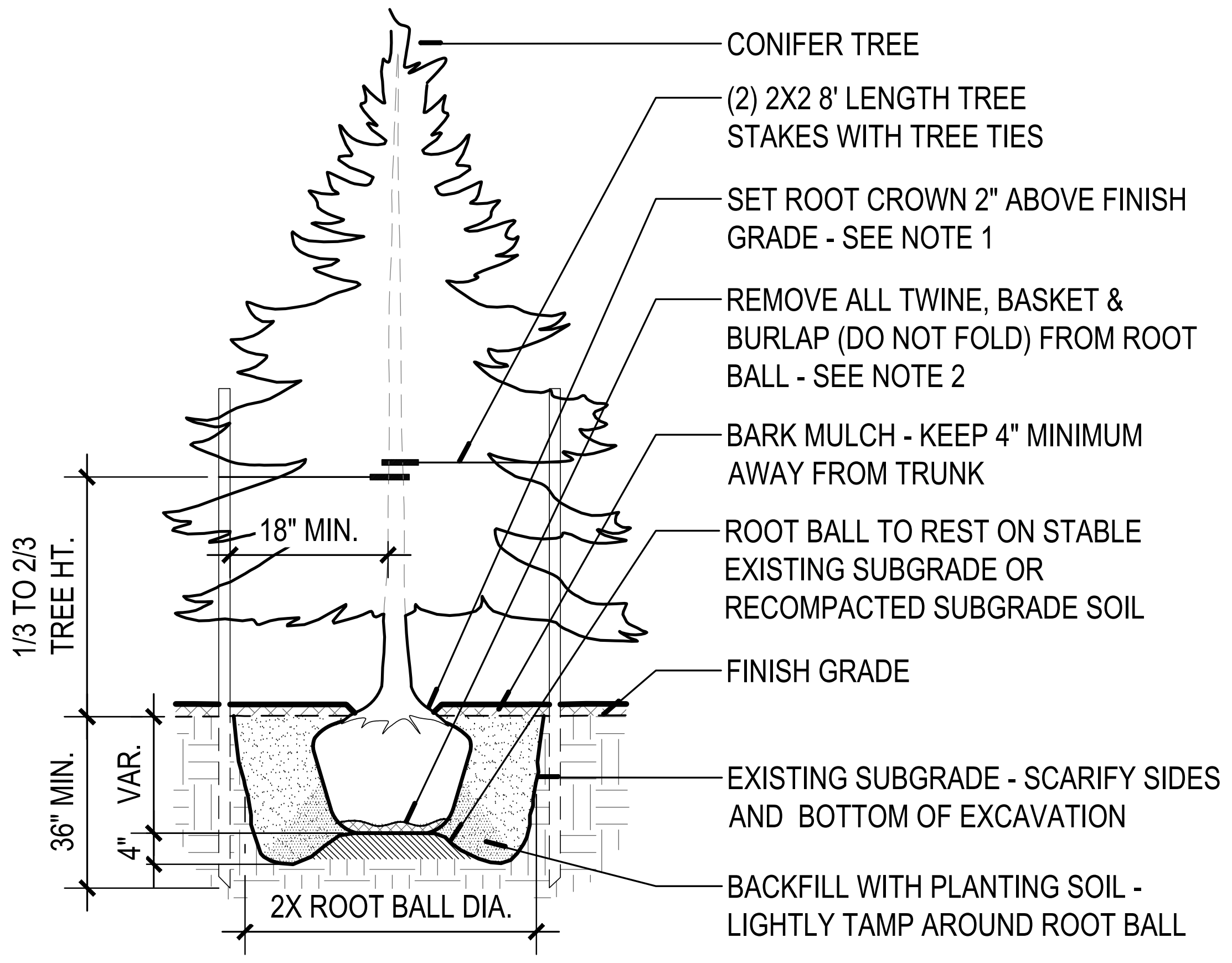
DECIDUOUS TREE PLANTING ON SLOPE

NTS

5
USL-13

NOTES:
1. ROOT CROWN TO BE VISIBLE BEFORE TREE IS SET. REMOVE TOP OF ROOT BALL MEDIA TO LOCATE IF NEEDED.

2. BURLAP, TWINE, & METAL BASKET TO BE CUT AND REMOVED ENTIRELY DOWN TO BASE OF ROOT BALL AFTER TREE IS SET (MATERIAL ON BOTTOM CAN REMAIN). IF ROOT BALL IS UNSTABLE OR BREAKING, ONLY REMOVE THE TOP 12" OF BURLAP.



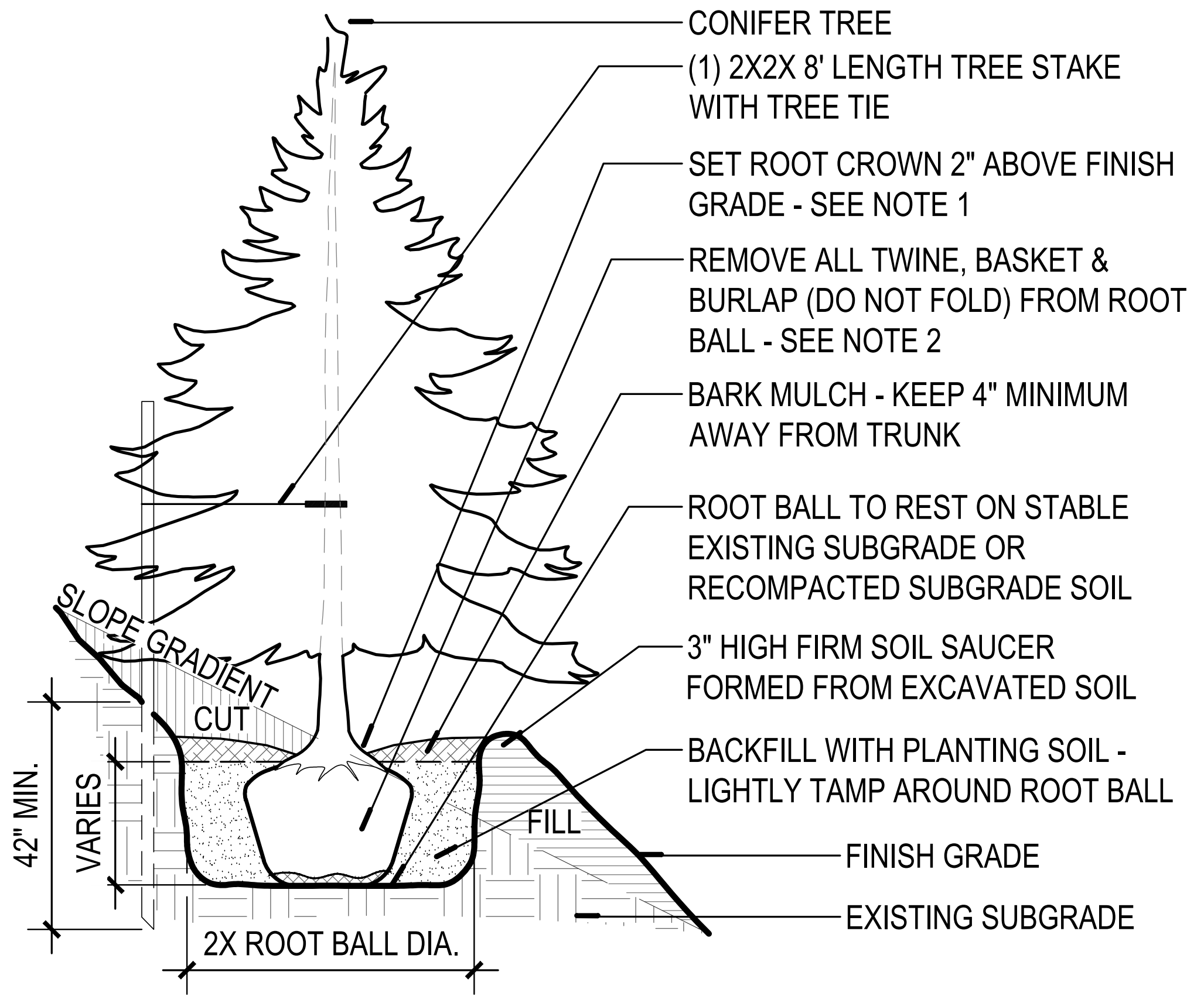
CONIFER TREE PLANTING

NTS

6
USL-13

NOTES:
1. ROOT CROWN TO BE VISIBLE BEFORE TREE IS SET. REMOVE TOP OF ROOT BALL MEDIA TO LOCATE IF NEEDED.

2. BURLAP, TWINE, & METAL BASKET TO BE CUT AND REMOVED ENTIRELY DOWN TO BASE OF ROOT BALL AFTER TREE IS SET (MATERIAL ON BOTTOM CAN REMAIN). IF ROOT BALL IS UNSTABLE OR BREAKING, ONLY REMOVE THE TOP 12" OF BURLAP.



CONIFER TREE PLANTING ON SLOPE

NTS

7
USL-13

DSGN A. HOLDER
DR K. STOCKLEIN
CHK D. WALTERS
APVD M. FAHA

NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GREENWORKS

SAFELY DELIVERED

Willamette Water Supply
Our Reliable Water
WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

90% DESIGN
(NOT FOR CONSTRUCTION)

LANDSCAPE
UPPER SITE ELECTRICAL BUILDING
PLANTING DETAILS

SHEET 196
DWG USL-13
DATE 09/10/19
PROJ 196999

FILENAME: 17111_DETAILS_PLNT.DWG PLOT DATE AND TIME: 9/5/2019 7:21:04 PM

APPENDIX B: SROZ Memo and City Preliminary Concurrence

From:	Rappold, Kerry <rappold@ci.wilsonville.or.us>
Sent:	Wednesday, March 9, 2016 10:30 AM
To:	Ethan Rosenthal
Cc:	Jennifer Miller; Jude Grounds (JGrounds@carollo.com); Gigi Cooper
Subject:	RE: Water Treatment Plant SROZ review

Hi Ethan,

I've reviewed the revised memo and concur with the preliminary SROZ mapping (dated March 7, 2016). At this point, only a preliminary concurrence is provided. The mapping will be finalized with a future land use application.

Let me know if you have any questions.

Thanks.

Kerry Rappold
Natural Resources Program Manager
City of Wilsonville
503-570-1570
503-682-7025 (fax)
rappold@ci.wilsonville.or.us

From: Ethan Rosenthal [mailto:Ejro@deainc.com]
Sent: Monday, March 07, 2016 5:04 PM
To: Rappold, Kerry
Cc: Jennifer Miller; Jude Grounds (JGrounds@carollo.com); Gigi Cooper
Subject: RE: Water Treatment Plant SROZ review

Kerry,

Thanks for the review and comments in email below. Attached is a revised version that addresses each of your comments, with figures updated accordingly. I also provided a response to your comments in email below. Please take a look and if all looks good it would be greatly appreciated if you could provide a letter or at least an email confirmation that the City agrees with the SROZ boundaries as delineated in the memo.

Please let me know if you have questions/comments. Thanks again for your help. Regards,

-Ethan

Ethan Rosenthal | Project Manager/Ecologist
David Evans and Associates, Inc. | Water and Environment
2100 SW River Parkway | Portland, OR 97201 | www.deainc.com
d: 503.499.0572 | c: 503.805.3962 | ejro@deainc.com

From: Rappold, Kerry [mailto:rappold@ci.wilsonville.or.us]
Sent: Thursday, March 03, 2016 12:17 PM
To: Ethan Rosenthal
Cc: Jennifer Miller; Jude Grounds (JGrounds@carollo.com); Gigi Cooper
Subject: RE: Water Treatment Plant SROZ review

Hi Ethan,

As we discussed on the phone, I've reviewed the memo and the proposed SROZ mapping. I have the following comments:

1. The mapping does not need to include the APTH. The APTH is merely a tool to illustrate the different types of riparian corridors. The mapping should satisfy the minimum Title 3 requirements, and reflect the extent of the riparian corridor (i.e., top of slope) and contiguous wildlife habitat.

***Response**: Reference to APTH has been removed from the memo and is not included in the mapping.*

2. Provide documentation as to whether the delineated wetlands are deemed "locally significant." Wetlands need to be 0.5 acre in size or larger to be considered locally significant, and satisfy additional requirements found within Section 4.139.10.02 (Adding Wetlands).

***Response**: Wetland significance determination was added to the methods and results sections. Wetland acreage for each wetland was added in the results section and Figure 2. No wetlands met the 0.5 acre threshold to be considered significant.*

3. Provide a statement about the maximum area (i.e., 5%) that may be impacted by development in the ALCU. If the applicant proposes development in the ALCU, they shall demonstrate steps taken to avoid or minimize the impact.

***Response**: A statement re: maximum area (5%) and need to demonstrate impact avoidance and minimization was added to the Results/SROZ Mapping/Final Mapping section.*

Let me know if you have any questions.

Thanks.

Kerry Rappold
Natural Resources Program Manager
City of Wilsonville
503-570-1570
503-682-7025 (fax)
rappold@ci.wilsonville.or.us

DISCLOSURE NOTICE: Messages to and from this E-mail address may be subject to the Oregon Public Records Law.

From: Ethan Rosenthal [mailto:Ejro@deainc.com]
Sent: Tuesday, March 01, 2016 11:22 AM
To: Rappold, Kerry
Cc: Jennifer Miller; Jude Grounds (JGrounds@carollo.com); Gigi Cooper
Subject: Water Treatment Plant SROZ review

Hello Kerry,

We met a while back to discuss delineation of the SROZ boundaries at the Willamette River Water Treatment Plant in support of the current master planning work. We have mapped out the boundaries based on our understanding of the City's code and on guidance that you previously provided. We are hoping you can take a look at the attached memo and let us know if you concur with the boundaries as we've mapped them or provide additional guidance if we have misinterpreted things.

Please let me know if you have any questions. Thanks for your help,

-Ethan

Ethan Rosenthal | Project Manager/Ecologist
David Evans and Associates, Inc. | Water and Environment
2100 SW River Parkway | Portland, OR 97201 | www.deainc.com
d: 503.499.0572 | c: 503.805.3962 | ejro@deainc.com

DAVID EVANS
AND ASSOCIATES INC.

MEMORANDUM

DATE: March 7, 2016

TO: Kerry Rappold, Natural Resource Program Manager
City of Wilsonville
29799 SW Town Center Loop E
Wilsonville, OR 97070

FROM: Ethan Rosenthal

SUBJECT: Willamette River Water Treatment Plant Significant Resource Overlay Zone Verification

PROJECT: Willamette River Water Treatment Plant 2015 Master Plan Update
(CARO0000-0013)

CC: Jude Grounds (Carollo Engineers, Inc.)

This memorandum is intended to document site-level mapping of the City of Wilsonville's (City) Significant Resource Overlay Zone (SROZ) at the Willamette River Water Treatment Plant (WRWTP) site (Tax lots 31W23B01900 and 31W23B01800) (Figure 1). Delineation of the SROZ has been conducted in support of the WRWTP master plan update. This memorandum is being provided to the City for review and general agreement of the SROZ boundaries. It is understood that official concurrence might not be possible, since a land use application is not being submitted at this point in time. However, review and general agreement by the City will still allow the master plan process to better define areas that may be off-limits to development and/or require mitigation if impacted.

SITE DESCRIPTION

The WRWTP site is situated on a high terrace along the north bank of the Willamette River. The terrace gradually slopes downward from the northern end to the southern end of the site, then steepens considerably along a forested bluff that leads to the Willamette River. The site is often described as two areas: an Upper Site (roughly the northern third) and a Lower Site (roughly the southern two thirds), as shown in Figure 1.

The Lower Site contains the existing WRWTP facility, along with the WRWTP Park containing lawn, paved trails, ornamental plantings and a water feature. A water storage tank (clearwell) is buried under a portion of the lawn area. The west edge of the Lower Site contains an intermittent drainage feature, including a small wetland, situated in a steep, generally forested ravine. The south side of the Lower Site contains a steep forested bluff that leads down to the Willamette River.

The Upper Site consists of a former hazelnut orchard, maintained lawn areas near the WRWTP access road, and areas of fill covered in lawn grasses. Arrowhead Creek flows from west to east through the north end of the property and is situated in a forested ravine. Two wetlands were delineated within the narrow Arrowhead Creek floodplain.

METHODS

Wetland Delineation

A wetland delineation was conducted to define the boundaries of jurisdictional wetlands and waterways. These boundaries are also used in mapping of the City's SROZ as described in further detail below. The project site was visited on March 17, 2015 for general site reconnaissance and later visited on May 8, 2015 to conduct a formal wetland delineation. The wetland delineation followed standard methods and is documented in detail in a separate project wetland delineation report (DEA 2015), and can be made available upon request. Wetland and waterway boundaries were flagged and mapped by a professional land survey crew and added to the project survey base map.

Determination of Locally Significant Wetlands

City Code Section 4.139.10.02 provides requirements for determining if wetlands should be designated as "significant wetlands." However, only wetlands 0.5 acres or larger are reviewed for potential significance (Rappold, personal communications, March 3, 2016).

SROZ Mapping

Mapping Approaches

SROZ mapping for the site follows two general mapping approaches, which are described below. Results of these two approaches are then overlain onto each other. The SROZ consists of all areas mapped by each approach.

1. Approach one is based on Metro's Title 3 mapping method, which is based on standard buffer widths determined by the type of resource being protected (i.e., wetlands and waterways) and presence of steep slopes (i.e., 25 percent slope or greater), shown in pink on Figure 2. Typically, the buffer is 50 feet, but it can extend as far as 200 feet if steep slopes are present (see Table NR-1 of City Code Section 4.139.00). For the WRWTP site, a professional land survey of the site with two foot contours was used to assess slope steepness.
2. Approach two is based on City of Wilsonville Code Section 4.139.00. With the second approach, the SROZ is the extent of native tree canopy that extends out from the edge of the water resource features (i.e., wetlands and streams).

Site Visits and City Guidance

The City of Wilsonville Planning and Land Development Ordinance (Chapter 4 of the Wilsonville Code, updated January 2015) was reviewed for applicability to the project, with emphasis on mapping of existing conditions related to the SROZ. A site visit was conducted with Mr. Rappold on October 1, 2015 to clarify the SROZ mapping approaches as they relate to the WRWTP site. Based on the site visit with Mr. Rappold, it was agreed that native tree canopy (i.e. the edge of potential SROZ boundary) would not extend into an adjacent abandoned hazelnut orchard or include non-native hawthorn trees situated between the hazelnut orchard and riparian forest area along Arrowhead Creek. Another site visit was conducted on October 9, 2015 to collect additional information pertinent to SROZ mapping, particularly the edge of native tree canopy along potential SROZ boundaries. A resource-grade global positioning system (GPS), with typical horizontal accuracy of three feet or better, was used to collect points along the outer edge of native tree canopy drip lines. This data was overlaid onto the project basemap and geo-referenced aerial photo to draw the outer edge of the tree canopy (shown as the dashed line on Figure 2).

RESULTS

Wetland Delineation

Willamette River

The WRWTP site is located adjacent to the north bank of the Willamette River. The river bank consists of a steep forested bluff leading down to the ordinary high water (OHW) elevation of the river. OHW, based on field indicators, occurs at elevation 74 feet (NAVD88). Field indicators included sediment marks and drift deposits found on persistent woody vegetation. An increase in herbaceous species cover was also noted above versus below the OHW elevation.

Unnamed Intermittent Drainage to Willamette River and Associated Wetland

A small unnamed intermittent tributary (creek) to the Willamette River occurs along the western property boundary and is situated in a steep and deep V-shaped ravine. The creek ranges between two and three feet wide at the OHW mark. The creek had about one to two inches of flow during the March 17 site visit but was dry during the May 8 visit. The ravine side slopes are forested, primarily with Douglas fir and sword fern (*Polystichum munitum*). An exception to this is at the upper end of the creek where topography is less steep and conditions more open. Here a combination of Himalayan blackberry (*Rubus armeniacus*), stinging nettle (*Urtica dioica*), and planted trees occur adjacent to the drainage feature.

The upper end of the creek enters the site via a culvert along the west property boundary. This area also has a small emergent wetland (0.04_acres) associated with the creek. The wetland is dominated by non-native invasive reed canarygrass (*Phalaris arundinacea*).

Arrowhead Creek

Arrowhead Creek is likely a perennial stream, but may occasionally dry out late in the summer. The creek resides in a forested ravine with a narrow floodplain in the bottom. The creek is somewhat incised and OHW was mapped roughly at top of bank. Upland vegetation borders the creek throughout most of the narrow floodplain, with the exception of two small wetlands (0.03 and 0.09 acres). The wetlands appear to receive their hydrology from hillside seepage and drain via subsurface flow to the creek. Although occasional overbank flooding may occur, it is likely less than a 2 year event and therefore OHW was generally confined to the channel. Roughly 6 inches of flow was observed during the May 8 site visit, with some deeper pools present. Substrates ranged from silt to small cobble, with much of the larger substrate being embedded in the finer sediments. Some trash was also observed in the channel.

Significant Wetlands

None of the three delineated wetlands described above met the threshold of 0.5 acres to be considered significant wetlands.

SROZ Mapping

Preliminary Mapping

Figure 2 shows preliminary SROZ mapping based on 1) the edge of contiguous native tree canopy extending out from the water features and 2) the Metro Title 3 approach, which is based on a 50 foot buffer from the edge of the top of ravine. Ravine slopes were greater than 25 percent.

Final Mapping

The final SROZ, shown on Figure 3, combines the preliminary mapping components into two areas distinguished by hatching pattern. Both areas are considered part of the SROZ. The cross-hatched area is defined by City Code as the “Area of Limited Conflicting Use”. The City will closely evaluate impacts proposed in this area and mitigation standards (Section 4.139.07) generally apply. Within the Area of Limited Conflicting Use the City allows for no more than five percent of the area to be impacted by development. If development is proposed in this area, then the applicant is required to demonstrate steps taken to avoid or minimize impacts. The SROZ-Metro Title III area, which is closer to the resource, is not addressed by City mitigation standards and impacts are generally not allowed.

City Code also refers to an area termed the “Significant Resource Impact Area” (SR Impact Area), which occurs adjacent to the outer edge of the SROZ (yellow shaded area shown on Figure 3). The SR Impact Area is not part of the SROZ, but is instead a 25 foot buffer around the final SROZ boundary. Although development is allowed in the SR Impact Area, it is reviewed closely to make sure that such development does not adversely impact resources within the SROZ (e.g. development that affects tree roots within the SR Impact Area that may adversely affect a tree within the SROZ).

NEXT STEPS

1. City to review this memo and provide concurrence and/or feedback regarding delineated SROZ boundary.
2. DEA to revise memo if needed, based on City feedback.
3. Final review and concurrence by City if needed.
4. WRWTP Master Plan incorporates concurred SROZ boundaries into design layouts to assess potential impacts to SROZ.
5. Additional conversations with City, if needed, regarding potential SROZ impacts and required mitigation.

REFERENCES

David Evans and Associates, Inc. (DEA). 2015. Draft wetland delineation report, Willamette River Water Treatment Plan. Prepared for the Tualatin Valley Water District and City of Hillsboro, Oregon. September, 2015.

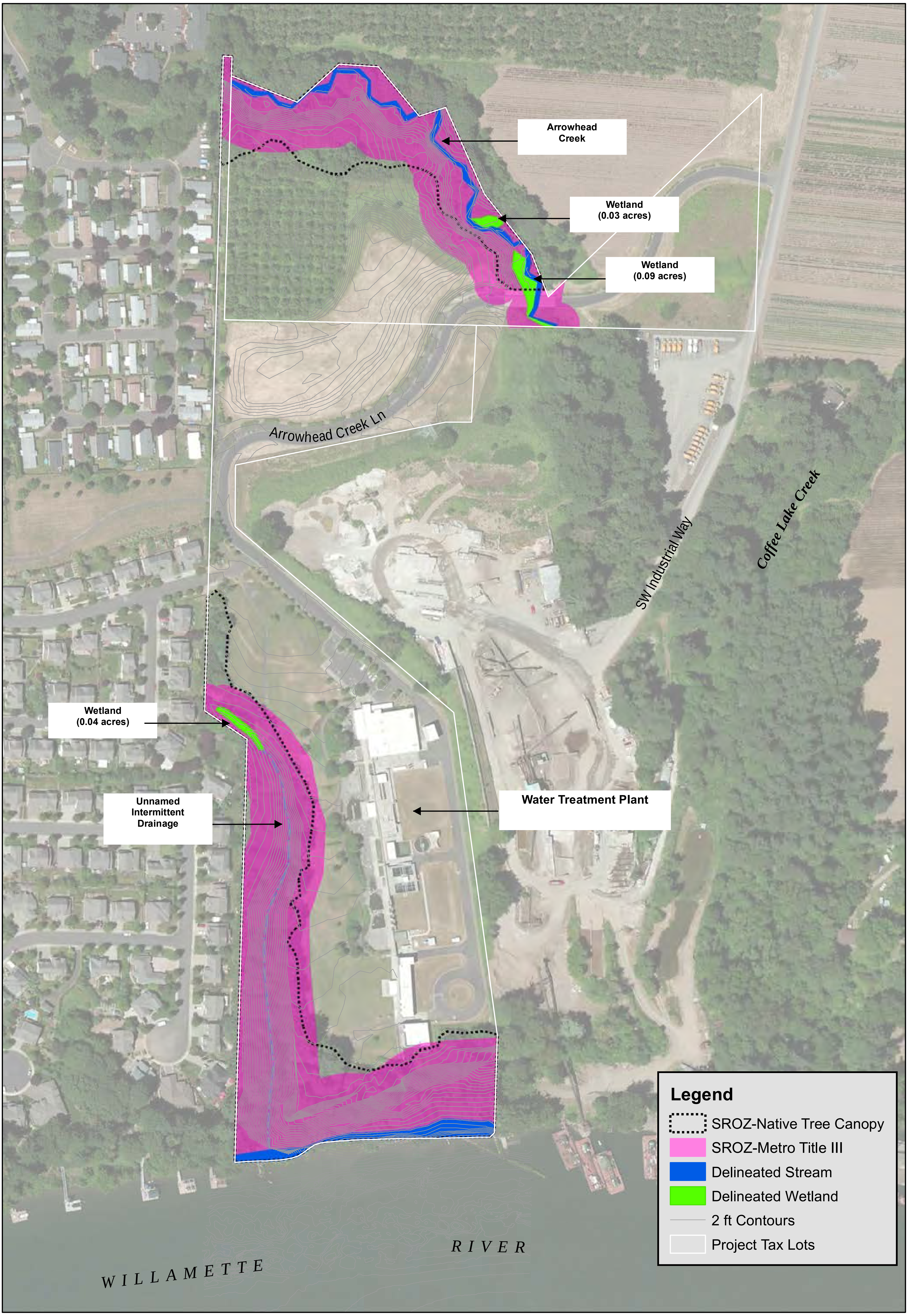
Attachments/Enclosures:

Figure 1: Vicinity Map
Figure 2: SROZ Mapping Process
Figure 3: SROZ Final Boundary

File Path: P:\C\CARO00000013\0600INFO\0670Reports\SROZ Verification Memo\2016-03-03_SROZ Memo revised\2016-03-07_RevisedSROZVerificationMemo.docx

ESRI, ArcGIS Online, USA Topographic Maps. 1961. Sherwood, Oregon.

Figure 1
Vicinity



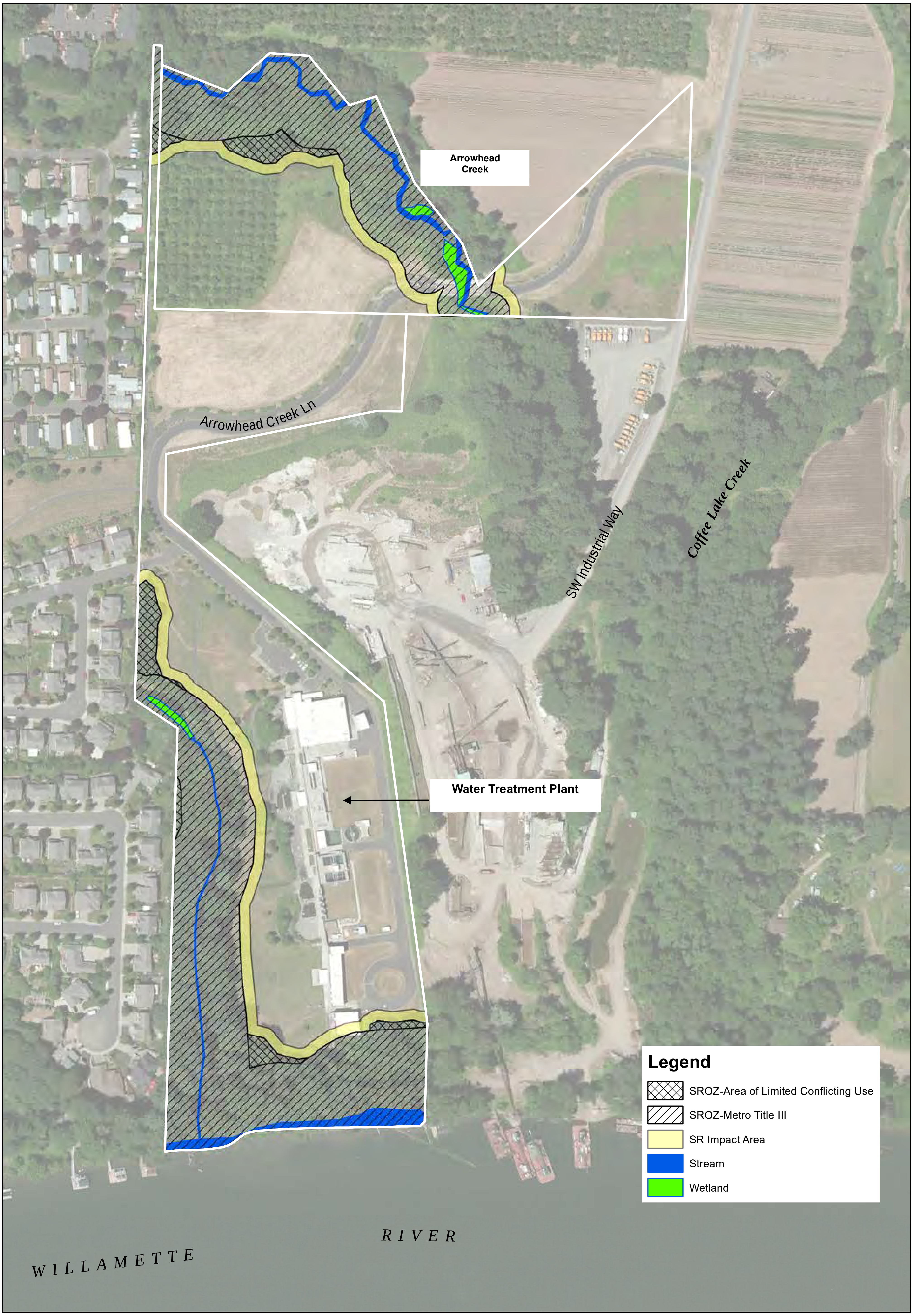
ESRI, ArcGIS Online, World Imagery. 2010. Microsoft.

Figure 2: Significant Resource Overlay Zone SROZ Mapping Process

N

0 200 400 Feet

Document Path: P:\C\CARO00000013\0600INFO\GS\Maps\Tech Reports\SROZ_Memo\Fig_2-SROZ_LayerDevelopment.mxd



ESRI, ArcGIS Online, World Imagery. 2010. Microsoft.

Figure 3: Significant Resource Overlay Zone SROZ Final Boundary

Document Path: P:\C\CARO00000013\0600INFO\GS\Maps\Tech Reports\SROZ_Memo\Fig_3-SROZ_Final.mxd

APPENDIX C: Site Photos

Photo 1: Looking southeast at typical forested vegetation condition along slope adjacent to the Willamette River. Similar forested conditions occur adjacent to unnamed tributary to the Willamette River.

Photo 2: Looking southwest at OHWM of the Willamette River, which lies at the base of the shrub marked with the orange flag to the right of the large tree, which displays sediment deposits (May 8, 2015). Drift deposits at OHWM present in shrubs to left of large tree.

Photo 2: Looking southeast at Wetland A (foreground) and unnamed tributary to the Willamette River, which leads from a culvert outfall to the right of the photo and flows south to the Willamette River (March 17, 2015).

Photo 3: Looking northwest at box culvert where Arrowhead Creek enters the west end of study area (May 8, 2015). OHWM lies at the base of the shrubs marked with the orange flags.

Photo 3: Looking north at Wetland C adjacent to Arrowhead Creek (May 8, 2015). Relatively steep slopes lead up from the wetland.

Photo 4: Looking north at Arrowhead Creek from under the Arrow Creek Lane bridge (May 8, 2015).

Photo 6: Looking southeast from the bridge deck at Arrowhead Creek and associated Wetland C, which extends outside the study area (May 8, 2015). Relatively steep slopes lead up from the wetland on all sides.

Photo 6: Looking northwest along forested edge of SROZ along north side of Arrowhead Creek. Nursery area starts near top of slope.

Exhibit E: U.S. Army Corps of Engineers Permit and Oregon Department of State Lands Joint Permit

DEPARTMENT OF THE ARMY PERMIT

Permittee:

Tualatin Valley Water District
1850 SW 170th Ave.
Beaverton, OR 97003

City of Hillsboro
150 E. Main Street
Hillsboro, OR 97123-4028

Permit No: NWP-2015-0041

Issuing Office: U.S. Army Corps of Engineers, Portland District

NOTE: The term "you" and its derivatives as used in this permit means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the U.S. Army Corps of Engineers (Corps) having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

You are authorized to perform work in accordance with the terms and conditions specified below.

Project Description: The project is the Willamette Water Supply System Project and involves completing seismic and capacity upgrades at an existing intake within and along the Willamette River, construction of a new water treatment plant, construction of new water storage tanks, and construction of water transmission lines. The project will permanently impact 0.86 acres of wetland and 13 square feet of non-wetland waters, and temporarily impact 4.51 acres of wetland, 0.28 acre of non-wetland waters and 1.58 acres of roadside ditches. Approximately 0.47 acre of temporary impacts will result in a conversion of palustrine forested wetland to palustrine emergent or palustrine scrub shrub wetland in the area directly over the transmission pipeline. Approximately 0.40 acres of indirect impact to palustrine forested wetland would occur due to loss of forested buffer at the proposed water treatment plant. The project infrastructure would allow for the withdrawal of up to 150 million gallons of water per day.

The project consists of the following elements:

- Existing 66-inch diameter fish screens will be replaced with new 78-inch diameter fish screens. The old screens will be un-bolted and new screens will be bolted on. Divers will perform the work and a barge mounted crane will maneuver the screens.

- Up to 10 H-piles will be modified to accommodate the larger fish screens. The contractor may complete one of the following to accommodate the larger screens: 1) The existing H-pile would be cut by divers and attached to brackets to extend the area protected by the pile; or 2) the existing H-pile will be removed using a vibratory hammer and replaced with either a steel H-pile designated HP 24 or smaller, or wood pile that has not been treated with preservatives or pesticides. The existing H-pile may be cut at 2-feet below the mud line if it is unable to be completely removed. New pile will be installed using vibratory methods until refusal and finished with an impact hammer.

- The project includes site seismic improvements to protect the intake, pump station, and associated structures. Sixteen (16) 4-foot diameter concrete tangent piles will be constructed on the bank of the Willamette River to provide seismic stabilization at the intake. Of the sixteen piles, one will be constructed below the ordinary high water mark (OHWM) of the Willamette River. The tangent piles will extend approximately 50 feet deep. Existing access roads will be upgraded using geotextile fabric and crushed rock to access the site.

- Approximately thirty-seven (37) 10-foot diameter piles and a jet grout block will be constructed above the OHWM of the Willamette River near the intake pipe. Jet grouting consists of injecting liquid concrete into the soil to create a soil/concrete mixture below the ground surface. The piles and jet grout block will extend 450 feet in length at the top of the slope in two segments.

- Pump station facilities will be constructed in the City of Wilsonville in uplands and will not involve work in waters of the United States.

- A new water treatment plant (WTP) will be constructed near the City of Sherwood. The new WTP will permanently impact a total of 0.86 acres of wetland for site grading, construction of a retaining wall, construction of an access road, and building construction. Construction will also temporarily impact 0.10 acre of forested wetland. Loss of forested buffer will result in indirect impacts to 0.40 acres of palustrine forested wetland.

- New reservoir facilities will be constructed on South Cooper Mountain. The reservoir facilities, staging, and stockpile areas, will all be constructed in uplands.

- Construction of the water transmission pipelines will impact wetlands, non-wetland waters, and ditches. The transmission pipe will convey water from the pump station, to the WTP near Sherwood, Oregon, to the new water storage tanks on South Cooper Mountain, and to connections with existing Tualatin Valley Water District and City of Hillsboro water distribution systems. The transmission pipeline will be installed using trench excavation and trenchless construction (jack and bore, pipe ramming, shielded tunneling, and microtunneling).

Detailed Project impacts are included in Attachment 1.

Purpose: To provide an increased amount of drinking water that is resilient to seismic events and drought, and provides water source redundancy for the water customers of the City of Hillsboro and the Tualatin Valley Water District.

Project Location: The project is located in the Willamette River, the Tualatin River and several of its tributaries, multiple wetlands, and ditches in the cities of Wilsonville, Sherwood, Beaverton, Tigard, Tualatin, and Hillsboro, in Clackamas and Washington Counties, Oregon.

Drawings: Seventy Eight (78) Drawings and Figures (Attachment 2)

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on November 9, 2028. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before the above date is reached.

2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party in compliance with General Condition No. 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.

3. If you discover any previously unknown historic or archeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.

5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions (Attachment 3).

6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

a. Upon starting the activities authorized by this permit, Permittee shall notify the U.S. Army Corps of Engineers, Portland District, Regulatory Branch that the work has started. Notification shall be provided at the start of each construction year, detailing the work packages that will be constructed and the approximate start dates. Notification shall be provided by e-mail to cenwp.notify@usace.army.mil and the email subject line shall include: NWP-2015-41, Washington County.

b. Permittee must allow representatives from the Corps of Engineers to inspect the authorized activity and any mitigation, preservation, or avoidance areas at any time deemed necessary to ensure that the authorized activity is being or has been accomplished in accordance with the terms and conditions of your permit.

c. The following special condition is a part of all Department of the Army permits that provide authorization under Section 10 of the Rivers and Harbors Act, regardless whether the permit provides such authorization under Section 10 alone, or in combination with authorization under other laws:

The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the U.S Army Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

d. Permittee shall complete all in-water work, to the maximum extent practicable, within the preferred time period (i.e., work window) specified in Oregon Department of Fish and Wildlife's (ODFW) "Oregon Guidelines for Timing of In-Water Work to Protect Fish and Wildlife Resources," June 2008, or most current version, available at: http://www.dfw.state.or.us/lands/inwater/.

If work cannot be completed within the preferred timing window, despite every attempt to do so, permittee shall submit a written request to work outside of the preferred window to the District Engineer. The request can be made by means of the joint-agency In-water Work Period Variance Request for Previously Permitted Authorizations form which can be found at http://www.oregon.gov/dsl/WW/Pages/WWforms.aspx. Permittee shall not begin any in-water work outside of the preferred window until they have received written approval from the District Engineer.

e. This Corps permit does not authorize you to take an endangered species, in particular the USFWS Animal Trust Species or USFWS Plant Trust Species or NMFS Trust Species. In order to legally take a listed species, you must have separate authorization under the ESA (e.g., an ESA Section 10 permit, or a BO under ESA Section 7, with "incidental take" provisions with which you must comply). The enclosed BiOp prepared by the National Marine Fisheries Service (NMFS) dated October 1, 2018 contains mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" that is also specified in the BO (NMFS Reference Number WCR-2017-7795). Your authorization under this Corps permit is conditional upon your compliance with all of the mandatory terms and conditions associated with incidental take of the attached BO, which terms and conditions are incorporated by reference in this permit (Attachment 4). Failure to comply with the terms and conditions associated with incidental take of the BO, where a take of the listed species occurs, would constitute an unauthorized take, and it would also constitute noncompliance with your Corps permit. The NMFS is the appropriate authority to determine compliance with the terms and conditions of its BO, and with the ESA.

f. Permittee shall conduct species surveys to determine Streak Horned lark (*Eremophila alpestris strigata*) presence within suitable habitat if work will occur within the habitat during nesting season (typically April through August). The surveys should occur the year prior to planned construction and occur during the nesting season. For construction beginning in 2019 within areas determined to be suitable habitat, species surveys should be completed and submitted to the Corps for review prior to work commencing. Permittee shall provide the results of the survey to the address listed in Special Condition a. to allow the Corps to determine if the lark may be impacted by the proposed project.

g. Permittee shall implement and abide by the Programmatic Agreement (PA), entitled “PROGRAMMATIC AGREEMENT AMONG THE UNITED STATES ARMY CORPS OF ENGINEERS AND THE OREGON STATE HISTORIC PRESERVATION OFFICE AND TUALATIN VALLEY WATER DISTRICT, and CITY OF HILLSBORO” in its entirety. The U.S. Army Corps of Engineers has been designated the lead federal agency responsible for implementing and enforcing the Programmatic Agreement as signed. If you fail to comply with the implementation and associated enforcement of the PA, the Corps may determine you are out of compliance with the conditions of the Department of the Army permit or authorization and suspend the permit or authorization. Suspension may result in modification or revocation of the authorized work.

h. Permittee shall obtain 1.73 credits from the Butler Mitigation Bank. Prior to performing work in waters of the U.S. authorized by this permit, permittee shall submit documentation of the completed mitigation bank transaction to the U.S. Army Corps of Engineers, Portland District, Regulatory Branch. Documentation shall be submitted by e-mail to cenwp.notify@usace.army.mil and the email subject line shall include: NWP-2015-41, Washington County.

i. Permittee shall re-vegetate disturbed areas at the project site during the earliest appropriate planting season after activity is completed. The vegetation shall consist of native, non-invasive herbs, shrubs, and trees.

j. Permittee shall submit detailed restoration plans for the areas where open-trench crossing is proposed across a stream for each work package prior to the discharge of fill into Waters of the U.S. The restoration plans should be consistent with the guidance outlined in the plan titled "Willamette Water Supply Program – Conceptual Post-Construction Site Restoration Plan" dated February 28, 2017.

k. Permittee shall provide a copy of the permit transmittal letter, permit form, and permit drawings to all contractors performing any work authorized by Corps No. NWP-2015-41.

l. Permittee shall complete and sign the enclosed Compliance Certification (Attachment 5). Permittee shall submit the completed certification to the U.S. Army Corps of Engineers, Portland District, Regulatory Branch by December 31st of each year construction activities occur. The certification should be accompanied with a description of the work that was completed.

m. Permittee shall submit an as built report to the Corps at the address shown in Special Condition (a) by December 31 of the year a work package is completed. An as built report shall be submitted for each completed work package. The report shall contain photographs of the site and the initial grading survey of resource areas within the work package. A map identifying the locations and directions of the photographs shall be included in the as-built report.

Further Information:

1. <u>Congressional Authorities</u>: You have been authorized to undertake the activity described above pursuant to:

(X) Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).
(X) Section 404 of the Clean Water Act (33 U.S.C. 1344).
( ) Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. <u>Limits of this Authorization:</u>

a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.

b. This permit does not grant any property rights or exclusive privileges.

c. This permit does not authorize any injury to the property or rights of others.

d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability: In issuing this permit, the Federal Government does not assume any liability for the following:

a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.

b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.

c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.

d. Design or construction deficiencies associated with the permitted work.

e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision: This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

a. You fail to comply with the terms and conditions of this permit.

b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (see 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions: General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

December 6, 2018

(PERMITTEE SIGNATURE) **(DATE)**

Mark Knudson Chief Executive Officer

(PRINTED NAME) **(TITLE)**

Kevin Hanway

December 6, 2018

(PERMITTEE SIGNATURE) **(DATE)**

Kevin Hanway Director

(PRINTED NAME) **(TITLE)**

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

FOR THE COMMANDER, AARON L. DORF, COLONEL, CORPS OF ENGINEERS, DISTRICT COMMANDER:

for

(DISTRICT COMMANDER) **(DATE)**

William D. Abadie
Chief, Regulatory Branch

When the structures or work authorized by this permit are still in existence at the time the property is transferred , the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign below.

PERMIT TRANSFEREE:

____________________________________ ______________________
Transferee Signature **DATE**

____
Name (Please print)

____
Address

____
City, State, and Zip Code

Department of State Lands
775 Summer Street, Suite 100
Salem, OR 97301-1279
☎ 503-986-5200

Permit No.: **60102-RF**
Permit Type: **Removal/Fill**
Waterway: **Wetlands/Waterways**
County: **Clackamas/Washington**
Expiration Date: **May 7, 2019**

TUALTIN VALLEY WATER DISTRICT

IS AUTHORIZED IN ACCORDANCE WITH ORS 196.800 TO 196.990 TO PERFORM THE OPERATIONS DESCRIBED IN THE ATTACHED COPY OF THE APPLICATION, SUBJECT TO THE SPECIAL CONDITIONS LISTED ON ATTACHMENT A AND TO THE FOLLOWING GENERAL CONDITIONS:

1. This permit does not authorize trespass on the lands of others. The permit holder must obtain all necessary access permits or rights-of-way before entering lands owned by another.
2. This permit does not authorize any work that is not in compliance with local zoning or other local, state, or federal regulation pertaining to the operations authorized by this permit. The permit holder is responsible for obtaining the necessary approvals and permits before proceeding under this permit.
3. All work done under this permit must comply with Oregon Administrative Rules, Chapter 340; Standards of Quality for Public Waters of Oregon. Specific water quality provisions for this project are set forth on Attachment A.
4. Violations of the terms and conditions of this permit are subject to administrative and/or legal action, which may result in revocation of the permit or damages. The permit holder is responsible for the activities of all contractors or other operators involved in work done at the site or under this permit.
5. Employees of the Department of State Lands (DSL) and all duly authorized representatives of the Director must be permitted access to the project area at all reasonable times for the purpose of inspecting work performed under this permit.
6. Any permit holder who objects to the conditions of this permit may request a hearing from the Director, in writing, within twenty-one (21) calendar days of the date this permit was issued.
7. In issuing this permit, DSL makes no representation regarding the quality or adequacy of the permitted project design, materials, construction, or maintenance, except to approve the project's design and materials, as set forth in the permit application, as satisfying the resource protection, scenic, safety, recreation, and public access requirements of ORS Chapters 196, 390, and related administrative rules.
8. Permittee must defend and hold harmless the State of Oregon, and its officers, agents and employees from any claim, suit, or action for property damage or personal injury or death arising out of the design, material, construction, or maintenance of the permitted improvements.
9. Authorization from the U.S. Army Corps of Engineers may also be required.

NOTICE: If removal is from state-owned submerged and submersible land, the permittee must comply with leasing and royalty provisions of ORS 274.530. If the project involves creation of new lands by filling on state-owned submerged or submersible lands, you must comply with ORS 274.905 to 274.940 if you want a transfer of title; public rights to such filled lands are not extinguished by issuance of this permit. This permit does not relieve the permittee of an obligation to secure appropriate leases from DSL, to conduct activities on state-owned submerged or submersible lands. Failure to comply with these requirements may result in civil or criminal liability. For more information about these requirements, please contact Department of State Lands, 503-986-5200.

Kirk Jarvie, Southern Region Manager
Aquatic Resource Management
Oregon Department of State Lands

Kirk Jarvie
Authorized Signature

May 7, 2018
Date Issued

Exhibit F: U.S. Army Corps of Engineers/Oregon Department of State Lands Joint Permit Application (June 2017) [excerpts]

Joint Permit Application

This is a joint application, and must be sent to both agencies, who administer separate permit programs. Alternative forms of permit applications may be acceptable; contact the Corps and DSL for more information.

Date Stamp

U.S. Army Corps of Engineers Portland District	1859 **Oregon Department of State Lands**
Corps Action ID Number	DSL Number

(1) APPLICANT AND LANDOWNER CONTACT INFORMATION

	Applicant #1	Applicant #2	Authorized Agent (if applicable) ☑ Consultant ☐ Contractor
Contact Name	Mark Knudson Chief Exec. Officer	Kevin Hanway Water Department Director	Ethan Rosenthal
Business Name	Tualatin Valley Water District	City of Hillsboro	David Evans and Assoc., Inc.
Mailing Address 1	1850 SW 170th Ave.	150 E. Main Street	2100 SW River Parkway
Mailing Address 2			
City, State, Zip	Beaverton, OR 97003	Hillsboro, OR 97123-4028	Portland, OR 97201
Business Phone	503-941-4570	503-941-4570	503-499-0572
Cell Phone			
Fax			
Email	Mark.Knudson@tvwd.org	Kevin.Hanway@hillsboro-oregon.gov	ejro@deainc.com

(2) PROJECT INFORMATION

A. Provide the project location.

Project Name Willamette Water Supply System	Tax Lot # See Attachment A	Latitude & Longitude* See Attachment A
Project Address / Location Not applicable	City (nearest) Wilsonville, Sherwood, Beaverton, Tigard, Tualatin, and Hillsboro	County Clackamas and Washington

Township See Attachment A	Range See Attachment A	Section See Attachment A	Quarter/Quarter See Attachment A

Brief Directions to the Site
See Attachment A

B. What types of waterbodies or wetlands are present in your project area? (Check all that apply.)

☑ River / Stream
☐ Estuary or Tidal Wetland
☑ Non-Tidal Wetland
☐ Other
☐ Lake / Reservoir / Pond
☐ Pacific Ocean

Waterbody or Wetland Name** See attached	River Mile See attached	6th Field HUC Name See attached	6th Field HUC (12 digits) See attached

C. Indicate the project category. (Check all that apply.)

☐ Commercial Development
☑ Institutional Development
☐ Transportation
☐ Industrial Development
☐ Agricultural
☐ Restoration
☐ Residential Development
☐ Recreational
☐ Bank Stabilization

(2) PROJECT INFORMATION

☐ Dredging	☑ Utility lines	☐ Survey or Sampling
☑ In- or Over-Water Structure	☐ Maintenance	☐ Other:

* In decimal format (e.g., 44.9399, -123.0283)
** If there is no official name for the wetland or waterway, create a unique name (such as “Wetland 1” or “Tributary A”).

(3) PROJECT PURPOSE AND NEED

Provide a statement of the purpose and need for the overall project.

Population size and municipal water needs in Washington County are expected to double in the next 50 years, with new source supplies needed as early as 2026. The Tualatin Valley Water District (TVWD) and the City of Hillsboro (Hillsboro), collectively referred to as the Project Participants, have identified the Willamette Water Supply System (WWSS or Project—see Note below) as the best option for future delivery of drinking water to their service areas in Washington County. There are four primary components of the WWSS: the Raw Water Facilities (RWF), the WWSS Water Treatment Plant (WTP), the Reservoir Facilities, and the Transmission Pipelines, described below. The RWF will be built in partnership with the Project Participants and the cities of Wilsonville, Sherwood, Tigard, and Beaverton, collectively referred to as the Partners. Those communities will design, permit, and construct any related water infrastructure facilities separately from the WWSS or will have to buy capacity from the WWSS at a later date. The Willamette River at Wilsonville will be the water supply source for the WWSS. Developing this additional water supply through a partnership supports the region’s plans for responsible growth within the urban growth boundary (UGB).

The purpose of the proposed WWSS is to provide a long-term, resilient water supply to serve the projected water supply needs of the Project Participants. To ensure that the Project purpose is fulfilled, the water supply must meet the following needs:

- Meet projected future water demands supporting the region’s plans for responsible growth within the UGB
- Reliably deliver a long-term water supply, including in times of droughts, earthquakes, or other disasters
- Supply finished water to TVWD and Hillsboro customers
- Offer a cost-effective water supply source in service by July 2026
- Support ownership and control of the water supply via a partnership between TVWD and Hillsboro

(**Note**: In some supporting documentation and attachments to this application, the Project is referred to as the Willamette Water Supply Program or Program instead of the Willamette Water Supply System.)

(4) DESCRIPTION OF RESOURCES IN PROJECT AREA

A. Describe the existing physical and biological characteristics of each wetland or waterway. Reference the wetland and waters delineation report if one is available. Include the list of items provided in the instructions.

A description of jurisdictional wetlands and waterways within the project area is provided in the table in Attachment A named *“Attachment A.2: JPA Section (4.A) WWSP Jurisdictional Wetland and Waterway Crossings.”* A wetland functional assessment is provided in Attachment B (permanently impacted wetlands and high quality wetlands that will be avoided). The project area was documented in several wetland delineation reports. Wetland delineation concurrence letters received to date are provided in Attachment C. All wetland delineation reports have been submitted to the U.S. Army Corps of Engineers (USACE) and Oregon Department of State Lands (DSL) under a separate transmittal.

B. Describe the existing navigation, fishing and recreational use of the waterway or wetland.

The Project crosses several small drainages not typically used for navigation, fishing, or recreational uses. The only two waterways in the project area with such uses are the Willamette River at the RWF (intake) and the Tualatin River along the proposed pipeline alignment. Both rivers in the general vicinity of the proposed Project elements provide boating, fishing, and recreational uses. Because the Tualatin River is relatively narrow, boating usage tends to be human-powered vessels such as canoes and kayaks, though there is the potential for small motorized watercraft. The Willamette River is much larger and, therefore, a wider array of watercraft can be found.

(5) PROJECT SPECIFIC CRITERIA AND ALTERNATIVES ANALYSIS

Describe project-specific criteria necessary to achieve the project purpose. Describe alternative sites and project designs that were considered to avoid or minimize impacts to the waterway or wetland.

A detailed alternatives analysis has been conducted for the Project that considers alternative water supply sources, alternative pipeline alignments and routing from the RWF, alternative WWSS WTP sites, and alternative Reservoir Facilities sites. This analysis is provided as Attachment D.

(6) PROJECT DESCRIPTION

A. Briefly summarize the overall project including work in areas both in and outside of waters or wetlands.

The Project is located in Clackamas and Washington counties (see figures provided in Attachment E). There are four primary components of the WWSS, as follows:

- The **Raw Water Facilities** (RWF) refer to the proposed modifications to the existing Willamette River intake (including replacement of the existing fish screens with larger capacity screens), seismic stability improvements, raw water pump station upgrades, new electrical and hydraulic surge control facilities for the pump station, stormwater management facilities, and associated raw water pipelines that will convey water from the Willamette River through the upgraded raw water pump station. The RWF are located immediately adjacent to the Willamette River near the Willamette River Water Treatment Plant (WRWTP). Two raw water pipelines will exit the raw water pump station to convey water to two water treatment plants (the existing WRWTP and the proposed WWSS WTP, described below). Owners of the RWF will include TVWD and the cities of Wilsonville, Sherwood, Hillsboro, Beaverton, and Tigard, with the exception of the raw water pipeline serving the WWSS WTP, which will be owned by TVWD and Hillsboro. The existing water rights associated with the RWF (Permits S-46319, S-49240, S-54940, S-45565 (relocation pending)) authorize the use of up to 332.7 cubic feet per second (cfs) (179 million gallons per day (mgd)) for municipal purposes. A table presenting these water rights is in Appendix C. The proposed withdrawal capacity of the RWF is 150 mgd (232.1 cfs).

- The **WWSS Water Treatment Plant (WWSS WTP)** refers to the proposed water treatment plant, including a finished water pump station, that will be located in unincorporated Washington County near the city of Sherwood. The WWSS WTP will receive water from the raw water pipeline, perform treatment to meet or exceed drinking water standards, and then pump that treated water into the finished water pipeline. This facility will serve TVWD and Hillsboro, with phased construction to expand the capacity to 120 mgd.
- The **Reservoir Facilities** site will contain two aboveground water storage tanks proposed to be located in the Cooper Mountain area of Washington County. The storage tanks will receive and store finished water that has been treated at the WWSS WTP. Water will be gravity fed from the storage tanks into the northern sections of the water pipeline. The Reservoir Facilities will serve TVWD and Hillsboro. The combined storage capacity of the two water storage tanks totals 30 million gallons (mg).
- **Transmission Pipelines** will connect the RWF, WWSS WTP, and Reservoir Facilities, and ultimately tie in to the Project Participants' existing water distribution systems. The Transmission Pipelines will convey raw water from the RWF to the WWSS WTP, and finished water from the WWSS WTP to the Reservoir Facilities and the existing water distribution system tie-ins. These pipelines will serve TVWD and Hillsboro, and will also tie in to the City of Beaverton's and Joint Water Commission's (JWC) transmission systems to allow for emergency access between the systems. The capacity within individual pipeline sections will vary by location, but the overall system will provide approximately 105.7 mgd of water transmission capacity.

(6) PROJECT DESCRIPTION

To facilitate completion by July 2026, the Project Participants divided the Project into work packages, each of which is assigned a simple naming convention code, as shown in Table 1.

Table 1. Project Components

Project Component	Code	Common Name	Approximate Component Size
Raw Water Facilities	RWF_1.0	Raw Water Facilities	12 acres
WWSS WTP	WTP_1.0	Willamette Water Supply System WTP	20 acres
Reservoir Facilities	RES_1.0	South Beaverton Area Water Storage	10 acres
Transmission Pipelines	PLM_1.0	Wilsonville Area Pipeline Project	3.0 miles
	PLM_2.0	Kinsman Road Partnership Project	0.5 mile
	PLM_3.0	124th Avenue Partnership Project	2.7 miles
	PLM_4.0	Tualatin-Sherwood Area Pipeline Project	4.8 miles
	PLM_5.0	Scholls Area Pipeline Project	7.7 miles
	PLW_1.0	South Hillsboro Area Pipeline Project	3.9 miles
	PLW_2.0	Cornelius Pass Pipeline Project	3.4 miles
	PLE_1.0	Beaverton Area Pipeline Project	5.5 miles

ADDITIONAL ENVIRONMENTAL BENEFITS PROJECTS

In addition to the water supply system infrastructure, two voluntary habitat restoration projects (additional environmental benefits) will be supported as part of the overall WWSS. These projects will be in addition to any compensatory mitigation required by federal, state, and local regulations for the WWSS. At a program level, the benefits of these two projects are to: (1) demonstrate the Project's commitment to environmental stewardship within the watersheds and communities in which it operates, and (2) promote lasting partnerships with area stakeholders. The WWSS will support these environmental benefits projects by acting as a funding partner. Each project will be responsible for obtaining its own permits, and therefore the permits that authorize the WWSS will not authorize these projects. Descriptions of the two habitat restoration projects are provided below (figures are provided in Attachment E).

Chicken Creek Restoration Project

The Chicken Creek restoration project is located within the Tualatin River National Wildlife Refuge (the Refuge). The Project would provide funds to support this project, which currently includes the following partners: Refuge, Clean Water Services (CWS), and Ducks Unlimited.

Chicken Creek is located on the Atfalat'I Unit of the Refuge's larger Sherwood Management Unit and historically meandered through a floodplain mosaic of wet and dry prairie, riparian forest, and wetlands to its connection with the Tualatin River. In the early part of the 20th century, the creek was channelized to the western part of the property to facilitate farming and now exists in a linear, deeply incised ditch. Once the creek was channelized, the mosaic of habitat was converted to agricultural lands that supported feed crops and a dairy farm. Agriculture operations occurred for almost 100 years until, in 1996, the property was purchased by the Refuge. Early restoration efforts emphasized creating a complex of managed wetlands to provide foraging, wintering, and some breeding habitat for migratory birds. As a part of these restoration activities, a water diversion structure was placed at the head of the channelized portion of Chicken Creek to provide water for managed herbaceous wetlands; however, rather than restoring the creek's historical connection to the Tualatin River, the creek remained channelized.

The restoration project is currently in the design phase, with implementation anticipated to start in 2018. This project, which was identified during the Refuge's Comprehensive Conservation Plan process, would restore an approximately 1.5-mile reach of Chicken Creek and its associated floodplain, which would benefit listed steelhead trout, lamprey, and cutthroat trout, as well as migratory birds and other native species. Beaver activity would be promoted as part of long-term restoration efforts.

Molalla Confluence Project

The Molalla confluence project is located within Molalla River State Park at the confluence of the Molalla, Pudding, and Willamette rivers. The confluence is roughly 3.5 miles downstream of the existing WRWTP intake and proposed RWF on the Willamette River. WWSS would provide funds to support this project, which currently includes the following partners: Oregon State Parks, Molalla River Watch, and Cascade Pacific Resource Conservation and Development. The Molalla project is in the planning and early design phase, and will be implemented over several years. Early pilot projects to control invasive knotweed in the floodplain have already begun. A map illustrating the project opportunities is provided in Attachment E.

The project area consists of a hydrologically complex area centered at Molalla River State Park, and composed of 450 acres of floodplain forest and channels within the two-year inundation zone of the Willamette River. The Molalla River supports populations of native winter steelhead (in full recovery and considered a stronghold population), spring Chinook salmon, a naturalized population of coho salmon, Pacific and Western brook lamprey, Oregon chub, and wildlife such as bald eagle, heron, pond turtle, beaver, waterfowl, migratory songbirds, elk, deer, and cougar. The confluence area is used by many of these species, as well as migrating fish populations on the mainstem Willamette River.

The project addresses several limiting factors and associated actions identified in the Upper Willamette River Recovery Plan for Chinook Salmon and Steelhead (NMFS/ODFW, 2011), including but not limited to the following activities: increasing instream habitat complexity, enhancing riparian habitat, reconnecting side channel and off-channel habitats, and protecting existing high quality aquatic and riparian habitats. Enhancing floodplain habitat and improving vegetation communities at the park is identified as a priority action for the Molalla River watershed in The Middle and Lower Molalla River Restoration Action Plan (Molalla River Watershed Council and Molalla River Improvement District, 2011).

B. Describe work within waters and wetlands.

This section provides a description of work proposed specifically within regulated waters and wetlands, at a level of detail intended for USACE and DSL permitting. Figures of proposed work within waters and wetlands are provided in Attachment E. Additional detail, such as proposed stormwater management and in-depth construction methods, is available in the Project's Biological Assessment (BA), provided as Attachment I. Project impact quantities are provided in the table in Attachment A named "*Attachment A.3 Wetland and Waterways Impact Table*."

The following discussion details the distinction between temporary and permanent impact types:

- ***Temporary Acreage and Functional Impact:*** Includes temporary ground clearing and/or earthwork where contours and plant community type can be restored similar to preconstruction conditions or better. For example, open-trench work through an emergent wetland dominated by reed canarygrass (e.g., dominated by invasive species) will be restored to at least an emergent wetland community. Replanting will be accomplished using native species, with the understanding that non-native species from the surrounding environment are likely to encroach. Site restoration will occur in accordance with the Conceptual Site Restoration Plan provided in Attachment F. No mitigation is proposed for these temporary impacts.
- ***Temporary Acreage Impacts but with a Permanent Impact to Resource Functions (noted as temporary impacts in the impacts table, but with an asterisk to signify the permanent functional loss):*** Includes temporary ground clearing and/or earthwork where plant community type cannot be restored to preconstruction conditions or better. For example, if construction removes a forested wetland community and a similar community cannot be planted directly over the pipeline, this would result in a permanent diminishment (impact) to wetland functions. However, since the area over the pipe would still be graded similar to preconstruction conditions and planted with native plantings, there would be no loss in wetland acreage from this activity, and wetland functions would still be provided but at a lower level. Site restoration will occur in accordance with the Conceptual Site Restoration Plan provided in Attachment F. Although there are no permanent impacts to wetland acreage, the affected wetland function will be mitigated through purchase of wetland mitigation bank credits. This will occur based on a ratio of one mitigation bank credit per acre of affected wetland.

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- ***Permanent Impact to Resource Acreage and Functions***: Permanent impacts refer to those areas where wetland acreage would be lost in perpetuity. For example, development of the proposed WWSS WTP site will result in some unavoidable permanent loss of wetlands in order to properly grade the site and situate the various treatment facilities. The affected acreage will be mitigated through purchase of wetland mitigation bank credits. This will occur based on a ratio of one mitigation bank credit per acre of affected wetland.

RAW WATER FACILITIES (RWF)

Modifications to the RWF located on the Willamette River in Wilsonville will include modifications to the intake (including replacement of screens and associated modifications of existing piles), site seismic improvements, and modifications to the existing raw water pump station at the WRWTP, including construction of associated facilities. The RWF also include the portion of raw water transmission line located on the WRWTP property, which will cross Arrowhead Creek. Only the intake and seismic improvements will entail work in regulated waters. The Arrowhead Creek crossing will be a trenchless crossing and therefore will not impact regulated waters. Further description of regulated activities is provided below.

Raw Water Intake Modifications

No removal or fill activities are associated with these modifications other than the structural fill associated with the screen replacement and pile modifications. The existing raw water intake will be modified to increase its capacity from 70 mgd to 150 mgd. Within the river, the existing intake includes two 66-inch-diameter tee-screens with a total permitted design capacity of 70 mgd (35 mgd each screen) and with openings small enough to prevent debris and aquatic organisms from being drawn into the RWF. The existing screen system protects anadromous juvenile fish using Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS) standards to meet fish passage requirements. As part of the modifications to increase withdrawal capacity, two new 78-inch-diameter tee-screens will be bolted on in place of the existing screens. The existing screens are protected from impacts by ten piles; up to ten of these piles would need to be modified to accommodate the new, larger screens.

Replacement of the screens and modification of the screen protection H-piles will be accomplished by the contractor working from a barge. Divers will remove and replace the screens using an onboard crane, so there will be no disturbance to the riverbank. Two construction methods are under consideration to modify up to ten of the screen protection H-piles to accommodate the larger screens: (1) Divers will cut the existing H-piles and attach brackets to extend the area protected by the piles. (2) The existing H-pile will be extracted with a vibratory hammer or cut 2 feet below riverbed, if the pile cannot be completely removed. The new pile will be installed with a vibratory hammer and then set with an impact hammer. The pile may be concrete, 24 inches in diameter or smaller, steel H-pile designated HP24 or smaller, or wood that has not been treated with preservatives or pesticides. Sound attenuation methods will be used when using an impact hammer. The number of screen protection piles that will need to be modified and the construction method will be determined in final design. All construction activities in the river will be conducted during the Willamette River in-water work window of June 1 to October 31.

Raw Water Facilities Site Seismic Improvements

The majority of seismic improvement activities will occur above the Section 404 and Oregon Removal-Fill Law ordinary high water (OHW) mark (elevation 74 feet North American Vertical Datum of 1988 (NAVD88), based on field indicators); however, a very small section of pile wall and associated temporary construction footprint will occur below this elevation. Slightly more work would occur below the Section 10 OHW elevation (78.7 feet NAVD88, based on modeled elevation provided by the USACE); however, the majority of work still occurs above this elevation. See the impacts table in Attachment A.3 for detailed acreage and volume quantities for work below OHW. Further description is provided below.

The riverbank adjacent to the existing raw water intake has the potential for related slope failure during a seismic event, and for the slide mass to bury and damage the intake. Site seismic improvements will be constructed as part of the Project to address seismic and structural vulnerabilities at the raw water intake and raw water pump station. A subsurface wall of piles will be constructed on the Willamette River riverbank to protect the raw water intake from damage that would result if it were buried during a seismic event. A second subsurface wall of piles will be constructed near the top of the slope to protect the existing raw water pump station, the structures associated with the pump station, and the WWSS pipeline exiting the pump station from damage due to slope failure during a seismic event. Construction of the seismic improvements would last approximately eight months.

Access to the construction area for seismic improvements will be via existing unpaved access roads that will be improved and extended by laying down temporary materials of crushed rock and geotextile. The construction area will accommodate access roads and work platforms for a drill rig and crane used to install the piles. The access roads will be approximately 12 feet wide and will require localized leveling of the slope. The total construction area for seismic improvements would affect approximately 0.5 acre of forested riparian area. Construction below the OHW elevation will occur during the Willamette River in-water work window.

Intake Protection. Approximately sixteen 4-foot-diameter tangent piles will be built into the bank above the intake screens to stabilize the potential failure zone. The piles will be constructed near the toe of the riverbank and will extend approximately 50 feet deep. Of the 16 piles, 1 pile is anticipated to be located below OHW elevation. The pile wall will be buried approximately 1 foot below grade, and the ground level will be restored to preconstruction elevations.

The pile wall will be constructed using a track-mounted drill rig that would be placed parallel to the wall construction. An auger will be used to drill shafts, and then a steel casing will be installed to protect the soil from caving into the shaft. Concrete will be pumped in to backfill the shaft, creating the piles. After construction, the slope will be regraded, and the hillside revegetated with appropriate riparian species and in accordance with local jurisdictional requirements.

Pump Station and Associated Structures Protection. The raw water pump station and the locations for proposed associated structures are also at risk of damage from potential for slope failure. Approximately thirty-seven 10-foot-diameter piles, each extending approximately 120 feet deep, will be constructed near the top of the slope. The piles will be located no closer than 15 feet from the intake pipe. Within 15 feet of the intake pipe, a jet grout block approximately 36 feet by 50 feet by 35 feet will be installed underground to connect two segments of the pile wall while protecting the intake pipe.

Together, the drilled shafts and jet grout block will extend approximately 450 feet along the top of the slope in two segments. This 10-foot-diameter pile wall will be constructed as described above for the 4-foot-diameter pile wall. The jet grout block will also be constructed using a track-mounted drill rig placed parallel to the wall construction. Jet grouting consists of injecting liquid concrete into the soil to create a soil/concrete mixture below the ground surface. During this process, a borehole is drilled to the desired depth, and then concrete (sometimes mixed with water and air) is pumped into the borehole. As the injection equipment rotates and is withdrawn from the borehole, a column of loosened soil stabilized with concrete is created.

Raw Water Pump Station

The pump station facilities will be constructed in upland areas, including partly within the existing WRWTP site. No work in wetlands or other waters is associated with these facilities.

WWSS WATER TREATMENT PLANT

As noted above, the proposed WWSS WTP will be located near the city of Sherwood. The initial capacity of the new water treatment plant will be 60 mgd, with planned expansions to an ultimate capacity of 120 mgd. The water treatment plant will be expanded in multiple stages, but all construction and new facilities are anticipated to fall within the original footprint (see the Project’s BA in Attachment I for additional description).

The WWSS WTP will be constructed using typical construction methods for buildings, such as grading, laying spread footing foundations, and erecting building sides. Construction equipment is expected to include bulldozers, water trucks, loaders, cranes, excavators, haul trucks, soil compactors, pavers, concrete trucks, dewatering pumps, cranes and/or lifts, and light and heavy duty general construction trucks. If blasting or other specialized equipment is required to excavate rock, all of the operations, including transportation, storage, and handling of explosives and blasting materials, will comply with county, state, and federal regulations.

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Construction of the WWSS WTP is expected to take approximately three years, and will affect approximately 20 acres. Of this area, impervious surfaces will account for approximately 10 acres, and the remaining approximately 10 acres will be landscaped. Wetlands will be impacted by construction of the WWSS WTP as described below.

Wetland impact quantities are provided in Attachment A.3. Construction will result in the permanent total loss of Wetlands A, B, D, E, F, and Potential Wetland H (PW-H), which are small isolated depressional wetlands (see Attachment E, Work Package Design Drawings). Construction will result in permanent and temporary impacts to a portion of Wetland C. Wetland C is a wetland swale that drains northward to a tributary of Hedges Creek, which is a tributary to the Tualatin River. Retaining walls are proposed in order to limit the permanent impacts to Wetland C. However, providing for equipment access during construction of the retaining walls will result in temporary impacts. Temporarily disturbed areas will be restored to native conditions post-construction. Wetland G is a very large, isolated depressional wetland. This wetland will be purposefully avoided in order to maintain its habitat quality and functions.

RESERVOIR FACILITIES

No known impacts to regulated wetlands or waterways will occur at the Reservoir Facilities site and associated staging areas. A wetland delineation has not been conducted at this site due to lack of property access. However, based on review of surrounding conditions, landscape position, National Wetland Inventory, and soils maps, there is a very low likelihood of jurisdictional resources within the proposed development footprint for the Reservoir Facilities. There is likely to be a stream and potentially slope wetlands in a ravine along the east side of the property. However, the proposed development footprint only extends to the upper slopes of the ravine and, therefore, is assumed to avoid jurisdictional resources. A wetland delineation will be conducted prior to permit issuance to confirm these assumptions.

The staging areas for work on the Reservoir Facilities are anticipated to be approximately 6.9 acres, of which up to 0.3 acre is located within the Reservoir Facilities site, and the remainder is on the property to the west, across SW Grabhorn Road. The staging area west of SW Grabhorn Road was delineated for wetlands. Currently, this area consists primarily of non-native grassland, Himalayan blackberry shrub thickets, and scrub-forest habitats. A wetland and an intermittent drainage system located in the northwest corner of the property would be avoided. Both staging areas will be graded to establish final contours and revegetated with native plantings upon completion of the work.

TRANSMISSION PIPELINES

Transmission Pipelines have been sited to avoid and minimize impacts to wetlands and waterways to the greatest extent practicable. However, site constraints dictate that the pipelines leave developed road rights-of-way in certain locations along the pipeline route, which results in wetland and waterway impacts in some locations. Further detail of how resources were avoided is provided in the Alternatives Analysis (see Attachment D). Pipeline resource crossings (i.e., wetlands and waterways) will include both open-trench crossings and trenchless crossings (e.g., boring). Trenchless approaches will be used to avoid and minimize resource impacts where practicable. Depths of the pipeline at creek crossings will be set to minimize the risk of potential future scour exposing the pipe.

The WWSS includes 12 turnouts for connecting the WWSS pipelines to existing water distribution systems. Turnouts consist of a short length of pipe and a below-grade meter vault and, in some cases, a below-grade pressure-regulating or flow-control station. Any modifications to existing water distribution systems beyond the meter vault would be permitted and constructed separately, and are not considered part of the WWSS. The turnouts are not located in any resource crossings and will not be discussed further in this document.

Unavoidable Impacts to Resources from Transmission Pipelines

The Transmission Pipelines will result in some unavoidable impacts to wetlands and waters, as shown in the figures provided in Attachment E and listed in the impacts table provided in Attachment A.3 (note that Attachment A.3 addresses the removal-fill quantification requirements of Sections 6F, 6G, 6H, and 6I of this application). The vast majority of these impacts will be of a temporary nature, primarily from open-trench construction. However, some permanent impacts to wetlands and waters will occur as a result of pipe appurtenances (e.g., blowoff valves) that need to be sited in low spots. A description of pipeline open-trench construction activities relevant to proposed resource crossings is provided below.

Transmission Pipeline Work Areas

Permanent easements along the pipeline would typically be about 50 feet wide, with an additional 25 feet of temporary (construction) easement, for a typical total work area width of 75 feet (see Transmission Pipeline Work Package Design Drawings provided in Attachment E). However, widths will vary depending upon site-specific conditions, such as avoiding existing facilities or conformance to property boundaries. The total work area is intended to provide space for equipment operation and staging areas during construction. If additional staging area is necessary during construction, the contractor would be responsible for identifying, securing, maintaining, and restoring those locations according to the project specifications. Staging areas will not be located within resource areas.

During open-trench construction, the work area would be graded to establish appropriate contours for construction, and to provide safe and efficient machinery movement and operation. Topsoil would be removed and stored on-site for use during backfill and revegetation when appropriate.

Required trench width is a function of pipeline diameter, geotechnical properties of the surrounding soils, backfill material, trench protection methods, contractor construction methods, and inspection requirements, but would typically be 8 feet to 12 feet wide. Beneath the active stream channel, the depth of earth cover over the pipe will be a minimum of twice the pipe diameter, or deep enough to avoid active scour as indicated by a subsequent site-specific analysis. Beyond the active channel, minimum cover would vary according to local conditions, but would typically not be less than 4 feet deep.

Trench Protection

Trench protection methods are determined by soil conditions and trench depth, and are designed to prevent cave-ins. Trench protection methods at resource crossings would include one or more of the following: trench boxes, soldier piles and lagging, sheet piles, or other engineered retaining structures. Trench protection components would be removed as the trench is backfilled.

Open-Trench Construction Dewatering

High groundwater is frequently encountered in open-trench construction through resource crossings, and its management is essential in order to provide safe construction conditions and quality pipeline installation. In areas of known, persistent high groundwater, pre-drainage methods can involve using well points (pre-drilled temporary wells) to lower local groundwater elevations before the trench is excavated. Well point systems are designed to meet construction safety needs as well as to protect adjacent natural resources. Where listed species are present, changes in stream flow within active channels would be monitored; sheet piles could be utilized between well points and the active channel to limit the effects of dewatering on streamflows.

A common method for controlling groundwater intrusion into the open pipeline trench is to use pumps at the bottom of the excavation area (in a sump) to draw down groundwater below the open trench bottom. Typically, the water is pumped out by solids-handling sump pumps. Sump pump systems have limited capacity and are not capable of significantly changing the water table to the extent that wetlands or streams would be affected.

Groundwater collected from well points and sump pump systems generally is pumped into a temporary retention pond or tank for treatment before being discharged to upland areas or routed to appropriate storm drains, upon meeting discharge requirements. Discharge of groundwater is coordinated with local agencies through erosion and sediment control permitting. Settlement and/or filtration of groundwater through settling tanks or other systems may be necessary before groundwater can be discharged, in order to meet Oregon Department of Environmental Quality (DEQ) Water Quality Standards (the relevant state regulation is the Beneficial Uses, Policies, and Criteria for Oregon (OAR 340-041-0036), which states that no more than a 10 percent cumulative increase in natural stream turbidities is allowed, as measured relative to a control point immediately upstream of the turbidity-causing activity). After treatment, if required, water can be discharged to a stream, river, wetland, open area, or storm drain system.

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Transmission Pipeline Work Area Isolation

Isolating work areas during open-trench construction within an active channel generally involves shifting flows from one side of a stream to the other as construction progresses, unless complete impoundment is possible and does not last more than seven days. Work areas within streams and adjacent wetland areas can be isolated, allowing the flow of upstream water to continue downstream and providing fish passage as needed. Several methods can be used to reroute or temporarily isolate streams and fish from the work area, including pipes, cofferdams, diversion ditches, silt curtains, sheet piles, sand bags, inflatable dams, or similar methods. To minimize disturbance to downstream fish populations and habitats, the discharge point from the temporary diversion is located immediately downstream of the worksite.

Trench Backfill

Backfill materials for the pipe bedding and pipe zone (the fill area adjacent to the pipe and within 1 foot above the pipe) provide necessary support to the pipeline, and are placed and compacted around the curvature of the pipe. Backfill will be composed of granular material (aggregate) or controlled low-strength material (low-strength concrete). Using aggregate backfill requires a slightly wider trench to accommodate compaction activities. No compaction is necessary for low-strength concrete.

Native soils from on-site excavation materials are typically not considered suitable for bedding and pipe zone materials, so granular aggregate materials are used. Select native soils are typically used for backfill above the pipe zone in areas not sensitive to settlement.

Aggregate backfill is typically more porous than native soils, and in places where aggregate is used for backfill, the pipe zone could act as a conduit for groundwater flow. To limit groundwater flow through the pipe zone, low-permeability concrete trench cutoff walls (constructed from low-strength concrete) would be installed in trenches that are backfilled with aggregate. Trench cutoff walls are installed at specific intervals and locations to prevent subsurface water from wetlands and waterways being channeled through the pipeline trench.

Blowoff Valve Construction and Operation

Blowoff valves, or low-point drains, provide an outlet to drain the transmission pipeline during testing, commissioning, and maintenance activities. Blowoffs are necessary at low points on the pipeline regardless of the surrounding geography or topography, but they are often needed at resource crossings because of the lower pipe elevations at these locations. Blowoff valves will not occur below OHW; however, they are located on streambanks and adjacent wetlands at some locations (see impacts table in Attachment A.3).

Blowoffs are constructed with one or more isolation valves and a vertical casing pipe that extends to the ground surface. During blowoff events, the construction or maintenance crew connects discharge piping to the vertical casing when water is under pressure. After the transmission line is depressurized, a sump pump can be lowered into the vertical casing to pump out the remaining water. Blowoffs located within urban areas direct outflow toward street storm drains whenever possible. Discharge rates will be coordinated with the jurisdictional utility agency to avoid overloading the downstream receiving systems.

If a storm or sanitary sewer system is unavailable for discharge, and it is necessary to discharge to upland areas, wetlands, or surface waters, the water will be dechlorinated and treated (settled or filtered), as needed, to meet water quality and discharge regulations. Residual chlorine that might remain in the water will be removed if necessary by adding ascorbic acid (vitamin C) or sodium bisulfate to the water (the relevant state regulation is the Beneficial Uses, Policies, and Criteria for Oregon (OAR 340-041-0036)). Discharge rates at each drain location will be controlled by throttling valves installed on the drain locations. For the Transmission Pipelines, any blowoff valves that discharge directly to a drainage will be designed to prevent soil erosion or channel erosion. Blowoff discharge rates would not exceed the bankfull discharge rate for the receiving channel, in order to prevent soil or channel erosion. Bankfull discharge will be estimated using local stream gage data, previous drainage studies, or published regional regression equations. Temporary best management practices (BMPs) might also be applied to control downstream effects during regular maintenance or emergency drainage.

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Trenchless Crossings

Trenchless crossings will not result in impacts to jurisdictional wetlands or waterways. All staging and work areas will be located out of jurisdictional resources. A brief description of such work is provided in this JPA, since the work will be located near regulated resources, including passing underneath such resources. A more detailed description of trenchless crossing methods is provided in the Project's BA (Attachment I).

Trenchless crossing methods will be used at several locations along the pipeline, as identified in the resource descriptions table (Attachment A.2) and the impacts table (Attachment A.3). Several factors are used to determine the most appropriate type of trenchless crossing method, such as the type of feature being crossed (e.g., natural resource, railroad, highway), subsurface geotechnical conditions, the pipe diameter, and the length of a given crossing.

Shallow crossings for the Project generally include crossings for some wetlands and streams, as well as railroads, major roadways, and major utilities along the pipeline alignment. Shallow crossings are generally anticipated to be less than 25 to 30 feet deep to the top of the pipe (but not less than twice the diameter of the pipeline at resource crossings), and they allow simpler shoring and dewatering designs than deep crossings. Trenchless methods appropriate for shallow resource crossings primarily include jack and bore (also called auger boring) and pipe ramming; where groundwater conditions are appropriate, a shielded tunnel boring machine can be used. Deeper crossings typically require microtunneling or horizontal directional drilling (HDD). At this time, HDD is not anticipated for use in constructing the Project; however, specific methods of construction will be determined during final design and construction bidding.

Generally, a minimum work area of approximately 60 feet by 150 feet is required at an entry shaft, whereas the space requirements for the exit shaft work area are smaller—a minimum of 50 feet by 80 feet. The minimum work area dimensions would be larger if the site had steep contours or other restrictions. If additional staging area is needed during construction, the contractor would be responsible for identifying, securing, maintaining, and restoring those locations according to the Project specifications. Additional staging areas will not be located within resource areas.

Stream/river morphology significantly impacts the layout of deep crossings. The alignments of trenchless crossings will extend beyond the limits of stream floodplains, with shafts set back from the floodplain side slopes in order to minimize slope instability and seismic risks.

During shaft construction (or staging setup for HDD), the work area will be graded to establish appropriate contours for construction, and to provide for the safe and efficient movement and operation of machinery. Jack and bore, pipe ramming, shielded tunneling, and microtunneling methods involve excavating underground from an entry shaft to a receiving shaft to avoid disturbing surface features between the two shafts (HDD does not require shafts). Entry shafts are typically 20 feet by 40 feet for jack and bore or pipe ramming, and 35 feet in diameter for shielded tunneling or microtunneling (for a 66-inch-diameter pipe). Additional area is necessary for staging in order to provide sufficient room to accommodate excavation and tunneling equipment. Exit shafts are typically 12 feet by 15 feet for jack and bore or pipe ramming, and 25 feet in diameter for shielded tunneling or microtunneling (for a 66-inch-diameter pipe).

In trenchless construction using shafts (jack and bore, pipe ramming, shielded tunneling, and microtunneling), high groundwater must be managed so that safe construction conditions and quality pipeline installation can be provided. Pre-drainage methods might involve using dewatering wells to lower local groundwater elevations before excavating shafts for trenchless construction. Dewatering wells are designed to meet construction requirements as well as protect adjacent natural resources.

A common method for managing groundwater intrusion into the shaft itself is to use pumps at the bottom of the shaft (in a sump) to remove groundwater that may leak into the shaft. Typically, the water would be pumped out by solids-handling sump pumps. Sump pump systems have limited capacity and are not capable of significantly changing the water table to the extent that wetlands or streams would be affected.

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Groundwater collected from well points and sump pump systems generally is pumped into a temporary retention pond or tank for treatment before being discharged to upland areas or routed to appropriate storm drains, upon meeting discharge requirements. Discharge of groundwater is coordinated with local agencies through erosion and sediment control permitting. Settlement and/or filtration of groundwater through settling tanks and systems may be necessary before groundwater can be discharged, in order to meet DEQ Water Quality Standards (the relevant state regulation is the Beneficial Uses, Policies, and Criteria for Oregon (OAR 340-041-0036)). After treatment, if required, water may be discharged to a stream, river, wetland, open area, or storm drain system.

Once tunnel construction is complete, shaft components can be left in place permanently or, as is typically done for steel shaft components, removed. The concrete slab seal at the bottom of the shaft is punctured to prevent flotation, and the shaft is backfilled.

Post-Construction Site Restoration and Revegetation

A conceptual post-construction site restoration plan has been developed for proposed pipeline resources crossings (i.e., wetlands, creeks, and riparian areas) associated with the Project (see Attachment F). This plan is considered conceptual and is intended to provide overall site restoration guidance, specifically along proposed pipeline construction corridors. Site-specific design work for restoration at resource crossings will be required as part of final design for each Project work package, and will need to take into consideration local site conditions, engineering constraints, local regulatory requirements (e.g., CWS and local land use code requirements), and conditions associated with any Project-wide federal and state permits that have been issued.

C. Construction Methods. Describe how the removal and/or fill activities will be accomplished to minimize impacts to waters and wetlands.

Impact avoidance and minimization measures will include the following:

- Perform any in-water work (any construction activities below OHW elevation) during the following ODFW-designated and NMFS-approved windows:
    - Willamette River: June 1–October 31
    - Willamette River tributaries: July 15–October 15
    - Tualatin River tributaries: July 15–September 30
- Have a biologist qualified to conduct fish salvage on-site during work area isolation to assist in implementing conservation measures. Remove fish that are present from the isolated work area by electrofishing and/or netting. Identify any captured fish and then release them unharmed, outside of the work area.
- Install and remove work area isolation measures so that downstream water flows are maintained. Maintain and control water flow for the duration of the diversion to prevent downstream dewatering.
- Minimize alteration or disturbance of streambanks and existing riparian vegetation.
- Flag the Permitted Work Area (also referred to as the in-water work area, OHW elevation, and jurisdictional waters or wetlands) before mobilizing equipment on-site.
- Locate areas for storage of equipment and vehicles, other than track-mounted vehicles, at least 150 feet away from the Permitted Work Area, unless developed areas are available for staging, and appropriate containment measures are in place to ensure containment and isolation of equipment and vehicles from the work area.
- Locate areas for storing fuels and other potentially hazardous materials, and areas for refueling and servicing construction equipment and vehicles at least 150 feet away from the Permitted Work Area, unless developed areas are available for staging, and appropriate containment measures are in place to ensure containment and isolation of potentially hazardous materials, equipment, and vehicles from the work area.
- For track-mounted equipment, large cranes, and other equipment whose limited mobility makes it impractical to move them for refueling, take all feasible precautions to prevent and minimize the risk of fuel reaching the Permitted Work Area; implement appropriate spill prevention measures, and provide fuel containment systems designed to completely contain a potential material spill, as well as other pollution control devices

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and measures adequate to provide complete containment of hazardous material; and perform refueling operations to minimize the amount of fuel remaining in vehicles stored during non-work times.

- Maintain hazardous material containment booms and spill containment booms on-site to facilitate the cleanup of hazardous material spills. Install hazardous material containment booms where there is a potential for release of petroleum or other toxicants.
- Prohibit underwater blasting.
- Implement containment measures adequate to prevent pollutants or construction materials (such as waste spoils, petroleum products, concrete cured less than 24 hours, concrete cure water, silt, and welding slag and grindings) from entering the Permitted Work Area or any regulated waters.
- If flooding of the work area is expected to occur within 24 hours, evacuate all potential pollutants, equipment, and fuel from the anticipated inundation area.
- Do not permit any equipment in the wetted channel or any wetland, unless the work to be performed using such equipment is isolated from the wetted channel or wetland.
- Do not discharge contaminated or sediment-laden water from the Project or water contained within a cofferdam directly into any waters of the state until the water is satisfactorily treated (for example, by bioswale, filter, settlement pond, pumping to vegetated upland location, bio-bag, or dirt-bag), as appropriate.
- Do not use treated timbers within the Permitted Work Area for any purpose.
- Do not apply fertilizer within 50 feet of any wetland or waterbody.
- Before operating within 150 feet of the Permitted Work Area, inspect and clean all construction equipment; check all construction equipment for fluid leaks; remove external oil, grease, dirt, and caked mud; do not discharge untreated wash and rinse water into the Permitted Work Area; and establish temporary impoundments to catch water from equipment cleansing (which may only be performed at least 150 feet from the Permitted Work Area and in a location that does not contribute untreated wastewater to any waters of the state unless otherwise noted).
- Place waste materials and spoils above bank lines and away from any wetlands. If necessary, temporarily locate waste materials and spoils, before their removal from the Project site and disposal, above bank lines and away from any wetlands. Construction spoils will be disposed of in accordance with applicable regulations.
- Minimize the operation of equipment in or on the water to the extent feasible.
- For construction access roads and work areas near waterways and wetlands, use a rock work pad or other measures to minimize soil compaction from heavy equipment. Place a geotextile fabric, chain link fence, or other equally effective material under the temporary rock to protect existing ground and assist in removal of temporary work pad fill rock. Following construction, remove all of the temporary work pad materials, and regrade and restore the area according to the revegetation plans.
- Mandate that “diapering” of vehicles and stationary equipment to catch any toxicants (for example, oils, greases, and brake fluid) be used when the vehicles have any potential to contribute toxic materials into aquatic systems.
- Implement the following BMPs for trenchless (drilling, boring, or jacking) resource crossings:
    - Design, build, and maintain facilities to collect and treat construction and drilling discharge water using the appropriate technology applicable to site conditions. Provide treatment to remove debris, nutrients, sediment, petroleum hydrocarbons, metals, and other pollutants likely to be present. Use collection and proper disposal off site as an alternative to treatment.

    - Isolate drilling operations from wetted stream to prevent drilling fluids from contacting waters of the state and U.S.

    - Prevent loss of drilling fluid to the subsurface formation. If necessary, use drill casing. If drilling fluid or waste is released to surface water, a wetland or other sensitive environment, cease drilling operations until approval from the Owners' Representative is received to resume drilling. The Owners' Representative will notify the appropriate regulatory agencies of inadvertent release.

  - Recover, recycle, or dispose of drilling fluids and waste as needed to prevent entry into flowing water.
  - The contractor will submit its anticipated slurry operating pressures for review by the Owners' Representative, according to technical specifications, before construction begins.

- The contractor will implement an Erosion Control Plan to prevent the discharge of sediment to surface waters and ensure that turbidity does not exceed 10 percent above existing background conditions. An example Erosion Control Plan for a single crossing is provided in Attachment G. The Project will comply with issued National Pollutant Discharge Elimination System (NPDES) permit requirements.
  - Identify and isolate sensitive areas before construction begins. Install erosion and sediment control measures around and on the site.
- Implement the following BMPs when using a barge:
  - Before moving the barge to the project site, unless the barge is transported solely by water from within the state of Oregon, inspect the barge and ballast for invasive species to prevent bringing invasive species to the Project site. Contact the Oregon State Marine Board if invasive species are found.
  - Prohibit barge grounding. Do not at any time allow barges to be grounded on the bed or banks of the waterway.
  - Do not use impact hammers for barge support/anchor (spud) placement.
  - Install and maintain containment measures to prevent barge surface runoff from flushing oil, fuel, or other contaminants into the water.
  - Secure all equipment, as well as containers with fuel, hazardous materials, or waste, to the barge deck.
  - If a fuel container is used on the barge, provide a double-walled fuel container and place an absorbent containment boom around the container when it is on the barge.
  - Provide individual containment for each piece of equipment on the barge, including containment pans or absorbent booms to contain minor spills locally.
  - Develop a spill mitigation plan prior to the start of work.
- Implement one of the following sound attenuation methods when using an impact hammer to install the screen protection piles:
  - If the water velocity is 1.6 feet per second (fps) or less, surround the pile being driven by a confined or unconfined bubble curtain that will distribute small air bubbles around 100 percent of the pile perimeter for the full depth of the water column (see, e.g., NMFS and USFWS (2006), Wursig et al. (2002), and Longmuir and Lively (2001)).
  - If water velocity is greater than 1.6 fps, surround the pile being driven with a confined bubble curtain (e.g., surrounded by a fabric or non-metallic sleeve) that will distribute small air bubbles around 100 percent of the pile perimeter for the full depth of the water column.

(6) PROJECT DESCRIPTION

D. Describe source of fill material and disposal locations if known.

The Project will use a balanced cut/fill approach to the extent practicable. Nearly all wetland impacts will be temporary; that is, topsoil will be stockpiled and replaced after pipe installation. There will likely be excess cut because of the volume displacement of the buried pipes and specialized backfill materials, where necessary. The disposal locations for excess subsoil are currently not known, but they will be located in suitable upland locations or rock quarry sites that are being reclaimed.

E. Construction timeline.

What is the estimated project start date?	Construction bid for first work package included in this permit application = 2017
What is the estimated project completion date?	2026
Is any of the work underway or already complete? If yes, describe.	☑ Yes ☐ No

Two pipeline work packages have been permitted as part of local roadway projects for installation beneath previously proposed roadways. The first is the SW 124th Avenue Extension project, which is being carried out by Washington County (currently under construction). WWSS work package PLM_3.0 includes approximately 2.7 miles of pipeline and is being constructed concurrently with the SW 124th Avenue Extension project. The second work package is part of the Kinsman Road project, which is being carried out by the City of Wilsonville (currently under construction). WWSS work package PLM_2.0 includes approximately 0.5 mile of pipeline and is being constructed concurrently with the Kinsman Road project. These opportunity roadway projects allowed for considerable cost savings, and the pipeline construction associated with these packages has resulted in no additional resource impacts than would have resulted from the roadway projects alone. A third opportunity project, PLW_1.1, which is a small subset of the PLW_1.0 work package, is also under construction. This opportunity project does not include impacts to regulated resources and therefore did not require permits from the USACE or DSL.

F. Fill Volumes and Dimensions (if more than 4 impact sites, include a summary table as an attachment)
(See Attachment A.3)

Wetland / Waterbody Name *	**Fill Dimensions**					**Duration of Impact****	**Material*****
	Length (ft.)	**Width (ft.)**	**Depth (ft.)**	**Area (sq. ft. or ac.)**	**Volume (c.y.)**		
		See impacts table in Attachment A.3.					

G. Total Fill Volumes and Dimensions

Fill Impacts to Waters	**Length (ft.)**	**Area (sq. ft. or ac.)**	**Volume (c.y.)**
Total Fill to Wetlands	**See impacts table in Attachment A.3**		
Total Fill Below Ordinary High Water			
Total Fill Below Highest Measured Tide			
Total Fill Below High Tide Line			
Total Fill Below Mean High Water Tidal Elevation			

H. Removal Volumes and Dimensions (if more than 4 impact sites, include a summary table as an attachment)

Wetland / Waterbody Name*	**Removal Dimensions**					**Duration of Impact****	**Material*****
	Length (ft.)	**Width (ft.)**	**Depth (ft.)**	**Area (sq. ft. or ac.)**	**Volume (c.y.)**		
		See impacts table in Attachment A.3					

(6) PROJECT DESCRIPTION

I. Total Removal Volumes and Dimensions

Removal Impacts to Waters	**Length (ft.)**	**Area (sq. ft. or ac.)**	**Volume (c.y.)**
Total Removal to Wetlands	**See impacts table in Attachment A.3**		
Total Removal Below Ordinary High Water			
Total Removal Below Highest Measured Tide			
Total Removal Below High Tide Line			
Total Removal Below Mean High Water Tidal Elevation			

* If there is no official name for the wetland or waterway, create a unique name (such as "Wetland 1" or "Tributary A").
** Indicate the days, months or years the fill or removal will remain. Enter "permanent" if applicable. For DSL, permanent removal or fill is defined as being in place for 24 months or longer.
*** Example: soil, gravel, wood, concrete, pilings, rock etc.

(7) ADDITIONAL INFORMATION

Are there any state or federally listed species on the project site? ☑ Yes ☐ No ☐ Unknown

Is the project site within designated or proposed critical habitat? ☑ Yes ☐ No ☐ Unknown

Is the project site within a national Wild and Scenic River? ☐ Yes ☑ No ☐ Unknown

Is the project site within the100-year floodplain? ☑ Yes ☐ No ☐ Unknown

*** If yes to any of the above, explain in Block 4 and describe measures to minimize adverse effects to these resources in Block 5.**

Is the project site within the Territorial Sea Plan (TSP) Area? ☐ Yes ☑ No ☐ Unknown

*** If yes, attach TSP review as a separate document for DSL.**

Is the project site within a designated Marine Reserve? ☐ Yes ☑ No ☐ Unknown

*** If yes, certain additional DSL restrictions will apply.**

Will the overall project involve construction dewatering or ground disturbance of one acre or more? ☑ Yes ☐ No ☐ Unknown

*** If yes, you may need a 1200-C permit from the Oregon Department of Environmental Quality (DEQ).**

Is the fill or dredged material a carrier of contaminants from on-site or off-site spills? ☐ Yes ☐ No ☑ Unknown

Has the fill or dredged material been physically and/or chemically tested? ☐ Yes ☐ No ☑ Unknown

***If yes, explain in Block 4 and provide references to any physical/chemical testing report(s).**

Has a cultural resource (archaeological) survey been performed on the project area? ☑ Yes ☐ No ☐ Unknown

*** If yes, provide a copy of the survey with this application. Do not describe any resources in this document.**

Identify any other federal agency that is funding, authorizing or implementing the project.

Agency Name	**Contact Name**	**Phone Number**	**Most Recent Date of Contact**
National Marine Fisheries Service	Annie Birnie	503-230-5407	1/23/2017
Oregon DEQ	Amy Simpson	503-229-5051	1/18/2017

List other certificates or approvals/denials required or received from other federal, state or local agencies for work described in this application. For example, certain activities that require a USACE permit also require 401 Water Quality Certification from Oregon DEQ.

Approving Agency	Certificate/ approval / denial description	Date Applied
Oregon DEQ	401 water quality certification	Same as JPA submittal

(7) ADDITIONAL INFORMATION

Other DSL and/or Corps Actions Associated with this Site (Check all that apply.)

☐ Work proposed on or over lands owned by or leased from the Corps

☑ State owned waterway DSL Waterway Lease # 22670-EA

Willamette River and Tualatin River

☐ Other Corps or DSL Permits Corps # DSL #

☐ Violation for Unauthorized Activity Corps # DSL #

☑ Wetland and Waters Delineation Corps # (see below) DSL # (see below)

Note: Wetland delineation reports have been submitted to the USACE and DSL as separate submittals from this JPA due to the size of the reports and to allow for early submittal and review of the delineation reports. The following agency tracking numbers have been assigned:

Work Package or Site Name	**Submitted to DSL**	**DSL File #**	**Submitted to USACE**	**USACE ID**	**Review Status**
PLM_1.0	1/19/2017	WD2017-0026	1/19/2017	(DA#) NWP-2015-41	under review
PLM_4.0	1/9/2017	WD2017-0006	1/9/2017	(DA#) NWP-2015-41	under review
PLM_5.0	1/19/2017	WD2017-0024	1/19/2017	(DA#) NWP-2015-41	under review
PLW_2.0	1/9/2017	WD2017-0007	1/9/2017	(DA#) NWP-2015-41	under review
Reservoir 2 site	1/9/2017	WD2017-0005	1/9/2017	(DA#) NWP-2015-41	DSL concurrence on 3/21/2017 USACE under review
WTP 1.0 (WWSS WTP)	1/9/2017	WD2017-0008	1/9/2017	(DA#) NWP-2015-41	DSL concurrence on 3/29/2017 USACE under review
PLE_1.0	1/19/2017	WD2017-0025	1/19/2017	(DA#) NWP-2015-41	under review
PLW_1.0	1/19/2017	WD2017-0027	1/19/2017	(DA#) NWP-2015-41	under review
RWF_1.0 (WRWTP)	6/7/2016	WD2016-0249	1/9/2017	(DA#) NWP-2015-41	DSL concurrence on 8/31/2016 USACE under review
RES_1.0	Wetland delineation not yet conducted due to lack of site access				

☑ A wetland / waters delineation has been completed (if so, provide a copy with the application)

☐ The Corps has approved the wetland / waters delineation within the last 5 years

☑ DSL has approved the wetland / waters delineation within the last 5 years

(8) IMPACTS, RESTORATION/REHABILITATION, COMPENSATORY MITIGATION

A. Describe unavoidable environmental impacts that are likely to result from the proposed project. Include permanent, temporary, direct, and indirect impacts.

Section 6(B) describes the general types of wetland and waterway impacts that will occur as part of the Project, and the impacts table provided in Attachment A.3 provides the permanent and temporary impact quantities. Most direct impacts will be of a temporary nature as a result of open trenching for pipe installation. Site restoration will occur as described below in Section 8B. Indirect impacts are anticipated to be only temporary in nature and could include temporary disturbance to fish and wildlife in the vicinity of proposed Project construction. Direct and indirect impacts to species listed under the federal Endangered Species Act (individuals and their habitats) are addressed in the BA included as Attachment I.

B. For temporary removal or fill or disturbance of vegetation in waterways, wetlands or riparian (i.e., streamside) areas, discuss how the site will be restored after construction.

A Conceptual Post-Construction Site Restoration Plan is provided in Attachment F. Areas of temporary disturbance will typically be graded similar to preconstruction contours and planted with native vegetation. Plantings will typically include native trees, shrubs, and herbaceous material. However, there are some exceptions, primarily in agricultural wetlands, as described in Attachment F.

Compensatory Mitigation

C. Proposed mitigation approach. Check all that apply:

☐ Permittee-responsible Onsite Mitigation

☐ Permittee-responsible Offsite mitigation

☑ Mitigation Bank or in-lieu fee program

☐ Payment to Provide (not approved for use with USACE permits)

D. Provide a brief description of mitigation approach and the rationale for choosing that approach. If you believe mitigation should not be required, explain why.

Mitigation for all permanent wetland impacts, as well as for wetlands that will experience a permanent loss of wetland function (i.e., forested wetlands), is proposed using an approved wetland mitigation bank. The use of a mitigation bank in the Tualatin River Basin is proposed because individual impacts will be localized but distributed over a long distance, with each individual impact being relatively small. Consolidating mitigation at an approved mitigation bank is often a desired approach for long, linear projects such as the WWSS.

A review of how the mitigation proposed for the Project meets DSL's principal objectives is provided below.

Oregon Department of State Lands Principal Objectives:

(a) Replace functions and values lost at the removal-fill site;

Very little function will be lost as a result of the Project. Most of the proposed impacts will be temporary, and in many cases along the Transmission Pipelines, disturbed area will be restored to a more native plant community. In total, 1.18 acres of wetland will experience permanent loss of acreage and associated functions. Approximately 0.47 acre of wetland will experience temporary acreage impacts, but also will experience a permanent decrease in function due to conversion from a forested wetland type to a scrub-shrub or emergent wetland type. Functions and values lost due to these impacts will be offset through the use of mitigation bank credits. The mitigation banks in the Tualatin River Basin have received extensive review by regulatory and resource agencies to determine that the mitigation sites will provide important functions and values, including the water quality and wildlife habitat functions that will be most impacted by the proposed Project.

(b) Provide local replacement for locally important functions and values, where appropriate;

This principal objective is met through the purchase of mitigation bank credits. The mitigation bank underwent extensive review by regulatory and resource agencies to determine that the mitigation site will provide locally important functions and values. Project impacts are located within the bank service areas.

(8) IMPACTS, RESTORATION/REHABILITATION, COMPENSATORY MITIGATION

(c) Enhance, restore, create or preserve wetlands or tidal areas that are self-sustaining and minimize long-term maintenance needs;

This principal objective is met through the purchase of mitigation bank credits. The mitigation bank underwent extensive review by regulatory and resource agencies to determine that the mitigation site will be self-sustaining and minimize long-term maintenance needs.

(d) Ensure the siting of CWM in ecologically suitable locations considering: local watershed needs and priorities; appropriate landscape position for the wetland types, functions and values sought; connectivity to other habitats and protected resources; and the absence of contaminants or conflicting adjacent land uses that would compromise wetland functions; and

This principal objective is met through the purchase of mitigation bank credits. The mitigation bank underwent extensive review by regulatory and resource agencies to determine that the site occurs within an ecologically suitable location.

(e) Minimize temporal loss of wetlands and tidal waters and their functions and values.

This principal objective is met through the purchase of mitigation bank credits. Functions provided at the bank are already occurring; therefore, there will be no temporal loss of wetland functions and values proposed by the Project.

Mitigation Bank / In-Lieu Fee Information:

The applicants propose to purchase credits from either the Butler Wetland Mitigation Bank or Tualatin Valley Environmental Bank. A total of 1.65 credits will be purchased to offset the permanent loss of 1.18 acres of wetlands and 0.47 acre of temporary impacts to forested wetlands. Credits shall be purchased prior to permit issuance or as a permit condition, as required by the USACE and DSL.

If you are proposing permittee-responsible mitigation, have you prepared a compensatory mitigation plan?

☐ Yes. Submit the plan with this application and complete the remainder of this section.

☐ No. A mitigation plan will need to be submitted (for DSL, this plan is required for a complete

Mitigation Location Information (Fill out only if permittee-responsible mitigation is proposed)

Mitigation Site Name/Legal Description N/A	Mitigation Site Address N/A	Tax Lot # N/A
County N/A	City N/A	Latitude & Longitude (in DD.DDDD format) N/A

Township N/A	Range N/A	Section N/A	Quarter/Quarter N/A

(9) ADJACENT PROPERTY OWNERS FOR PROJECT AND MITIGATION SITE

☑ **Pre-printed mailing labels of adjacent property owners attached separately.**	**Project Site Adjacent Property Owners**	**Mitigation Site Adjacent Property Owners**

A list of adjacent property owners is provided in Attachment H (DSL and USACE).

(10) CITY/COUNTY PLANNING DEPARTMENT LAND USE AFFIDAVIT
(TO BE COMPLETED BY LOCAL PLANNING OFFICIAL)

I have reviewed the project described in this application and have determined that:

☐ This project is not regulated by the comprehensive plan and land use regulations.

☐ This project is consistent with the comprehensive plan and land use regulations.

☒ This project will be consistent with the comprehensive plan and land use regulations when the following local approval(s) are obtained:

- ☒ Conditional Use Approval
- ☒ Development Permit
- ☒ Other Permit (see comment section)

☐ This project is not consistent with the comprehensive plan. Consistency requires:

- ☐ Plan Amendment
- ☐ Zone Change
- ☐ Other Approval or Review (see comment section)

An application ☐ has ☒ has not been filed for local approvals checked above.

Local planning official name (print) Daniel Pauly	Title Senior Planner	[✓ City] / County (circle one) Wilsonville

Signature	Date 3/23/17

Comments:
- Work in Willamette River Greenway requires Conditional Use Permit
- Pipeline and associated vents, access points, etc. are exempt from Wilsonville land use permitting as "utilities"
- Buildings require development permit but are expected to be outside areas subject to JPA.

(11) COASTAL ZONE CERTIFICATION

If the proposed activity described in your permit application is within the Oregon coastal zone, the following certification is required before your application can be processed. A public notice will be issued with the certification statement, which will be forwarded to the Oregon Department of Land Conservation and Development (DLCD) for its concurrence or objection. For additional information on the Oregon Coastal Zone Management Program, contact DLCD at 635 Capitol Street NE, Suite 150, Salem, Oregon 97301 or call 503-373-0050.

CERTIFICATION STATEMENT

I certify that, to the best of my knowledge and belief, the proposed activity described in this application complies with the approved Oregon Coastal Zone Management Program and will be completed in a manner consistent with the program.

Print /Type Name N/A	Title N/A
Signature	Date

(13) ATTACHMENTS

☑ **Drawings (items in bold are required)**
- ☑ **Location map with roads identified**
- ☑ **U.S.G.S topographic map**
- ☑ **Tax lot map**
- ☑ **Site plan(s)**
- ☑ **Cross section drawing(s)**
- ☑ **Recent aerial photo**
- ☐ Project photos
- ☑ Erosion and Pollution Control Plan(s), if applicable
- ☑ DSL/Corps Wetland Concurrence letter and map, if approved and applicable

☑ Pre-printed labels for adjacent property owners (Required if more than 5)
☑ Restoration plan or rehabilitation plan for temporary impacts
☐ Mitigation plan
☑ Wetland functional assessment and/or stream functional assessment
☑ Alternatives analysis
☑ Biological assessment (if requested by Corps project manager during pre-application coordination.)
☑ Stormwater management plan (may be required by the Corps or DEQ)
☐ Other:
- ☐
- ☐

Send Completed form to:

U.S. Army Corps of Engineers
ATTN: CENWP-OD-GP
PO Box 2946
Portland, OR 97208-2946
Phone: 503-808-4373

Counties:
Baker, Clackamas, Clatsop, Columbia, Gilliam, Grant, Hood River, Jefferson, Lincoln, Malheur, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Union, Wallowa, Wasco, Washington, Wheeler, Yamhill

OR

U.S. Army Corps of Engineers
ATTN: CENWP-OD-GE
211 E. 7th AVE, Suite 105
Eugene, OR 97401-2722
Phone: 541-465-6868

Counties:
Benton, Coos, Crook, Curry, Deschutes, Douglas Jackson, Josephine, Harney, Klamath, Lake, Lane, Linn

Send Completed form to:

DSL - West of the Cascades:

Department of State Lands
775 Summer Street NE, Suite 100
Salem, OR 97301-1279
Phone: 503-986-5200

OR

DSL - East of the Cascades:

Department of State Lands
1645 NE Forbes Road, Suite 112
Bend, Oregon 97701
Phone: 541-388-6112

Send all Fees to:
Department of State Lands
775 Summer Street NE, Suite 100
Salem, OR 97301-1279
Pay by Credit Card by Calling 503-986-5253

Attachment A: JPA Form Information Supplements

Attachment B: Wetland Functional Assessment Memorandum

Attachment C: Wetland Delineation Concurrence Letters

Attachment D: Alternatives Analysis

Attachment E: Figures

- Vicinity (Map Keys)
- USGS Topographic Maps, Tax Maps, and Aerial Photos by Work Package
- Work Package Design Drawings
  - Raw Water Facilities
  - Reservoir Facilities
  - Willamette Water Supply System Water Treatment Plant (WWSS WTP)
  - Transmission Pipelines
- Additional Environmental Benefits Projects

Attachment F: Conceptual Post-Construction Site Restoration Plan

Attachment G: Example Erosion and Sediment Control Plan (Chicken Creek Crossing)

Attachment H: Adjacent Property Owners/Mailing Labels

Attachment I: Biological Assessment (Provided under separate cover to USACE)

Attachment J: Cultural Resources Report/Programmatic Agreement (Provided under separate cover to USACE)

Attachment A.2: JPA Section (4.A) WWSS Jurisdictional Wetland and Waterway Crossings (Impact acreage and volumes provided in table Attachment A.3)

Work Package	Resource Crossing	Delineation Feature ID's	Resource Description	Listed Species	Fish Habitat (per ODFW maps)	Planned Crossing Method or Activity	Impacts to Jurisdictional Resources Avoided?
RWF 1.0	Willamette River	Willamette River	Steep upland forested bluff leads down to a narrow, moderate to gradual sloping flood bench adjacent to open water/channel of Willamette River. OHW extends beyond the channel and onto the floodbench as evidenced by flood deposits, drift lines, and a break between persistent vegetation cover in the herbaceous layer. The intake is located in the river proper, with no aboveground structures.	UWR steelhead , UWR Chinook salmon critical habitat	Steelhead rearing and migration; provides habitat for non-listed species	Proposed fish screen replacement	Structural fill from the fish screen replacement only
RWF 1.0	Arrowhead Creek at Arrowhead Creek Lane	Arrowhead Creek	Perennial stream that drains to Coffee Lake Creek. Forested riparian corridor in most areas, but dominated by blackberry at proposed crossing location.	Drains to steelhead and Chinook critical habitat	No steelhead habitat; provides habitat for non-listed species	Trenchless	Impacts avoided
WTP 1.0 (WWSS WTP)	Wetland A	A	Small isolated depresssional palustrine scrub-shrub wetland, roughly half of which is surrounded by rocky slopes and rock overhangs. Dominated by native vegetation including Douglas spirea, Oregon ash, Pacific crabapple, slough sedge, swamp rose, and Pacific willow. Bordered by Oregon oak/madrone and Douglas fir habitats.	None	None	Development fill, entire wetland	Permanent impact
WTP 1.0 (WWSS WTP)	Wetland B	B	Small isolated depresssional unconsolidated bottom wetland, consists largely of unvegetated ponded water over 2 feet deep but less than 6 feet deep. Surrounded by rocky outcroppings, steep rock faces, and boulders. Where present, vegetation is dominated by reed canarygrass, colonial bentgrass, and swamp rose. Bordered by Oregon oak/madrone and Douglas fir habitats.	None	None	Development fill, entire wetland	Permanent impact
WTP 1.0 (WWSS WTP)	Wetland C	C	A palustrine forested and scrub-shrub wetland, typical of Oregon ash swale wetlands. Dominated by Oregon ash, swamp rose, Douglas spirea, and slough sedge. Drains off-site to the north and eventually to a tributary of the Tualatin River. Bordered by Oregon oak/madrone and Douglas fir habitats.	None	None	Development fill and retaining wall to limit impacts	Permanent impact; temporary impact to forested wetland to construct retaining wall will be mitigated as though permanent impact
WTP 1.0 (WWSS WTP)	Wetland D	D	Small isolated depressional wetland with shallow ponded water. Wetland a palustrine scrub-shrub wetland but also has a large palustrine unconsolidated bottom component. Vegetated area is dominated by Douglas spirea, Pacific crabapple, and swamp rose. Bordered by Oregon oak/madrone and Douglas fir habitats.	None	None	Development fill and retaining wall to limit impacts	Permanent impact; temporary impact to construct retaining wall
WTP 1.0 (WWSS WTP)	Wetland E	E	Small isolated depressional palustrine scrub-shrub wetland. Contained shallow ponded water. Vegetated area is dominated by Douglas spirea, Pacific crabapple, and Nootka rose. Bordered by Oregon oak/madrone and Douglas fir habitats.	None	None	Development fill, entire wetland	Permanent impact
WTP 1.0 (WWSS WTP)	Wetland F	F	Small isolated palustrine forested wetland, with some areas of palustrine scrub-shrub and emergent habitats. Dominated by Oregon ash, colonial bentgrass, toad rush, and Oregon ash saplings. Bordered by Oregon oak/madrone and Douglas fir habitats.	None	None	Development fill, entire wetland	Permanent impact

Attachment A.3: JPA Section 6.F-I, WWSP Jurisdictional Wetland and Waterway Impact Quantities (non-ditch features)

				Wetland Impacts			Waterway Impacts			
Location/Activity	Wetland Delineation Report ID	Temporary, Permanent, No Impact	Pipe Installation Method: Trenchless (T) Open Trench (O) Aerial (A)	sqft	Fill (CY)	Removal (CY)	sqft	Fill (CY)	Removal (CY)	Impact Description and Avoidance and Minimization Notes
RWF 1.0										
Intake	Willamette River	Sec. 404 -No impact, Sec. 10 see notes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Section 404 = No impact; screen replacement activity will not disturb riverbed. Section 10 = replacement of 66" screen with new 78" screen.
Arrowhead Creek crossing	Arrowhead Creek	No impact	T	n/a	n/a	n/a	n/a	n/a	n/a	No impact; Trenchless alignment does not impact wetland.
Tangent Pipe Wall	Willamette River	Permanent	n/a	n/a	n/a	n/a	13	23	23	Waterway impacts to the Willamette River are those below CWA Sect. 404 OHW (74 feet). Impacts below CWA Sect. 10 would include 208 sqft and 372.32 CY of removal and fill.
Tangent Pipe Wall	Willamette River	Temporary	n/a	n/a	n/a	n/a	436	16	16	Waterway impacts to the Willamette River are those below CWA Sect. 404 OHW (74 feet). Impacts below CWA Sect. 10 would include 3,485 sqft and 137 CY of removal and fill. Includes 1 foot of temp. crushed rock fill and removal over geotextile fabric for equipment access.
Subtotal - Temporary				0	0	0	436	16	16	
Subtotal - Permanent				0	0	0	13	23	23	
WTP 1.0										
Filter building foundation and WTP road paving	A	Permanent	n/a	2700	1700	800	n/a	n/a	n/a	Site grading and building siting will cause permanent, unavoidable impacts.
WTP road paving and site leveling	B	Permanent	n/a	4800	2667	533	n/a	n/a	n/a	WTP road paving and site leveling will cause permanent, unavoidable impacts.
Retaining wall	C	Permanent	n/a	10000	5500	1100	n/a	n/a	n/a	Retaining wall used to minimize disturbance to resource associated with grading.
Retaining wall	C	Temporary (*)	n/a	4200	156	156	n/a	n/a	n/a	Temporary impacts associated with constructing retaining wall. Includes 1 foot of temp. crushed rock fill and removal over geotextile fabric for equipment access. Impacts occur to 4,200 sq ft of forested wetland, which will require mitigation.
WTP road paving and site leveling	D	Permanent	n/a	10000	1900	0	n/a	n/a	n/a	WTP road paving and site leveling.
Ozone contactor foundation and WTP road paving	E	Permanent	n/a	3400	756	378	n/a	n/a	n/a	Site grading and building siting will cause permanent, unavoidable impacts.
WTP road paving and site leveling	F	Permanent	n/a	6600	2933	733	n/a	n/a	n/a	WTP road paving and site leveling.
Avoided by 200 ft all around	G	No impact	n/a	n/a	n/a	n/a	n/a	n/a	n/a	Avoided by at least 200 ft all around.
WTP road paving and site leveling	PW-H	Permanent	n/a	14000	3600	1500	n/a	n/a	n/a	WTP road paving and site leveling.
Subtotal - Temporary				4200	156	156	0	0	0	
Subtotal - Permanent				51500	19056	5044	0	0	0	
PLM 1.0 - Wilsonville Area Pipeline Project										
Coffee Lake Creek at Industrial Way	W-M1-1, S-M1-1	Temporary	O	1640	256	282	1140	154	164	Temporary impact; Fill volume = Cut volume minus pipe volume. Includes 1 foot of temp. crushed rock fill and removal over geotextile fabric for equipment access.
Tapman Creek at Ridder Road	S-M1-2	No Impact	O	n/a	n/a	n/a	n/a	n/a	n/a	No impact; Alignment does not impact wetland.
Subtotal - Temporary				1640	256	282	1140	154	164	
Subtotal - Permanent				0	0	0	0	0	0	

Exhibit G: Wetland Delineation Report (September 2015)

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

This form must be included with any wetland delineation report submitted to the Department of State Lands for review and approval. A wetland delineation report submittal is not "complete" unless the fully completed and signed report cover form and the required fee are submitted. Attach this form to the front of an unbound report or include a hard copy of the completed form with a CD/DVD that includes a single PDF file of the report cover form and report (minimum 300 dpi resolution) and submit to: **Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279.** A single PDF attachment of the completed cover from and report may be e-mailed to **Wetland_Delineation@dsl.state.or.us**. For submittal of PDF files larger than 10 MB, e-mail instructions on how to access the file from your ftp or other file sharing website. Fees can be paid by check or credit card. Make the check payable to the Oregon Department of State Lands. To pay the fee by credit card, call 503-986-5200.

☒ Applicant ☐ Owner Name, Firm and Address:
Niki Iverson, Water Resource Manager
City of Hillsboro Water Dept.
150 E Main Street
Hillsboro, OR 97123-4028

Business phone # **(503) 615-6770**
Mobile phone # (optional)
E-mail: **niki.iverson@hillsboro-oregon.gov**

☒ Authorized Legal Agent, Name and Address:
Todd Perimon, Principal Engineer
Tualatin Valley Water District
1850 SW 170th Av
Beaverton, OR 97006

Business phone # **(503) 848-3093**
Mobile phone #
E-mail: **ToddP@tvwd.org**

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: **Todd Perimon**____________ Signature: ____________

Date: Special instructions regarding site access:

Project and Site Information (using decimal degree format for lat/long.,enter centroid of site or start & end points of linear project)

Project Name: **Willamette River Water Treatment Plant**
Latitude: **45.2952454** Longitude: **-122.7818821**
Proposed Use: **Improvements to drinking water infrastructure.**
Tax Map # **31W23B Wilsonville**
Project Street Address (or other descriptive location):
On the Willamette River south of Wilsonville.

Township	Range	Section	QQ
1S	**1S**	**25**	

Tax Lot(s) **01800, 01900**
City: **Wilsonville** County: **Clackamas**
Waterway: **Willamette River** River Mile: **40**
NWI Quad(s): **Wilsonville, Oregon**

Wetland Delineation Information

Wetland Consultant Name, Firm and Address:
Attn: Ethan Rosenthal
David Evans and Associates, Inc.
2100 SW River Parkway
Portland, OR 97201

Phone # **503-499-0572**
Mobile phone #
E-mail: **ejro@deainc.com**

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.

Consultant Signature: Date: 8/24/15

Primary Contact for report review and site access is ☒ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☒ Yes ☐ No **Study Area size: 31.06 acres** **Total Wetland Acreage: 0.16 acres**

Check Box Below if Applicable:

- ☐ R-F permit application submitted
- ☐ Mitigation bank site
- ☐ Wetland restoration/enhancement project (not mitigation)
- ☐ Industrial Land Certification Program Site
- ☐ Reissuance of a recently expired delineation

Previous DSL # Expiration date ____

Fees:

- ☒ Fee payment submitted **$ 406**
- ☐ Fee ($100) for resubmittal of rejected report
- ☐ No fee for request for reissuance of an expired report

Other Information:	Y	N	
Has previous delineation/application been made on parcel?	☐	☒	If known, previous DSL #
Does LWI, if any, show wetland or waters on parcel?	☐	☒	

For Office Use Only

DSL Reviewer: ________ Fee Paid Date: ____ / ____ / ____ DSL WD # ________
Date Delineation Received: ____ / ____ / ____ DSL Project # ________ DSL Site # ________
Scanned: ☐ Final Scan: ☐ DSL WN # ________ DSL App. # ________

Wetland Delineation Report

Willamette River Water Treatment Plant

Prepared for:

Tualatin Valley Water District

1850 SW 170th Av
Beaverton, OR 97006

and

Hillsboro
OREGON

150 E Main Street
Hillsboro, OR 97123-4028

Prepared by:

DAVID EVANS
AND ASSOCIATES INC.

David Evans and Associates, Inc.
2100 SW River Parkway
Portland, Oregon 97201

September 2015

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1 INTRODUCTION

The Willamette Water Supply Program (WWSP or Program) has been identified by the Tualatin Valley Water District (TVWD) and the City of Hillsboro (Hillsboro, collectively referred to as the Partners) as the next infrastructure project to deliver drinking water to municipalities in Washington County by developing the mid-Willamette River at Wilsonville as an additional water supply source. The existing Willamette River Water Treatment Plant (WRWTP) will require modifications as part of the WWSP.

David Evans and Associates, Inc. (DEA) conducted an on-site Wetland Delineation for the WRWTP. The site is located in Clackamas County, Oregon (Township 1 South, Range 1 South, Section 25, Willamette Meridian) (see maps in Appendix A). The site lies within Tax Lots 31W23B01800 and 31W23B01900. The site was visited for a general site reconnaissance on March 17, 2015, and the delineation was performed on May 8, 2015. Three wetlands and three waters were delineated within the study area.

The purpose of this delineation is to determine the current presence, location, and size of federal and state jurisdictional wetlands and other waters of the state or United States. Once verified by the appropriate agencies, this Wetland Delineation will allow the Partners to design the WTP modifications with an understanding of potential impacts to waters of the state or U.S., including wetlands.

2 LANDSCAPE SETTING AND LAND USE

The 31.06 acre study area is located along the north bank of the Willamette River, south of SW Wilsonville Road, and west of Coffee Lake Creek. It lies between a residential area to the west, a gravel operation to the east, and an orchard to the north. The WRWTP occupies the southeast quadrant of the site, with several buildings, paths, parking areas, and above and below-ground water treatment facilities. Arrowhead Creek bisects the northern portion of the study area, and a small unnamed creek enters the southwestern portion of the study area and runs through a steep-sided drainage before emptying to the Willamette River. Arrowhead Creek Lane provides access to the WRWTP.

3 SITE ALTERATIONS

The WRWTP site is situated along a high terrace along the north bank of the Willamette River. The terrace gradually slopes downward from the northern end of the site to the southern end of the site and then steepens considerably along a forested bluff that leads down to the Willamette River. The site is often described as two areas, an upper site (roughly the northern third) and a lower site (roughly the southern two thirds). Power lines and Arrowhead Creek Lane bisect the two sites.

The lower site contains the existing WRWTP facility, along with a public park containing lawn, paved trails, ornamental plantings and a fountain. A water storage tank is buried under the southern portion of the lawn area. The west edge of the lower site contains an intermittent drainage feature (including a small wetland), situated in a steep, generally forested, ravine.

The upper site consists of a former hazelnut orchard, maintained lawn areas near the WRWTP access road, and areas of fill covered in lawn grasses. Arrowhead Creek flows from west to east through the north end of the property and is situated in a forested ravine. Two wetlands were delineated within the narrow Arrowhead Creek floodplain. All areas that were disturbed historically (during construction of the WRWTP, roadway, and power lines several decades ago) have returned to normal conditions.

4 PRECIPITATION DATA AND ANALYSIS

Wetland delineation field work occurred on May 8, 2015. Table 1 shows the prior two-week precipitation total for that date. The precipitation record reveals that precipitation was within the range of normal for the short and medium term. Although February and March were above normal, percent of normal precipitation for the water year for the month of April 2015 was 47 percent, which is not within 30% of normal for the month of April (Table 2). However, as shown in Table 3, percent of normal precipitation for the water year through the field date was within 30% of normal. Therefore, although conditions may have been somewhat drier than normal for April, since precipitation falls within 30% of normal for the water year, it was assumed that hydrologic conditions were within the range of normal, and no change in methods was needed.

Table 1: Precipitation for May 2015 Field Investigations and Two Weeks Prior, in Inches

Apr 24	**Apr 25**	**Apr 26**	**Apr 27**	**Apr 28**	**Apr 29**	**Apr 30**
0.00	0.17	0.23	0.07	0.94	0.08	0.11
May 1	**May 2**	**May 3**	**May 4**	**May 5**	**May 6**	**May 7**
0.00	0.00	0.00	0.00	0.00	0.00	0.00
May 8*	**Total**					
0.00	**1.60**					

**Day of field investigation. Source: (NWS 2015)*

Table 2: Percent of Normal Precipitation for the 3 Months Preceding the May Field Investigation

Month	Normal Precipitation for Month (Inches)	Observed Precipitation for Month (Inches)	Departure from Normal (inches)	Within 30% of Normal Precipitation for Water Year?
February 2015	4.41	4.57	+0.16	Yes (104% of normal)
March 2015	3.73	4.68	+0.95	Yes (125% of normal)
April 2015	3.01	1.41	-1.60	No (47% of normal)

Source: (NWS 2015)

Suitable required climatological data for wetland delineations is not available for the Wilsonville area. Therefore alternate nearby data were used as follows. Daily, monthly, and water year precipitation data were obtained from the Hillsboro, Oregon National Weather Service climatological data (NWS 2015). Because the WETS table, per Oregon Department of State Lands (DSL) methods, was not available for Hillsboro, the closest location (BEAVERTON 2 SSW, OR0595) is provided in Appendix D. For consistency, the percent of normal totals for the above tables were taken from the Hillsboro, Oregon NWS climatological data (NWS 2015) rather than from the WETS table. The NWS does not provide readily available compiled precipitation data for Beaverton.

Table 3: Percent of Normal Precipitation for the Water Year Preceding the May Field Investigations

Month	**Normal Precipitation (Inches)**	**Observed Precipitation (Inches)**	**Departure from Normal (inches)**	**Within 30% of Normal Precipitation for Water Year?**
May 8, 2015	34.32	28.55	-5.77	Yes (83% of normal)

Source: (NWS 2015)

5 METHODS

5.1 PRELIMINARY RESOURCE REVIEW

Reference materials were reviewed prior to the field investigation to provide information regarding the possible presence of wetlands, water features, hydric soils, wetland hydrology, and site topography. The materials reviewed are referenced in Appendix E, and included the following:

- Precipitation data for Hillsboro, Oregon (National Weather Service 2015).
- ESRI, ArcGIS Online, USA area Topographic Maps, Sherwood Valley, Oregon 1961
- ESRI, World Imagery, Aerials Express, 2010
- US Fish and Wildlife Service (USFWS), National Wetlands Inventory (NWI), Wetlands Mapper, 2015
- Natural Resource Conservation Service (NCRS). 2014. Web Soil Survey, Clackamas County Area, Oregon (OR610).
- Tax Lots for Clackamas County Area, Oregon (Metro RLIS Data, 2015).
- Local Wetlands and Riparian Corridor Inventory (LWI) for Wilsonville, Oregon (City of Wilsonville Planning Division 1999)

The USGS Quadrangles were examined to determine water features and topography of the site and adjacent properties that might influence on-site conditions (Appendix A: Figure 1). Figure 2 displays the study area tax lot boundaries. The LWI and NWI maps (Appendix A: Figure 3) were examined to determine if wetlands are mapped on site. The Soil Survey map (Appendix A: Figure 4) was reviewed to determine if any hydric soils are mapped on site. Table 4 summarizes the soils mapped within the study area.

Table 4: Soils Mapped (NRCS 2010) as Occuring in the Project Study Area

Map Unit	Soil Series	Hydric Status	SCS Drainage Description
53A	Latourell loam, 0 to 3 percent slopes	Non-hydric	Well drained
53B	Latourell loam, 3 to 8 percent slopes	Non-hydric	Well drained
71B	Quatama loam, 3 to 8 percent slopes	Non-hydric	Moderately well drained
86A	Willamette silt loam, 0 to 3 percent slopes	Non-hydric	Well drained
2310F	Woodburn silt loam, 20 to 55 percent	Non-hydric	Moderately well drained

5.2 FIELD METHODS

Wetland areas were delineated on May 8, 2015, according to the Level 2 Routine On-Site Method described in the *1987 U.S. Army Corps of Engineers* (USACE) *Wetland Delineation Manual* (Environmental Laboratory 1987) and the Regional Supplement to the USACE Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (USACE 2010). This method requires an area to possess a prevalence of hydrophytic vegetation, hydric soils, and wetland hydrology. Under normal circumstances, positive indicators of each of these three parameters must be present for an area to satisfy the criteria for jurisdictional wetlands. Soils, vegetation, and hydrologic indicators were inspected throughout the site and were documented at six data plots (Appendix B: Wetland Delineation Data Forms). Representative site photographs are included in Appendix C: Ground Level Color Photographs). Methods and information specific to the site are provided below.

5.2.1 Hydrology

All data was collected during the growing season, and no problematic conditions prevail. The entire project study area was examined for indicators of hydrology as established by the Corps 1987 Manual and Supplement.

5.2.2 Soils

Soils were inspected throughout the site and documented in each data plot (Appendix B). Soil pits were dug to a depth of 20 inches, when not hindered by the presence of rock or hardpan. Soil was analyzed for color using the *Munsell Soil Color Chart* (Munsell Color 1990).

5.2.3 Vegetation

Vegetation was inspected and identified throughout the site, and was documented in each data plot (Appendix B) in order to define wetland boundaries and document homogenous vegetation communities. In accordance with the USACE 1987 Manual (Environmental Laboratory 1987), vegetation plots were established in areas supporting a single plant community. Plant species observed were identified using Flora of the Pacific Northwest (Hitchcock and Cronquist 1973) and assigned their indicator status using the Western Mountains, Valleys, and Coast 2014 Regional Wetland Plant List.

Percent cover of each plant species was visually estimated. Plots were sized at 5-foot radius for herb layer and 30-foot radius for shrubs, saplings, vines, and trees. Plot sizes and shapes, however, were altered to assure that they represented only a single plant community as identified in descriptions below. Overhanging tree canopies were not documented if the trees were rooted in a different community.

5.2.4 Atypical Situations

The 1987 Manual and Regional Supplement define wetlands in which wetland indicators for one or more of the three parameters are absent due to recent human activities as "atypical situations". Although vegetation had been managed in the site for orchard and landscaping uses, all parameters were intact and the site had not undergone recent significant disturbance. Therefore, the procedures for atypical situations as described in the Supplement Chapter 5 were not needed.

6 WETLANDS AND NON-WETLAND WATERS

Three wetlands and three waters were delineated, and their locations are shown on Figure 6 in Appendix A. The three waters include the Willamette River, Arrowhead Creek, and unnamed intermittent drainage feature (Creek 1). No ditches were present, and the roadways and developed areas were drained by a stormwater system. All wetlands and waters delineated within the study area appear to be jurisdictional to DSL and USACE because of a clear connection to the Willamette River, a water of the US.

6.1 WETLANDS

Three wetlands were delineated in the study area (Wetlands A, B, and C) and are described below.

6.1.1 Wetland A

Wetland A (0.04 acre) was delineated in the southwestern portion of the study area (Appendix A: Figure 6). The wetland is associated with the northern end of the unnamed creek (Creek 1) which drains to the Willamette River. Wetland A would be classified as a palustrine emergent wetland based on the Cowardin classification system (Cowardin et al. 1979). It would be classified as a slope wetland according to the hydrogeomorphic (HGM) classification system, since it receives hydrology primarily from groundwater discharge. Wetland A is dominated by reed canarygrass (*Phalaris arundinacea*) and climbing nightshade (*Solanum dulcamara*). In Plot 1, soils were determined to be hydric based on the redox dark surface (F6) indicator (USACE 2010). The wetland boundary was determined by the steep slopes leading down to the wetland and the change from reed canarygrass to thick Himalayan blackberry (*Rubus armeniacus*) in the adjacent upland community (Plot 2), as well as hydrologic indicators (the extent of saturation and the extent of sediment deposits, which were lacking in Plot 2). The wetland is expected to be within both DSL and USACE jurisdiction.

6.1.2 Wetlands B and C

Wetlands B and C are associated with Arrowhead Creek. Wetland B (0.03 acre) is smaller and lies just north of Wetland C. Both wetlands are classified as slope wetlands according to the HGM classification system. Wetland B would be classified as palustrine emergent wetland based on the Cowardin classification system in spite of 10 percent cover by willow. Plot 3 is characteristic of Wetland B and was dominated by reed canarygrass and stinging nettle (*Urtica dioica*). Also present in the wetland plant community were great hedge-nettle (*Stachys chamisonis* var. *cooleyae*), water parsley (*Oenanthe sarmentosa*), cleavers (*Galium aparine*), and a Scouler's willow sapling (*Salix scouleriana*). Plot 3 met the hydric soils criteria by the redox dark surface indicator, and met the hydrology indicator by the presence of sediment deposits and aquatic invertebrates. Himalayan blackberry, beaked hazelnut (*Corylus cornuta*), sword fern (*Polystichum munitum*), and English holly (*Ilex aquifolium*) are present in the adjacent upland plant community (Plot 4). The wetland boundary for both Wetlands B and C was determined by the steep slopes leading down to the wetland and the change from reed canarygrass to thick Himalayan blackberry.

Wetland C (0.09 acre within study area) runs parallel to Arrowhead Creek and continues downstream under and south of the bridge on Arrowhead Creek Road. Dominating the wetland plant community described by Plot 5 are Oregon ash (*Fraxinus latifolia*), Himalayan blackberry, stinging nettle, great hedge-nettle, and cleavers. Reed canarygrass is also present in the plot. Plot 5 met hydric soils criteria by the redox dark surface indicator and met the hydrology indicator by the extent of sediment deposits. This wetland would be classified as palustrine forested wetland based on the Cowardin classification system (Cowardin et al. 1979); however, the area south of the bridge would be classified as palustrine emergent. Himalayan blackberry, beaked hazelnut, sword fern, and English holly are present in the adjacent upland plant community (Plot 6).

6.2 WATERS

Three waters were delineated within the study area and are described below.

6.2.1 Willamette River

The study area is located on the north bank of the Willamette River. The river bank consists of a steep forested bluff leading down to the ordinary high water line (OHWL) of the river. The OHWL, based on field indicators of sediment deposition and the presence of litter and debris found on persistent woody vegetation, occurs at elevation 74 feet (NAVD88).

6.2.2 Arrowhead Creek

Arrowhead Creek is likely a perennial stream- although it may occasionally dry out late in the summer, roughly 4 to 6 inches of flow was observed during the May 8 site visit, with some deeper pools present. The creek resides in a forested ravine with a narrow floodplain in the bottom. The creek is somewhat incised and ordinary high water was mapped roughly at top of bank based on shelving, sediment deposition, and the presence of litter and debris. Upland vegetation borders the creek throughout most of the narrow floodplain, with the exception of two wetlands (Wetland B and C). The wetlands appear to receive their hydrology from hill side seepage, and drain via subsurface flow to the creek. Although occasional overbank flooding may occur, it is likely less than a 2-year event and therefore the OHWL was generally confined to the channel (i.e., the channel likely overtops its banks less than once every two years). Substrates ranged from silt to small cobble, with much of the larger substrate being embedded in the finer sediments. Some trash was also observed in the channel.

6.2.3 Creek 1

A small unnamed intermittent tributary to the Willamette River (Creek 1) occurs along the western property boundary and is situated in a steep and deep V-shaped ravine. It is likely an intermittent stream since it contains a defined bed and bank and contained a few inches of flowing water during the March 17 site recon, but was mainly dry during the May 8 delineation site visit. The upper end of the creek enters the property via a culvert outfall along the west property boundary. Wetland A lies on either side of the northern end of the creek, near where it outfalls from a culvert outlet and before the gradient increases as it drops to the river. The wetland is dominated by reed canarygrass.

The creek ranges between 2- and 3-feet-wide at the OHWL. The ravine side slopes are forested, primarily with Douglas fir (*Pseudotsuga menziesii*) and sword fern. An exception to this is at the upper end of the creek where topography is less steep and conditions more open. Here, a combination of Himalayan blackberry, stinging nettle, and planted trees occur adjacent to the drainage feature.

7 DEVIATION FROM LWI OR NWI

The local wetland inventory (LWI) for Wilsonville, Oregon, did not show any mapped wetlands or waters aside from the Willamette River within the study area (City of Wilsonville, Oregon 1999). The national wetlands inventory (NWI) describes the Willamette River as the only waters within the area and describes no wetlands for the study area. The Willamette River is identified as an R2OWZ waters (riverine, lower perennial, open water with unknown bottom, intermittently exposed/permanent) (ESRI, ArcGIS 1961).

8 MAPPING METHOD

All features were flagged in the field and mapped by a professional survey crew with typical horizontal accuracy of one foot or better.

9 ADDITIONAL INFORMATION

No additional information.

10 RESULTS AND CONCLUSIONS

Three wetlands were delineated within the study area, and are summarized in Table 5. Three waters were delineated within the study area, and are summarized in Table 6. All features would likely be considered jurisdictional to the USACE and DSL due to direct connection to other waters.

Table 5: Summary of Wetlands within the Study Area

ID	Size (acres)	Cowardin Class	HGM Class	Preliminary Jurisdictional Determination
Wetland A	0.04	Palustrine emergent	Slope	USACE and DSL
Wetland B	0.03	Palustrine emergent	Slope	USACE and DSL
Wetland C	0.09	Palustrine forested	Slope	USACE and DSL
Total	**0.16**			

Table 6: Summary of Waters within the Study Area

ID	Size (acres)	OHWL Determination	Preliminary Jurisdictional Determination
Willamette River	0.30	Sediment deposits, drift lines, and float debris.	USACE and DSL
Arrowhead Creek	0.23	Break in slope angle of the bank and sediment deposits.	USACE and DSL
Creek 1	0.06	Changes in character of soil (from sand and gravel to upland soil).	USACE and DSL
Total	**0.59**		

11 DISCLAIMER

This report documents the investigation, best professional judgment, and conclusions of the investigator. It is correct and complete to the best of my knowledge. It should be considered a Preliminary Jurisdictional Determination of wetlands and other waters and used at your own risk until it has been reviewed and approved in writing by the Oregon Department of State Lands in Accordance with OAR 141-090-0005 through OAR 141-090-0555.

12 PREPARERS AND CONTRIBUTORS

Phil Rickus, DEA Ecologist, and Ethan Rosenthal, DEA Ecologist, performed the site delineation. Mr. Rickus is the primary author of the report, and Mr. Rosenthal provided quality assurance review. Dawn Afman, DEA Project Assistant, provided editing assistance. Melissa Foltz, DEA Project Assistant, prepared the report graphics.

13 LITERATURE CITATIONS

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14 APPENDICES

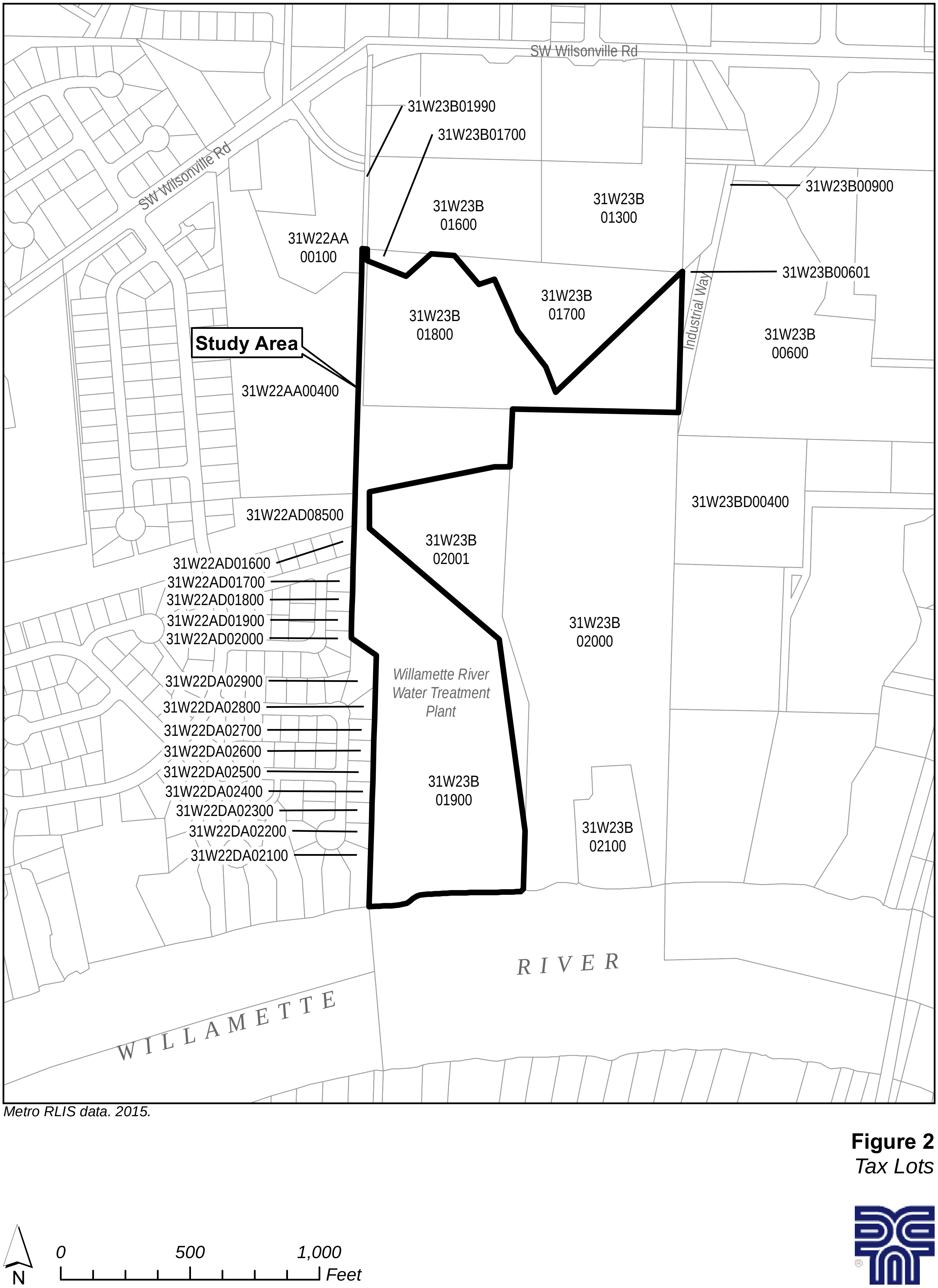
APPENDIX A: Figures

ESRI, ArcGIS Online, USA Topographic Maps. 1961. Sherwood, Oregon.

Figure 1
Vicinity

N

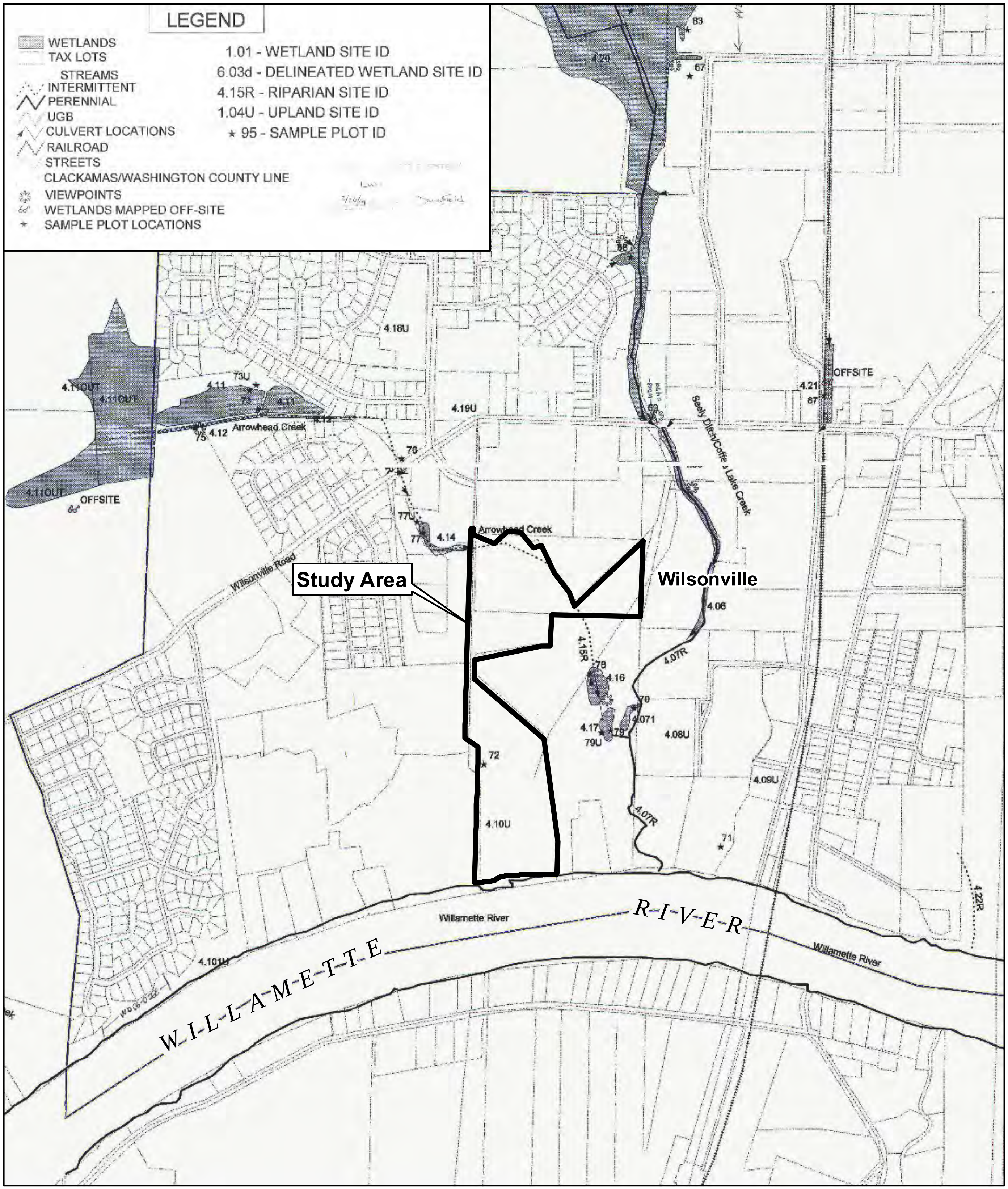
0 2,000 4,000
Feet



Metro RLIS data. 2015.

Figure 2
Tax Lots

Document Path: P:\T\TVWD00000006\0600INFO\GS\Maps\Wetland Delineation-WRWTP\Fig_02_WRWTP_Taxlots.mxd

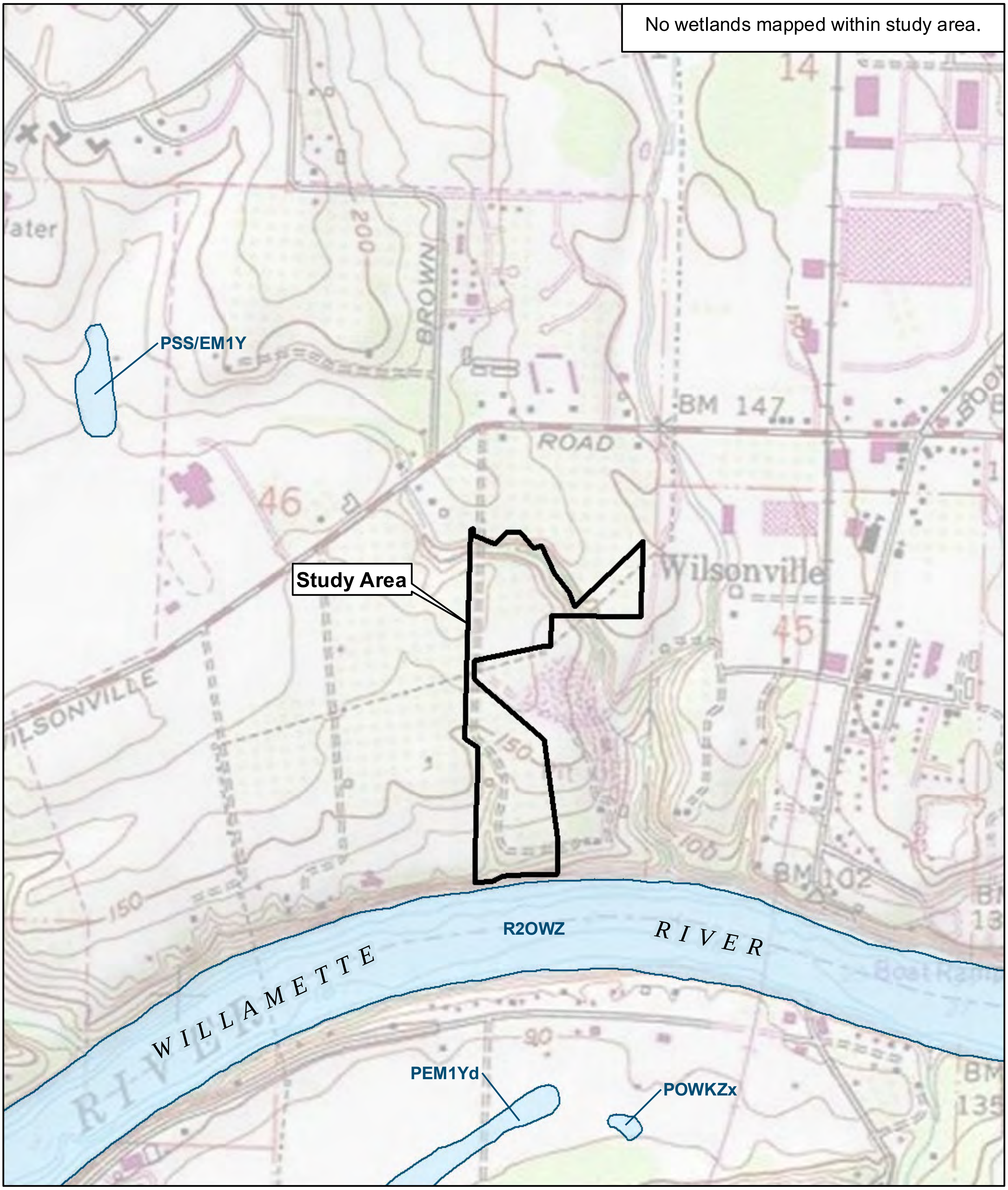


City of Wilsonville (Oregon), Planning Division.
1999. City of Wilsonville Local Wetlands and Riparian Corridor Inventory.

Figure 3a
Local Wetland Inventory

N

0 1,000 2,000 Feet

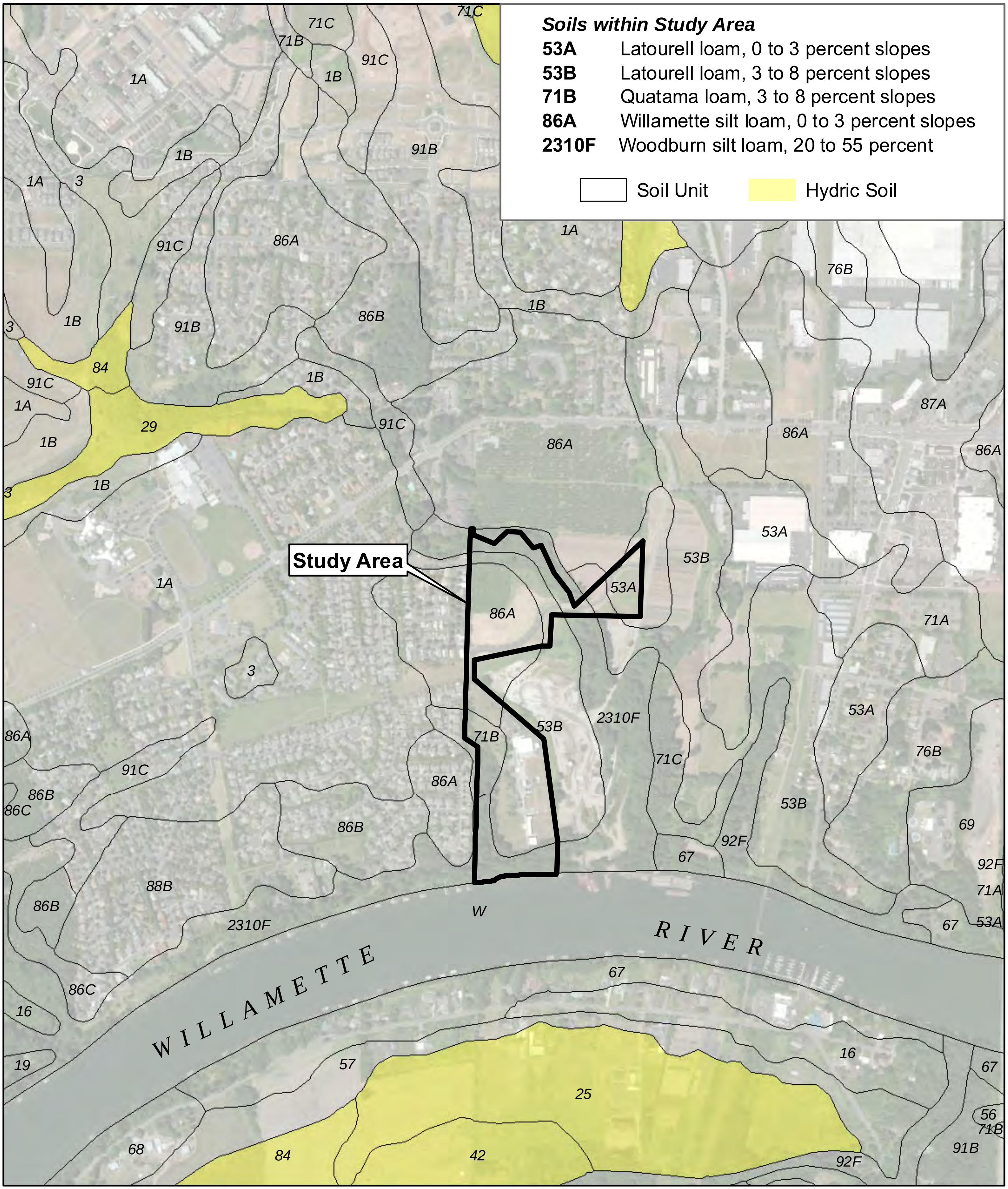


ESRI, ArcGIS Online, USA Topographic Maps. 1961. Sherwood, Oregon.

Metro RLIS data. 2015.

Figure 3b

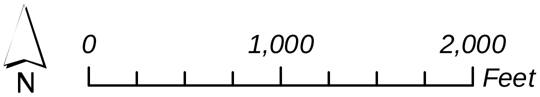
National Wetland Inventory

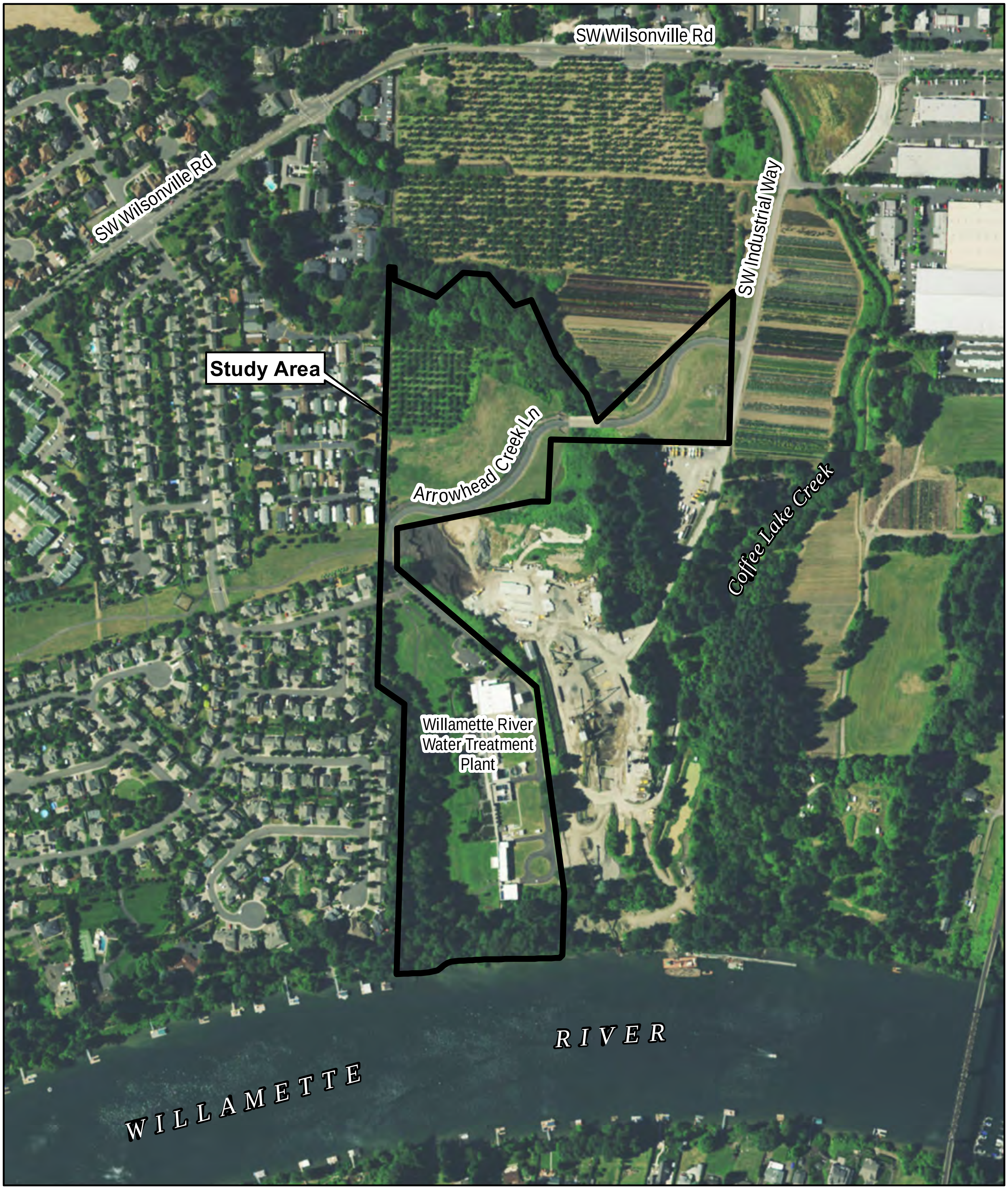


ESRI, ArcGIS Online, World Imagery. Microsoft. 2010. Portland, Oregon.

Natural Resources Conservation Service (NRCS).
2014. Soil Survey Geographic (SSURGO) database for
Clackamas County Area, Oregon.

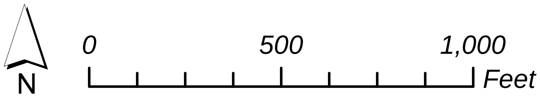
Figure 4
Soil Survey

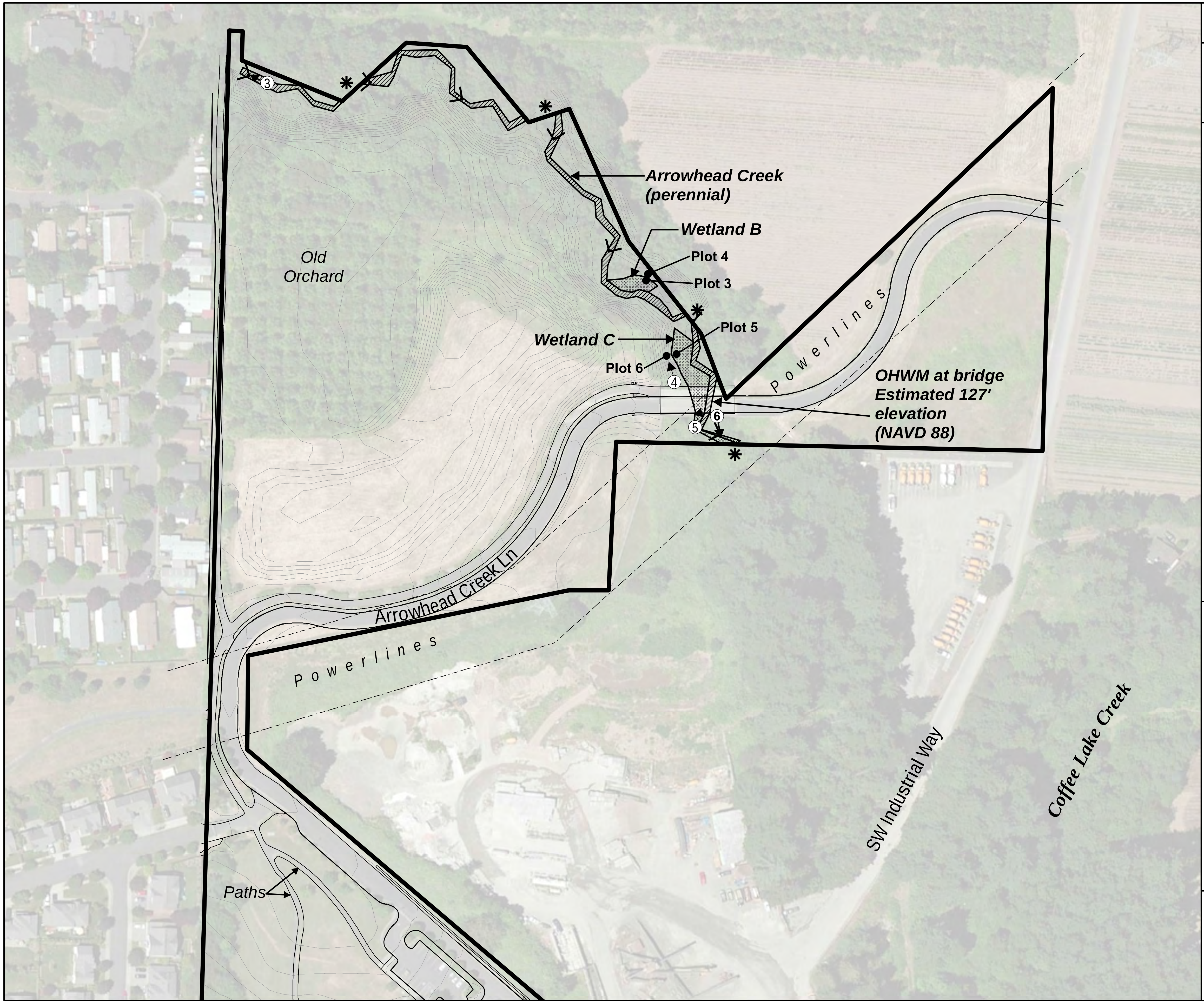




ESRI, ArcGIS Online, World Imagery. Microsoft. 2010. Portland, Oregon.

Figure 5
Aerial Photograph





Willamette River Water Treatment Plant

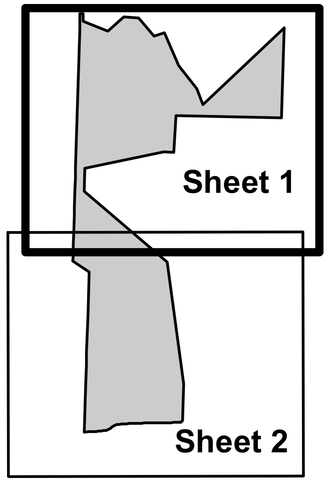
Figure 6, Sheet 1

Wetland Delineation

Legend

▭	Study Area
▨	OHW
░	Wetland
-·-	Intermittent Stream
■	Culvert Outfall
●	Data Plot
✱	Wetland/Water Resource extends outside of Study Area
○	Photo Points (directional)
—	2 ft Contour

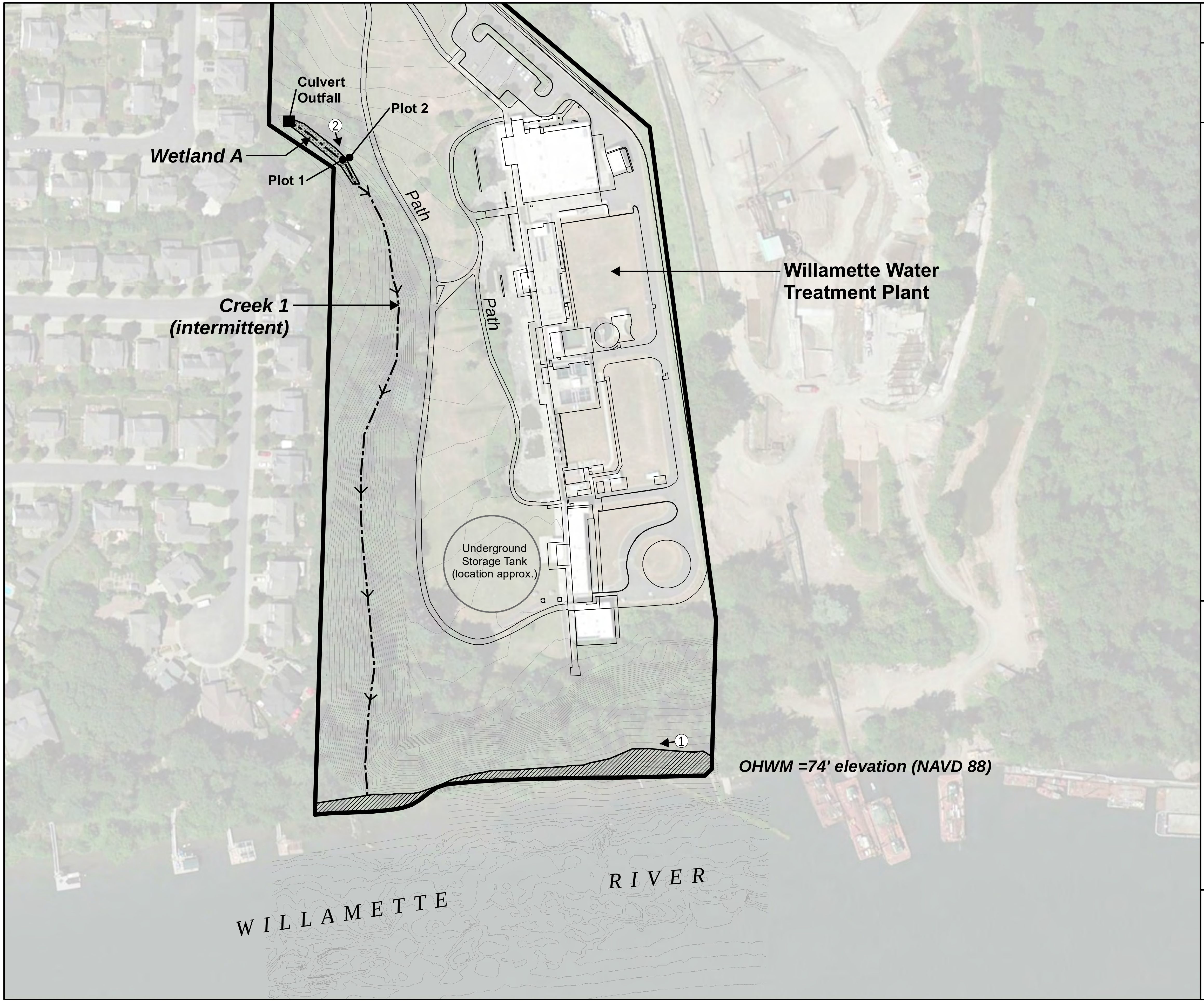
Accuraccy Statement:
All features were flagged in the field and mapped by a professional survey crew with typical horizontal accuracy of one foot or better.



ESRI, ArcGIS Online, World Imagery. Microsoft. 2010. Portland, Oregon.

Compass Land Surveyors. June 2015.

Document Path: \\Pdxfs1\project\T\TVWD00000006\0600INFO\GS\Maps\Wetland Delineation-WRWTP\Fig_06_WRWTP_WtldDelin.mxd



Willamette River Water Treatment Plant

Figure 6, Sheet 2

Wetland Delineation

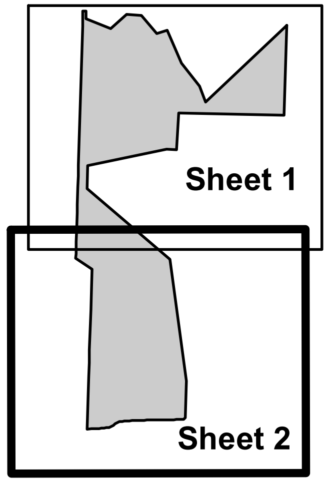
Legend

- ▭ Study Area
- ▨ OHW
- ▒ Wetland
- -·- Intermittent Stream
- ■ Culvert Outfall
- ● Data Plot
- ✳ Wetland/Water Resource extends outside of Study Area
- ○ Photo Points (directional)
- — 2 ft Contour

Accuracy Statement:
All features were flagged in the field and mapped by a professional survey crew with typical horizontal accuracy of one foot or better.

N

0 150 300 Feet



ESRI, ArcGIS Online, World Imagery. Microsoft. 2010. Portland, Oregon.

Compass Land Surveyors. June 2015.

Document Path: \\Pdxfs1\project\T\TVWD00000006\0600INFO\GS\Maps\Wetland Delineation-WRWTP\Fig_06_WRWTP_WtldDelin.mxd

APPENDIX B: Wetland Delineation Data Forms

Plot	Soil Unit	Soil Description	TRS	Latitude	Longitude	NWI wetlands
Plot 1	71B	Quatama loam, 3 to 8 percent slopes	T 3S R 1W Sec 23	45.29649325	122.7844467	None
Plot 2	71B	Quatama loam, 3 to 8 percent slopes	T 3S R 1W Sec 23	45.29650412	122.7844069	None
Plot 3	2310F	Woodburn silt loam, 20 to 55 percent slopes	T 3S R 1W Sec 23	45.29977679	122.7824072	None
Plot 4	2310F	Woodburn silt loam, 20 to 55 percent slopes	T 3S R 1W Sec 23	45.29980411	122.7823966	None
Plot 5	2310F	Woodburn silt loam, 20 to 55 percent slopes	T 3S R 1W Sec 23	45.29947676	122.7822183	None
Plot 6	2310F	Woodburn silt loam, 20 to 55 percent slopes	T 3S R 1W Sec 23	45.29946868	-122.782276	None

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Willamette River Water Treatment Plant City/County: Wilsonville/ Clackamas Sampling Date: May 8, 2015
Applicant/Owner: Tualatin Valley Water District and City of Hillsboro State: OR Sampling Point: Plot 1
Investigator(s): Rickus, Rosenthal Section, Township, Range: see spreadsheet
Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): none Slope (%): 7
Subregion (LRR): A Lat: see spreadsheet Long: see spreadsheet Datum: see spreadsheet
Soil Map Unit Name: see spreadsheet NWI classification: see spreadsheet
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ____
Hydric Soil Present? Yes ✓ No ____
Wetland Hydrology Present? Yes ✓ No ____

Is the Sampled Area within a Wetland? Yes ✓ No ____

Remarks:

Plot lies in a wetland adjacent to a small waterway that emerges from a culvert and becomes incised downslope of the wetland. Plot 1 lies a small terrace slightly above the OHWM.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: 5 feet)			
1. Phalaris arundinacea	100	y	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
= Total Cover	100		
Woody Vine Stratum (Plot size: 30 feet)			
1. Solanum dulcamara	10	y	FAC
2.			
= Total Cover	10		

% Bare Ground in Herb Stratum ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)
Total Number of Dominant Species Across All Strata: 2 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

✓ Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Wetland Non-Vascular Plants[1]
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL

Sampling Point: Plot 1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-20	10YR 3/1	90	5YR 4/6	10	C	M	silty clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)

___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
✓ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✓ No ______

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
✓ Saturation (A3)
___ Water Marks (B1)
✓ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)

___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B)**
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ______ No ✓ Depth (inches): ______
Water Table Present? Yes ______ No ✓ Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes ✓ No ______ Depth (inches): 10

Wetland Hydrology Present? Yes ✓ No ______

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Willamette River Water Treatment Plant City/County: Wilsonville/ Clackamas Sampling Date: May 8, 2015
Applicant/Owner: Tualatin Valley Water District and City of Hillsboro State: OR Sampling Point: Plot 2
Investigator(s): Rickus, Rosenthal Section, Township, Range: see spreadsheet
Landform (hillslope, terrace, etc.): slope Local relief (concave, convex, none): none Slope (%): 18
Subregion (LRR): A Lat: see spreadsheet Long: see spreadsheet Datum: see spreadsheet
Soil Map Unit Name: see spreadsheet NWI classification: see spreadsheet
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are “Normal Circumstances” present? Yes X No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No ✓	**Is the Sampled Area within a Wetland?** Yes ____ No ✓
Hydric Soil Present?	Yes ____	No ✓	
Wetland Hydrology Present?	Yes ____	No ✓	

Remarks:
Plot lies on the slope leading up from the terrace wetland.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: 30 feet)			
1. Rubus armeniacus	100	y	FACU
2.			
3.			
4.			
5.			
	100 = Total Cover		
Herb Stratum (Plot size: 5 feet)			
1. Polystichum munitum	1	y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	1 = Total Cover		
Woody Vine Stratum (Plot size: 30 feet)			
1.			
2.			
	= Total Cover		
% Bare Ground in Herb Stratum 30			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)
Total Number of Dominant Species Across All Strata: 2 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Wetland Non-Vascular Plants[1]
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No ✓

Remarks:

SOIL

Sampling Point: Plot 2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 3/2	100	--	--	--	--	silt loam	no redox

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)

___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ✓

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)

___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B)**
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B)**
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): ____________
Water Table Present? Yes _____ No ✓ Depth (inches): ____________
Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): ____________

Wetland Hydrology Present? Yes ______ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Willamette River Water Treatment Plant City/County: Wilsonville/ Clackamas Sampling Date: May 8, 2015

Applicant/Owner: Tualatin Valley Water District and City of Hillsboro State: OR Sampling Point: Plot 3

Investigator(s): Rickus, Rosenthal Section, Township, Range: see spreadsheet

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): none Slope (%): 5

Subregion (LRR): A Lat: see spreadsheet Long: see spreadsheet Datum: see spreadsheet

Soil Map Unit Name: see spreadsheet NWI classification: see spreadsheet

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ___
Hydric Soil Present? Yes ✓ No ___
Wetland Hydrology Present? Yes ✓ No ___

Is the Sampled Area within a Wetland? Yes ✓ No ___

Remarks:

Plot lies in a wetland adjacent to Arrowhead Creek, on a small terrace slightly above the OHWM.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: 30 feet)			
1. Salix scouleriana	10	y	FAC
2.			
3.			
4.			
5.			
= Total Cover	10		
Herb Stratum (Plot size: 5 feet)			
1. Phalaris arundinacea	30	y	FACW
2. Urtica dioica	30	y	FAC
3. Stachys cooleyae	15	n	FACW
4. Oenanthe sarmentosa	15	n	FACW
5. Galium aparine	10	n	FAC
6.			
7.			
8.			
9.			
10.			
11.			
= Total Cover	100		
Woody Vine Stratum (Plot size: 30 feet)			
1.			
2.			
= Total Cover			

% Bare Ground in Herb Stratum ___

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ___

Hydrophytic Vegetation Indicators:

- ✓ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ___

Remarks:

SOIL

Sampling Point: Plot 3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 3/1	90	10YR 4/6	10	C	M	silty clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
✓ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
✓ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
___ Salt Crust (B11)
✓ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
✓ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___
Water Table Present? Yes ___ No ✓ Depth (inches): ___
Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): ___

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Willamette River Water Treatment Plant City/County: Wilsonville/ Clackamas Sampling Date: May 8, 2015

Applicant/Owner: Tualatin Valley Water District and City of Hillsboro State: OR Sampling Point: Plot 4

Investigator(s): Rickus, Rosenthal Section, Township, Range: see spreadsheet

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): none Slope (%): 15

Subregion (LRR): A Lat: see spreadsheet Long: see spreadsheet Datum: see spreadsheet

Soil Map Unit Name: see spreadsheet NWI classification: see spreadsheet

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ____ No ✓

Hydric Soil Present? Yes ____ No ✓

Wetland Hydrology Present? Yes ____ No ✓

Is the Sampled Area within a Wetland? **Yes ____ No ✓**

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: 30 feet)			
1. Rubus armeniacus	50	y	FACU
2. Corylus cornuta	50	y	FACU
3. Ilex aquifolium	10	n	FACU
4.			
5.			
	110	= Total Cover	
Herb Stratum (Plot size: 5 feet)			
1. Polystichum munitum	15	y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	15	= Total Cover	
Woody Vine Stratum (Plot size: 30 feet)			
1. Hedera helix	30	y	FACU
2.			
	30	= Total Cover	

% Bare Ground in Herb Stratum 50

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 25 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes ____ No ✓**

Remarks:

SOIL

Sampling Point: Plot 4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Redox Features Type[1]	Redox Features Loc[2]	Texture	Remarks
0-20	10YR 3/2	100	--	--	--	--	silt loam	no redox

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ✓

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ______ No ✓ Depth (inches): ____________
Water Table Present? Yes ______ No ✓ Depth (inches): ____________
Saturation Present? (includes capillary fringe) Yes ______ No ✓ Depth (inches): ____________

Wetland Hydrology Present? Yes ______ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Willamette River Water Treatment Plant City/County: Wilsonville/ Clackamas Sampling Date: May 8, 2015

Applicant/Owner: Tualatin Valley Water District and City of Hillsboro State: OR Sampling Point: Plot 5

Investigator(s): Rickus, Rosenthal Section, Township, Range: see spreadsheet

Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): none Slope (%): 3

Subregion (LRR): A Lat: see spreadsheet Long: see spreadsheet Datum: see spreadsheet

Soil Map Unit Name: see spreadsheet NWI classification: see spreadsheet

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes X No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✓ No ______

Hydric Soil Present? Yes ✓ No ______

Wetland Hydrology Present? Yes ✓ No ______

Is the Sampled Area within a Wetland? Yes ✓ No ______

Remarks:

Plot lies in a wetland adjacent to Arrowhead Creek, on a small terrace slightly above the OHWM.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30 feet)			
1. Fraxinus latifolia	50	y	FACW
2.			
3.			
4.			
	50	= Total Cover	
Sapling/Shrub Stratum (Plot size: 30 feet)			
1. Rubus armeniacus	10	y	FACU
2.			
3.			
4.			
5.			
	10	= Total Cover	
Herb Stratum (Plot size: 5 feet)			
1. Phalaris arundinacea	5	n	FACW
2. Urtica dioica	15	y	FAC
3. Stachys chamissonis var. cooleyae	15	y	FACW
4. Galium aparine	10	y	FACU
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	45	= Total Cover	
Woody Vine Stratum (Plot size: 30 feet)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 60 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- ✓ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ______

Remarks:

SOIL

Sampling Point: Plot 5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 3/1	80	10YR 4/6	20	C	M	silty clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
✓ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______________

Depth (inches): ______________

Hydric Soil Present? Yes ✓ No ______

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
✓ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
✓ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ______ No ✓ Depth (inches): ____________
Water Table Present? Yes ______ No ✓ Depth (inches): ____________
Saturation Present? (includes capillary fringe) Yes ______ No ✓ Depth (inches): ____________

Wetland Hydrology Present? Yes ✓ No ______

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys, and Coast Region

Project/Site: Willamette River Water Treatment Plant City/County: Wilsonville/ Clackamas Sampling Date: May 8, 2015

Applicant/Owner: Tualatin Valley Water District and City of Hillsboro State: OR Sampling Point: Plot 6

Investigator(s): Rickus, Rosenthal Section, Township, Range: see spreadsheet

Landform (hillslope, terrace, etc.): slope Local relief (concave, convex, none): none Slope (%): 60

Subregion (LRR): A Lat: see spreadsheet Long: see spreadsheet Datum: see spreadsheet

Soil Map Unit Name: see spreadsheet NWI classification: see spreadsheet

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ___ No ✓

Hydric Soil Present? Yes ___ No ✓

Wetland Hydrology Present? Yes ___ No ✓

Is the Sampled Area within a Wetland? **Yes** ___ **No** ✓

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30 feet)			
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: 30 feet)			
1. Rubus armeniacus	100	y	FACU
2. Corylus cornuta	40	y	FACU
3. Ilex aquifolium	5	n	FACU
4.			
5.			
= Total Cover	145		
Herb Stratum (Plot size: 5 feet)			
1. Polystichum munitum	10	y	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
= Total Cover	10		
Woody Vine Stratum (Plot size: 30 feet)			
1.			
2.			
= Total Cover			

% Bare Ground in Herb Stratum 20

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ___

Hydrophytic Vegetation Indicators:

- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ___ **No** ✓

Remarks:

SOIL

Sampling Point: Plot 6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-20	10YR 3/2	100	--	--	--	--	silt loam	no redox

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ______ No ✓

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A, and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A, and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes _____ No ✓ Depth (inches): ____________
Water Table Present? Yes _____ No ✓ Depth (inches): ____________
Saturation Present? (includes capillary fringe) Yes _____ No ✓ Depth (inches): ____________

Wetland Hydrology Present? Yes ______ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

APPENDIX C: Site Photographs

Photo 1: Looking southwest at OHWM of the Willamette River, which lies at the base of the shrub marked with the orange flag to the right of the large tree, which displays sediment deposits (May 8, 2015). Drift deposits at OHWM present in shrubs to left of large tree.

Photo 2: Looking southeast at Wetland A (foreground) and Creek 1, which leads from a culvert outfall to the right of the photo and flows south to the Willamette River (March 17, 2015).

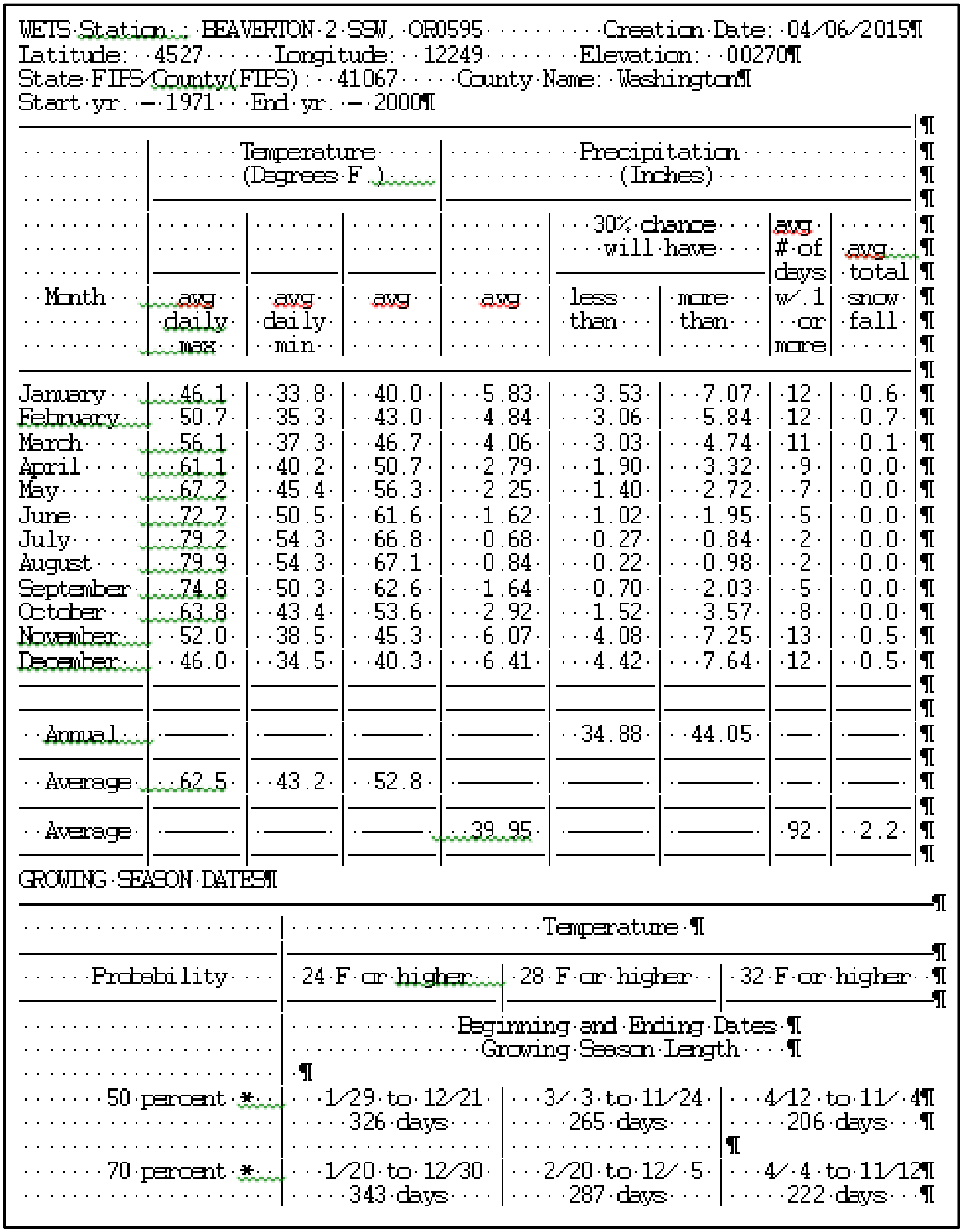
Photo 3: Looking northwest at box culvert where Arrowhead Creek enters the west end of study area (May 8, 2015). OHWM lies at the base of the shrubs marked with the orange flags.

Photo 2: Looking north at Wetland C adjacent to Arrowhead Creek (May 8, 2015). Relatively steep slopes lead up from the wetland.

Photo 3: Looking north at Arrowhead Creek from under the bridge (May 8, 2015).

Photo 6: Looking southeast from the bridge deck at Arrowhead Creek and associated Wetland C, which extends outside the study area (May 8, 2015). Relatively steep slopes lead up from the wetland on all sides.

APPENDIX D: WETS Table



```
WETS Station : BEAVERTON 2 SSW, OR0595          Creation Date: 04/06/2015
Latitude:  4527      Longitude:  12249       Elevation:  00270
State FIPS/County(FIPS):  41067     County Name: Washington
Start yr. - 1971   End yr. - 2000
___________________________________________________________________________________
          |       Temperature       |          Precipitation
          |       (Degrees F.)      |             (Inches)
          |_________________________|_______________________________________________
          |       |       |         |        |   30% chance   |avg   |
          |       |       |         |        |    will have   |# of  | avg.
          |_______|_______|_________|        |________________|days  | total
  Month   |  avg  |  avg  |  avg    |  avg   | less   | more  |w/.1  | snow
          | daily | daily |         |        | than   | than  |  or  | fall
          |  max  |  min  |         |        |        |       |more  |
___________________________________________________________________________________
January   |  46.1 |  33.8 |  40.0   |   5.83 |   3.53 |   7.07 | 12  |  0.6
February  |  50.7 |  35.3 |  43.0   |   4.84 |   3.06 |   5.84 | 12  |  0.7
March     |  56.1 |  37.3 |  46.7   |   4.06 |   3.03 |   4.74 | 11  |  0.1
April     |  61.1 |  40.2 |  50.7   |   2.79 |   1.90 |   3.32 |  9  |  0.0
May       |  67.2 |  45.4 |  56.3   |   2.25 |   1.40 |   2.72 |  7  |  0.0
June      |  72.7 |  50.5 |  61.6   |   1.62 |   1.02 |   1.95 |  5  |  0.0
July      |  79.2 |  54.3 |  66.8   |   0.68 |   0.27 |   0.84 |  2  |  0.0
August    |  79.9 |  54.3 |  67.1   |   0.84 |   0.22 |   0.98 |  2  |  0.0
September |  74.8 |  50.3 |  62.6   |   1.64 |   0.70 |   2.03 |  5  |  0.0
October   |  63.8 |  43.4 |  53.6   |   2.92 |   1.52 |   3.57 |  8  |  0.0
November  |  52.0 |  38.5 |  45.3   |   6.07 |   4.08 |   7.25 | 13  |  0.5
December  |  46.0 |  34.5 |  40.3   |   6.41 |   4.42 |   7.64 | 12  |  0.5
__________|_______|_______|_________|________|________|________|_____|______
__________|_______|_______|_________|________|________|________|_____|______
  Annual  | ----- | ----- | -----   | -----  |  34.88 |  44.05 | --  | -----
__________|_______|_______|_________|________|________|________|_____|______
  Average |  62.5 |  43.2 |  52.8   | -----  | -----  | -----  | --  | -----
__________|_______|_______|_________|________|________|________|_____|______
  Average | ----- | ----- | -----   |  39.95 | -----  | -----  | 92  |  2.2
__________|_______|_______|_________|________|________|________|_____|______
GROWING SEASON DATES
______________________________________________________________________________
                    |                    Temperature
____________________|_________________________________________________________
     Probability    | 24 F or higher  | 28 F or higher  | 32 F or higher
____________________|_________________|_________________|_____________________
                    |             Beginning and Ending Dates
                    |               Growing Season Length
                    |
       50 percent * |   1/29 to 12/21 |   3/ 3 to 11/24 |   4/12 to 11/ 4
                    |     326 days    |     265 days    |     206 days
                    |                 |                 |
       70 percent * |   1/20 to 12/30 |   2/20 to 12/ 5 |   4/ 4 to 11/12
                    |     343 days    |     287 days    |     222 days
```

Exhibit H: Oregon Department of State Lands Concurrence Report

WD # 2017-0024, Partial Concurrence, Wetland Delineation Report for the Proposed Willamette Water Supply Program Project, PLM_5.0

Oregon
Kate Brown, Governor

Department of State Lands
775 Summer Street NE, Suite 100
Salem, OR 97301-1279
(503) 986-5200
FAX (503) 378-4844
www.oregon.gov/dsl

State Land Board

Kate Brown
Governor

Jeanne P. Atkins
Secretary of State

Ted Wheeler
State Treasurer

August 31, 2016

City of Hillsboro Water Department
Attn: Niki Iverson, Water Resource Manager
150 E. Main Street
Hillsboro, OR 97123-4028

Re: WD #2016-0249 Wetland Delineation Report for Proposed Improvements for the Willamette River Water Treatment Plant Clackamas County; T 1S R 1W S 23B Tax Lots 1800 and 1900

Dear Ms. Iverson:

The Department of State Lands has reviewed the wetland delineation report prepared by David Evans and Associates, Inc. for the site referenced above. Based upon the information presented in the report and additional information submitted upon request, we concur with the wetland and waterway boundaries as mapped in Figure 6, Sheets 1 and 2 of the report. Within the study area, three wetlands (totaling approximately 0.16 acres), and portions of three waterways, the Willamette River, Arrowhead Creek, and an unnamed tributary to the Willamette were identified.

The wetlands and the waterways are all subject to the permit requirements of the state Removal-Fill Law. Under current regulations, a state permit is required for cumulative fill or annual excavation of 50 cubic yards or more in wetlands or below the ordinary high water line (OHWL) of a waterway (or the 2 year recurrence interval flood elevation if OHWL cannot be determined). However, the Willamette River is an essential salmonid stream; therefore, fill or removal of any amount of material below its OHWL and within any hydrologically-connected wetlands may require a state permit. In addition, the Willamette is also a state-owned waterway; any activity encroaching within the submerged and submersible land may require a lease, registration, or easement to occupy state-owned land. Please contact Justin Russel at (503) 986-5219 for more information.

This concurrence is for purposes of the state Removal-Fill Law only. Federal or local permit requirements may apply as well. The Army Corps of Engineers will review the report and make a determination of jurisdiction for purposes of the Clean Water Act at the time that a permit application is submitted. We recommend that you attach a copy of this concurrence letter to both copies of any subsequent joint permit application to speed application review.

Please be advised that state law establishes a preference for avoidance of wetland impacts. Because measures to avoid and minimize wetland impacts may include reconfiguring parcel layout and size or development design, we recommend that you work with Department staff on appropriate site design before completing the city or county land use approval process.

This concurrence is based on information provided to the agency. The jurisdictional determination is valid for five years from the date of this letter unless new information necessitates a revision. Circumstances under which the Department may change a determination are found in OAR 141-090-0045 (available on our web site or upon request). In addition, laws enacted by the legislature and/or rules adopted by the Department may result in a change in jurisdiction; individuals and applicants are subject to the regulations that are in effect at the time of the removal-fill activity or complete permit application. The applicant, landowner, or agent may submit a request for reconsideration of this determination in writing within six months of the date of this letter.

Thank you for having the site evaluated. Please phone me at 503-986-5232 if you have any questions.

Sincerely,

Peter Ryan, PWS
Jurisdiction Coordinator

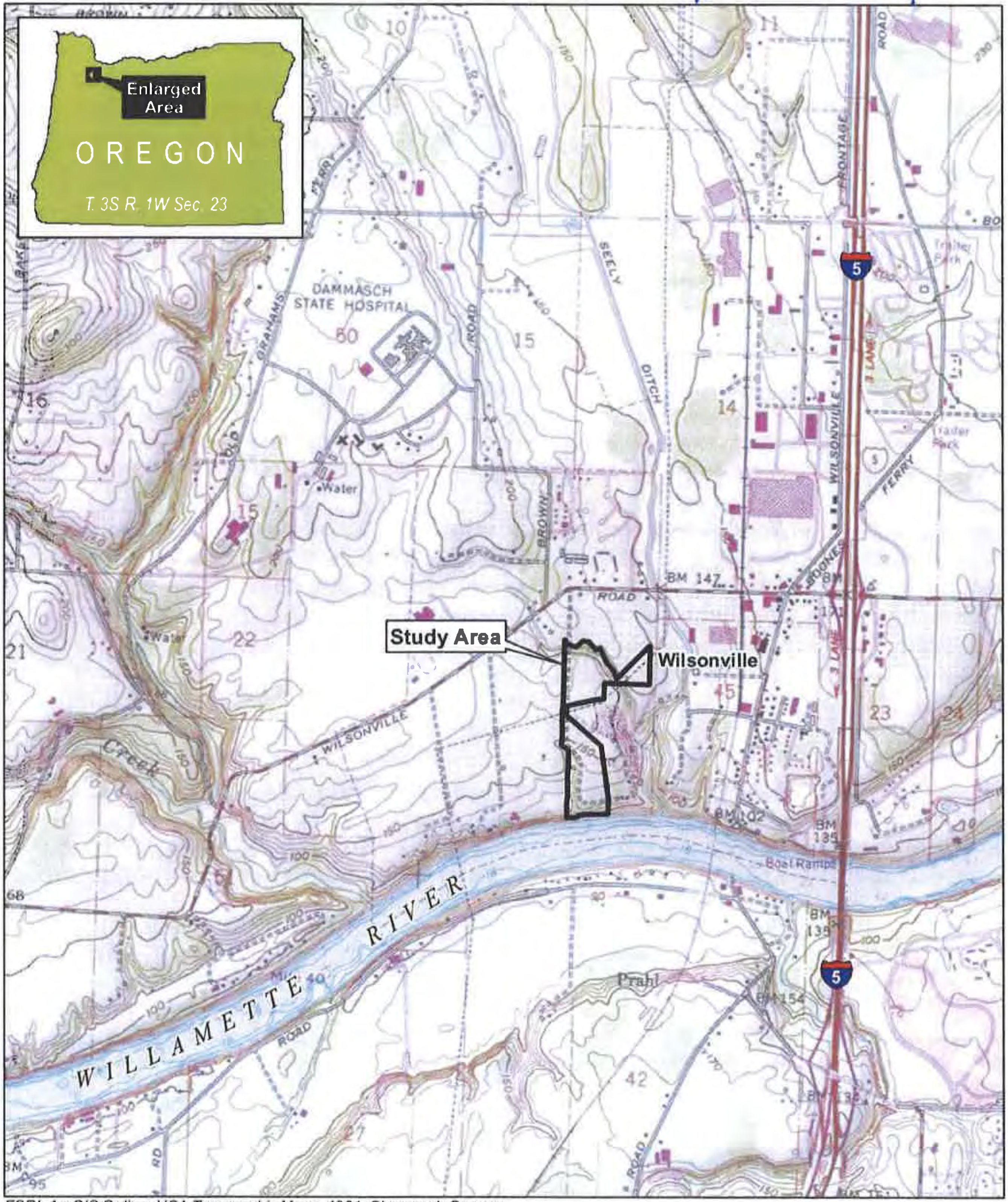
Approved by

Lori Warner-Dickason
Northern Field Operations Manager

Enclosures

ec: Ethan Rosenthal, David Evans and Associates, Inc.
City of Wilsonville Planning Department (Maps enclosed for updating LWI)
Dominic Yballe, Corps of Engineers
Anita Huffman, DSL

WD#2016-0249



ESRI, ArcGIS Online, USA Topographic Maps. 1961. Sherwood, Oregon.

Figure 1
Vicinity

N
0 2,000 4,000 Feet

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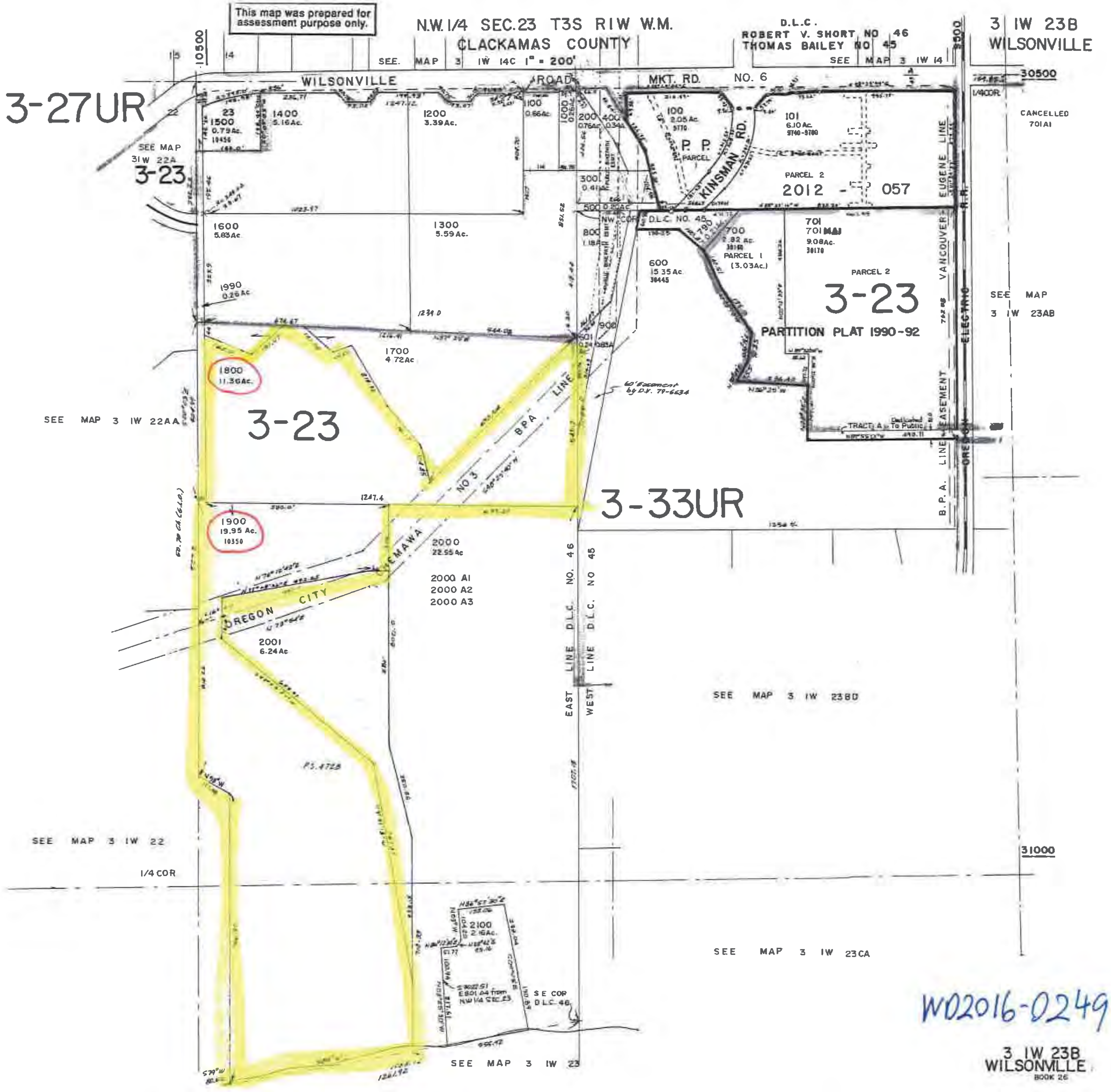
This map was prepared for assessment purpose only.

N.W. 1/4 SEC.23 T3S R1W W.M.
CLACKAMAS COUNTY
1" = 200'

3 1W 23B
WILSONVILLE



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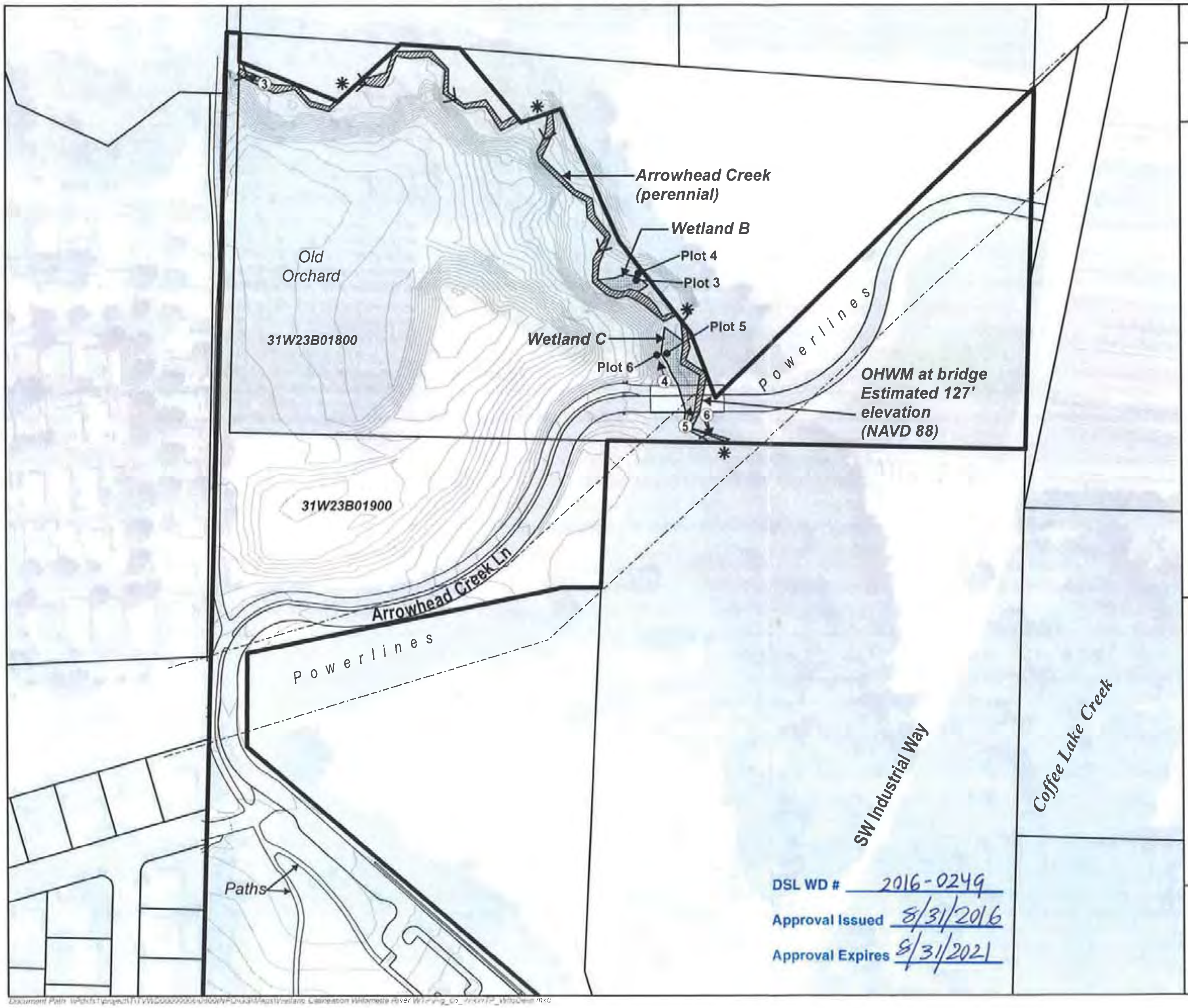
WILSONVILLE
BOOK 26

Willamette River Water Treatment Plant

Figure 6, Sheet 1
Wetland Delineation

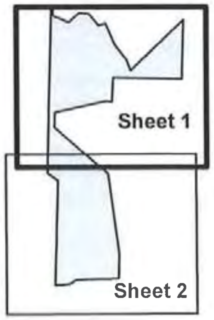


DSL WD # 2016-0249
Approval Issued 8/31/2016
Approval Expires 8/31/2021

Legend
- ▭ Study Area
- ▨ Ordinary High Water Mark (OHWM)
- ▨ Wetland
- -·- Intermittent Stream
- ■ Culvert Outfall
- ● Data Plot
- ✱ Wetland/Water Resource extends outside of Study Area
- ○ Photo Points (directional)
- — 10 ft Contour
- ▭ Taxlot

Accuracy Statement:
All features were flagged in the field and mapped by a professional survey crew with typical horizontal accuracy of one foot or better.

N 0 150 300 Feet



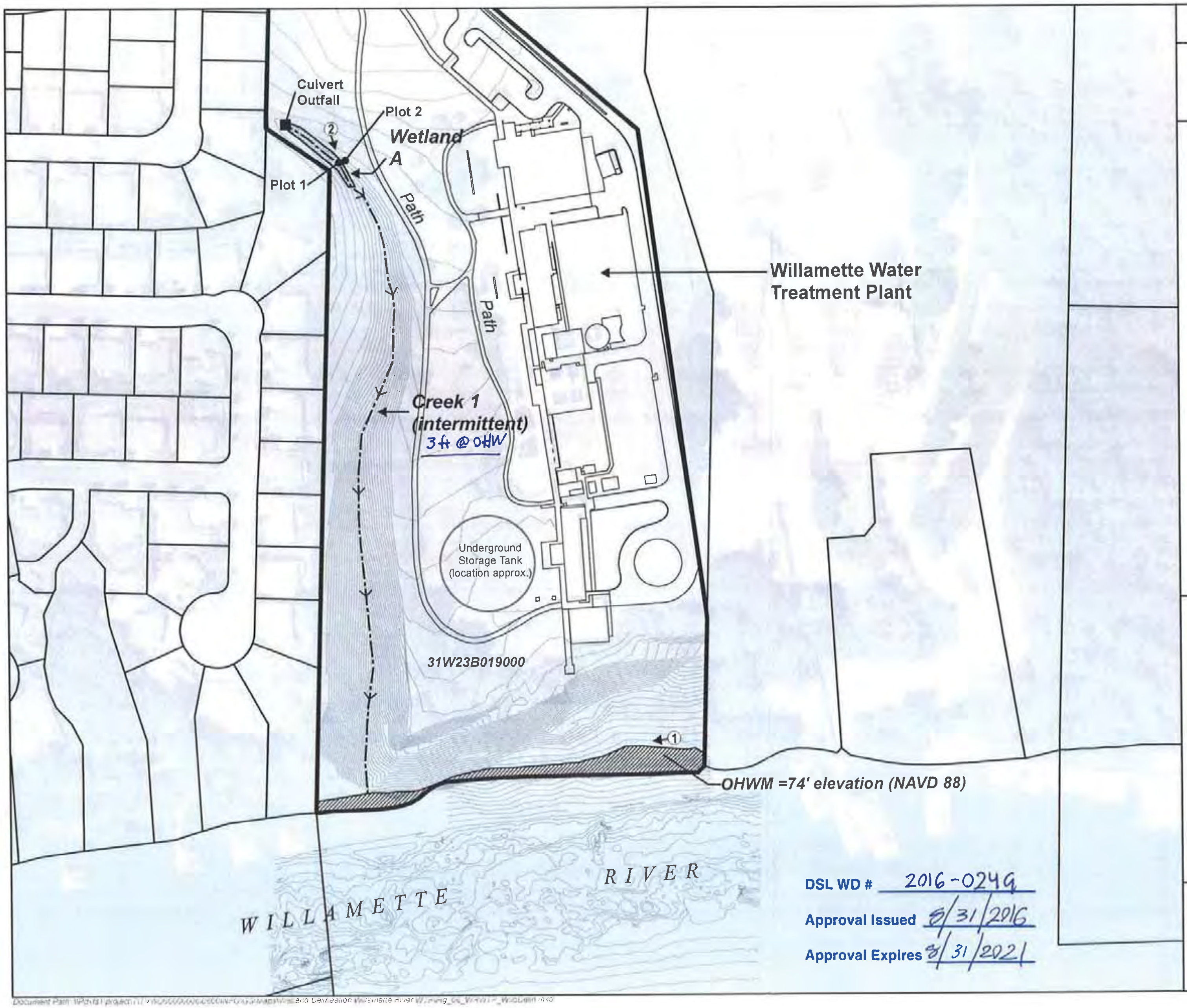
ESRI, ArcGIS Online, World Imagery. Microsoft. 2010. Portland, Oregon.

Compass Land Surveyors. June 2015.

Willamette River Water Treatment Plant

Figure 6, Sheet 2

Wetland Delineation



DSL WD # 2016-0249

Approval Issued 8/31/2016

Approval Expires 8/31/2021

Legend

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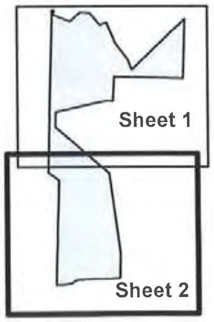


ESRI, ArcGIS Online, World Imagery. Microsoft. 2010. Portland, Oregon.

Compass Land Surveyors. June 2015.

Exhibit I: Construction Management Plan

Exhibit I – Construction Management Plan

Willamette Water Supply System, RWF_1.0

The Raw Water Facilities Project (RWF_1.0) is located on Arrowhead Creek Lane in Wilsonville, Oregon. RWF_1.0 is co-located with the existing Willamette River Water Treatment Plant (WRWTP) and Willamette River Water Treatment Plant Park (Park). Construction will be completed in phases from 2020 through 2024. The WRWTP will remain open and operational throughout the duration of construction other than short scheduled shutdowns to facilitate construction, and the Park will remain open or partially open throughout most of construction. During construction, the contractor will also be working adjacent to and in Arrowhead Creek Lane.

This exhibit describes anticipated construction traffic patterns during construction, and how potential conflicts with existing traffic and pedestrian patterns will be addressed. More detailed plans will be developed by the construction contractor prior to construction but will be consistent with the measures described herein.

1.1 Construction Methods

The following types of heavy equipment are anticipated to be used for construction: excavators, loaders, haul trucks, cranes, forklifts, drill rigs, grout batching and pumping equipment, and concrete delivery trucks.

The design has selected methods of construction to minimize vibration and noise impacts. One example is utilizing drilled piles in lieu of driven piles for the foundations of the Upper Site facilities. In addition, the contractor may utilize vibratory piling equipment coated with a noise insulating product to reduce ringing from vibration or other similar methods during construction. The contract documents will include limits of vibration and noise and require monitoring during construction accordingly to minimize the impact to the neighborhood, Park visitors, and the existing WRWTP.

1.2 Site Access

The main ingress and egress to the site will be via Arrowhead Creek Lane. Detailed requirements to minimize impacts to roadways and restore roadways after construction will be determined in coordination with the City of Wilsonville prior to construction, as part of obtaining required construction permits. Standard construction practices help limit impacts to paved surfaces and will be applied on this project, including limiting construction vehicle speed along roads, cleaning debris from Arrowhead Creek Lane in the circulation area between the staging and project sites, using steel plates to distribute heavy equipment loads that exceed the road bearing capacity, and limiting access of off-road or tracked vehicles on Arrowhead Creek Lane.

Construction traffic will include hauling material to and from quarries and disposal sites, and delivering concrete, mechanical equipment, pipe, and other necessary items from suppliers. Arrowhead Creek Lane is the only available route to the site, so construction traffic will access be routed to and from

Interstate 5 (I-5) via Wilsonville Road, as shown in Figure 1. Table 1 lists possible construction windows and an estimate of average daily truck trips (ADT), for each phase of construction.

Construction traffic will typically access the site between 7 a.m. and 8 p.m. on weekdays, and between 9 a.m. and 6 p.m. on Saturdays, Pacific Standard Time. Construction traffic will typically access the site between 7 a.m. and 9 p.m. on weekdays, and between 9 a.m. and 7 p.m. on Saturdays, Pacific Daylight Time If needed, a variance would be requested for work hours beyond these on a case by case basis. Construction workers will park in designated staging areas unless otherwise approved by the City of Wilsonville.

1.3 Site Circulation

Construction traffic will access the Upper Site (the area north of the existing Bonneville Power Administration (BPA) transmission lines) directly from Arrowhead Creek Lane. For access to the Lower Site (south of the BPA transmission lines), construction traffic will generally be routed in a counterclockwise pattern as shown in Figure 2. A temporary access route will generally follow the alignment of the existing pedestrian pathway along the west side of the Park to the river bank, along the proposed pipeline alignment. On the river bank itself, a temporary access road will be constructed to enable improvements along the river bank and at existing intake facilities (Figure 3). Construction traffic will exit the river bank on the existing driveway located along the eastern side of the WRWTP, along the proposed duct bank alignment, before reconnecting to Arrowhead Creek Lane. Access to the secure WRWTP driveway and Arrowhead Creek Lane on site will be coordinated with WRWTP operations staff and Wilsonville to minimize impacts to WRWTP operations.

1.4 Access Restrictions for Public Safety

The construction schedule has been optimized to minimize disruption to the public. Nonetheless, Park areas under construction will need to be closed to the public to protect the public from construction activities and traffic. Portions of the Park will remain open to the public during most of the 4 year construction period, including the water feature that runs along the west side of the WRWTP. The planned closures will enable a shorter total duration for project construction and an earlier return to normal Park uses as well as reduced effects on the neighborhood and WRWTP operations. The paragraphs that follow describe anticipated restrictions on public access for each area of the site and planned measures for maintaining public safety. Table 2 and Figure 4 summarize the required Park closures. WWSP communications staff will continue to work closely with City staff to coordinate the closures and communicate with the neighbors in advance of construction activities and access restrictions.

<u>Detours and Access Closures.</u> Prior to the planned detouring or closing of a section of road, driveway, or other access point for project neighbors, the WWSP Communications Team in coordination with City communications staff will supply neighbors, service providers and others impacted by the detour/closure a notice about the work, expected duration, and other information as appropriate. On-site signage, fencing, and other measures will be used as needed during construction to protect public safety.

<u>Pedestrian Pathway through the Park.</u> The raw water pipeline and seismic improvements will necessitate a closure of the existing pedestrian pathway through the Park as this area will be used as an

access road for both the seismic improvement and the raw water pipeline. The time frame for the closure pertaining to this area (highlighted red in Figure 4) will be approximately fourteen (14) months, from July 2020 through September 2021. During this closure, temporary fencing and signage will be in place as needed to protect public safety. The pedestrian pathway will be replaced and widened at the conclusion of the construction within the Park. The widened path may be used for access during Phase 2 of construction to expedite construction activities and minimize disruption to the existing WRWTP operations and for later long-term operations and maintenance access as needed. This would require the closure of the path. Any such construction closures would include temporary fencing and signage to protect public safety or alternate appropriate safety measures.

<u>Pedestrian Pathway along Arrowhead Creek Lane, North of WRWTP Parking Lot.</u> The existing pedestrian pathway at the intersection of Arrowhead Creek Lane and the BPA transmission lines presents a bottleneck area where closures to pedestrian and public traffic access will be necessary to protect the public from construction activities and traffic. All lanes of traffic will be closed with a bypass road constructed on the existing pedestrian path. Due to the bypass, the Park will be closed to cyclists and pedestrians for public safety. The Park will, therefore, undergo a full closure during work at the bottleneck intersection. During this time the ductbank will also be installed adjacent to the WRWTP parking lot south of the intersection. The work will be sequenced to accomplish both activities and minimize the Park closure. The time frame for the closure (highlighted blue for the bottleneck area and orange for the duct bank in the Figure 4) will be approximately five (5) months, from July 2021 through November 2021. During the closure, temporary fencing and signage to protect public safety would be utilized.

<u>River Overlook.</u> The existing river overlook at the south side of the pump station facility will be demolished for the seismic improvements in the area. The area will be closed to public access during demolition and construction. The time frame for the closure of the overlook area for the seismic improvements (highlighted yellow in Figure 4) will be approximately ten (10) months, from July 2020 through April 2021.

To facilitate the retrofit of the existing pump station building and construction of the raw water pipeline, an additional closure of the overlook area will be needed in Phase 2. The time frame for the closure for seismic retrofit of the existing pump station (highlighted purple in the Figure 4) will be approximately seventeen (17) months, from September 2022 through January 2024. The existing overlook will be replaced with a new at-grade overlook at the end of Phase 2 construction. The overlook itself, functionally is not available from July 2020 through October 2024, or approximately 52 months. The area will be fenced off accordingly for public safety.

Figure 1. **Site Access**

3 VICINITY AND HAUL ROUTE MAP

LEGEND

← — — — →	NORTH CONSTRUCTION HAUL ROUTE
←—— - ——→	SOUTH CONSTRUCTION HAUL ROUTE

HAUL ROUTE NOTES

1. THE CONTRACTOR IS RESPONSIBLE FOR THE SAFE AND COURTEOUS OPERATION OF ALL DELIVERY VEHICLES ACCESSING THE PROJECT SITE.
2. THE HAUL ROUTES SHOWN ARE PROPOSED FOR USE BY THE CONTRACTOR.

Figure 2. **Site Circulation for Phase 1**

Note: Site circulation is similar for Phase 2 but the new widened path in the Park would be followed instead

Figure 3. **River Bank Access Road**

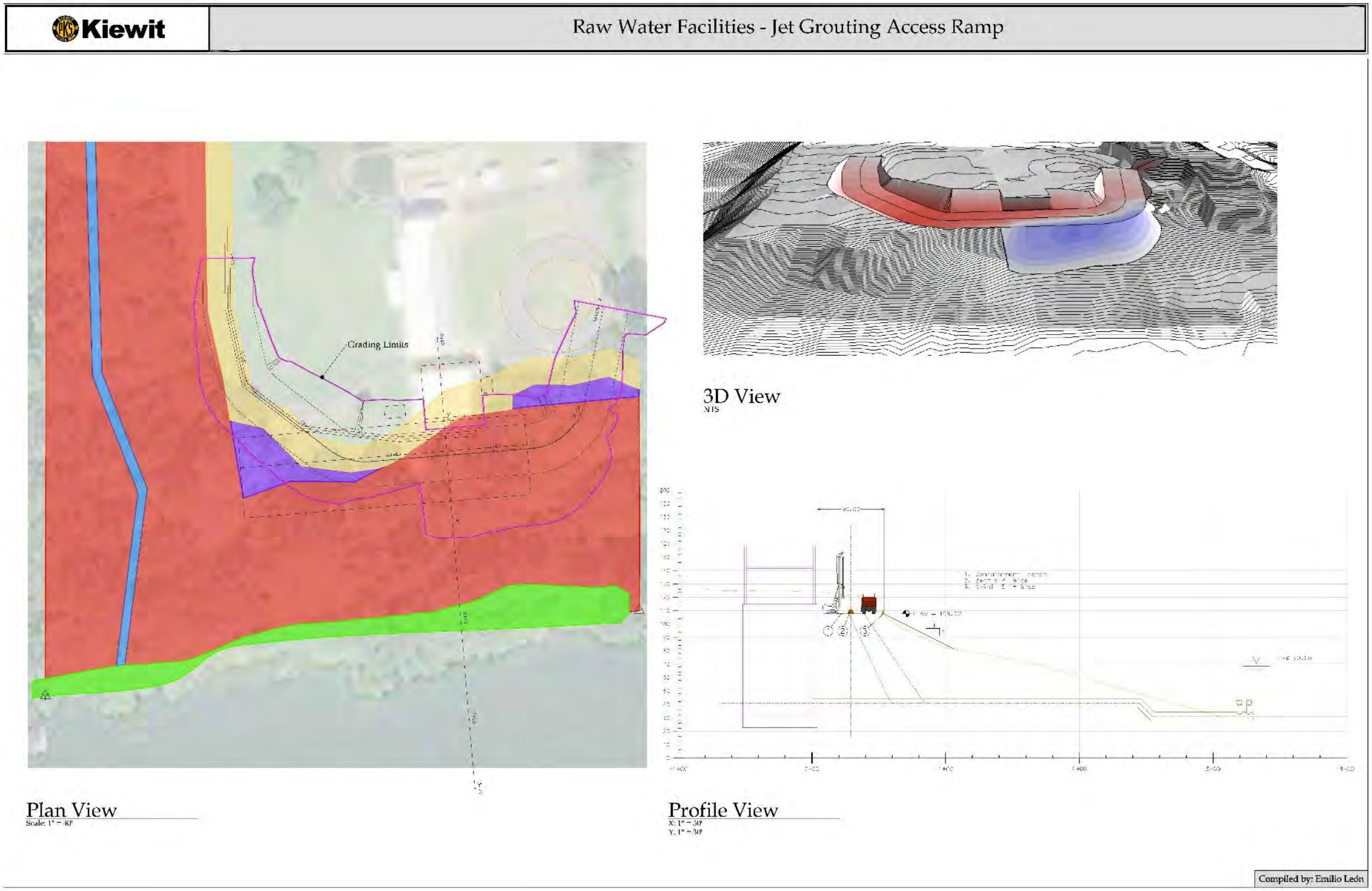


Figure 4. Construction Access and Restrictions

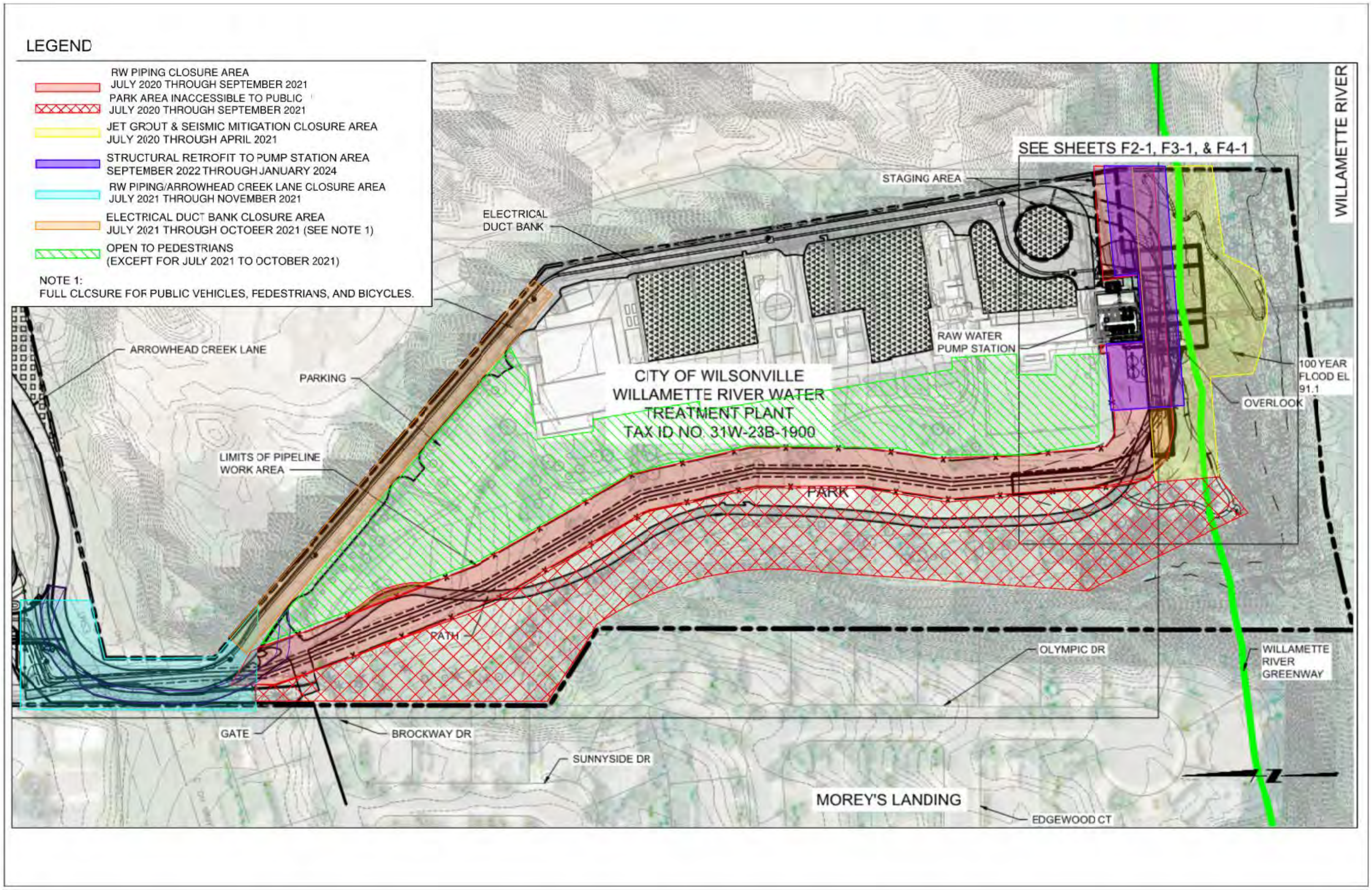


Table 1. Anticipated Project Phasing

Phase	Anticipated Start of Construction Window	Anticipated End of Construction Window	Estimated Construction Duration	Estimated Average Daily Truck Trips
1. Phase 1 Mobilization	June 2020	July 2020	2 Months	22
2. Phase 1 Construction	July 2020	February 2022	20 Months	30
3. Upper Site Mass Excavation	August 2020	June 2021	11 Months	27
4. Existing Caisson Stability and Seismic Improvements	July 2020	April 2021	10 Months	27
5. Phase 2 Construction	September 2022	September 2024	24 Months	32
6. Testing, Acceptance and Demobilization	October 2024	November 2024	2 Months	17

Note: All dates are subject to change and are based on a Notice to Proceed in June of 2020

Table 2. Summary of Anticipated Park Closures During Construction

Work Item	Anticipated Closure	Estimated Duration (Months)	Estimated Construction Dates
River Overlook	Partial Closure of Park at Overlook	10 months	July 2020 through April 2021
Pedestrian Pathway through the Park	Partial Closure of Park and Full Closure of Overlook	14 months	July 2020 through September 2021
Pedestrian Pathway along Arrowhead Creek Lane, North of the WRWTP Parking Lot	Full Closure of Park	5 months	July 2021 through November 2021
Structural Retrofit of Pump Station and Raw Water Pipeline Construction	Partial Closure of Park at Overlook	17 months	September 2022 through January 2024

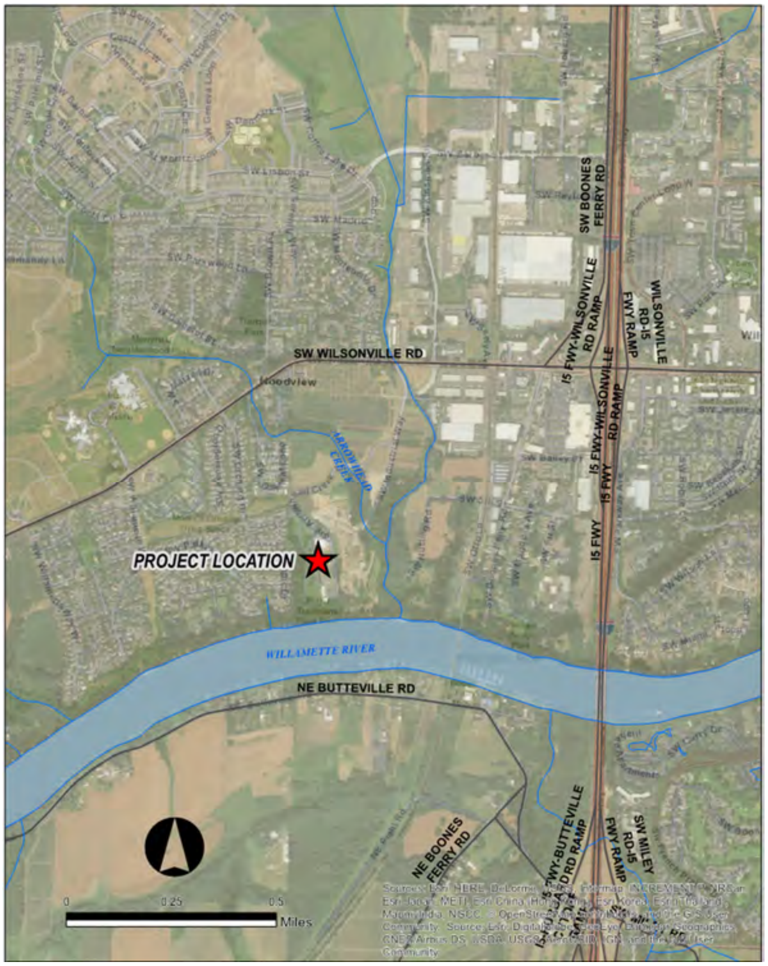
Note: All dates are subject to change and are based on a Notice to Proceed in June of 2020. Dates would be modified if any unforeseen conditions are encountered.

Exhibit J: Preliminary Stormwater Report

Memorandum

To: Paul Kneitz, Jeff McMullen, Black & Veatch Corporation
From: Ashley Cantlon, PE
Copies: File
Date: July 18, 2019
Subject: Raw Water Facility (RWF) 1.0 Stormwater Management Approach
Project No.: 18439

This memorandum has been prepared to address and document the proposed approach for managing stormwater associated with the proposed Raw Water Facilities (RWF 1.0) site. The proposed project site is in Wilsonville, south of the intersection between SW Brockway Drive and Arrowhead Creek Lane near the Willamette River. A vicinity map is included below.



Vicinity Map

A preliminary stormwater management plan was developed during the initial permitting application phase of this project (Willamette Water Supply System Stormwater Management Plan (WWSP), DEA, April 2017). This plan discusses this site along with others associated with the overall WWSP project, and was developed to a design level to support the project's Joint Permit Application (JPA).

This memorandum specifically discusses the RWF 1.0 project and addresses any modifications to the stormwater plan that are anticipated based on further development of the design. It does not, however, address management of stormwater during temporary construction staging and storage activities.

Project Description

Willamette Water Supply has identified this project as an integral component of a system that is currently being constructed to meet current and forecasted potable water demand. Concurrent with this raw water facility project, a water treatment plant, reservoir facilities, and large transmission pipelines are also in various stages of design and construction. This collective system will eventually serve as a water source for Washington County residents.

This raw water facility project proposes to construct the following new types of facilities on two lots (upper site and lower site):

Upper Site

- Generator pads
- Radio repeater tower
- Stormwater facilities
- 66" raw water pipeline and duct bank
- Surge tank pad area
- Access road
- HVAC pad

Lower Site

- Seismic stabilization
- Pipe installation (trenching)
- Access path widening and reconstruction
- Gravel and paver drive connection between roundabout and access path
- Paver staging area to be used during construction and left in place following construction
- Grind and overlay repairs to Arrowhead Creek Lane between upper and lower sites

Permitting

The following permit applications will be required for this project:

- State removal/fill permit through DSL
- City of Wilsonville Development Permit
- Section 401 water quality certification from DEQ

This project applied for and obtained permits using a joint permit application (JPA), following Standard Local Operating Procedures for Environmental Species (SLOPES V) to meet stormwater management requirements. National Marine Fisheries Services (NMFS) is the department within the National Oceanic and Atmospheric Administration (NOAA) that reviewed the stormwater management plan for compliance with SLOPES V as part of a consultation with the United States Army Corps of Engineers (USACE). Additionally, this project will need to meet City of Wilsonville stormwater management criteria, which will be addressed by applying the City's adopted BMP sizing tool to meet both local and federal requirements.

Project Size and Location

The proposed project will be located on the following properties: Township 3S, R1W, Section 23B, Tax Lots 1800 and 1900.

Development will include construction and reconstruction of approximately 2.3 acres of new impervious area.

A significant resource overlay zone (SROZ) is located within the property boundaries on both lots; however, the proposed development will not impact the SROZ. (See attached Figure 1)

Existing Conditions

Lot 1800 (the “upper” site) is currently undeveloped and is comprised of vegetated land cover (grass and farmed area with trees) and gradually slopes to the east toward Arrowhead Creek. This creek flows to the southeast from this project site to its confluence with Coffee Lake Creek, approximately 1,000 feet downstream, which eventually flows into the Willamette River.

Lot 1900 (the “lower” site) was previously developed as a Willamette River water intake and treatment plant. This site generally slopes to the south toward the Willamette River. An existing piped stormwater system collects runoff from the site and conveys flows to an outfall into the Willamette River.

Proposed Conditions

Improvements to the upper site will include adding new paved and gravel pads, a building, raw water pipeline and duct bank, and stormwater management infrastructure. Impervious area will increase from 0.06 acres under existing conditions to approximately 1.8 acres under proposed conditions. (See attached Figure 1)

Proposed development within the lower site includes trenching to perform pipe upgrades. An existing path will be reconstructed and widened from an 8-foot to a 12-foot width to allow emergency vehicle access to the lower site during emergency situations such as a seismic event. A new access road connection comprised of gravel and pavers will be constructed between this pathway and the roundabout at the end of Arrowhead Creek Lane. A staging area will also be constructed with pervious pavers inside the roundabout. (See attached Figure 2)

All improvements to the upper site constructed with this project or designed for future construction were included in the stormwater conveyance, treatment, and flow control analyses. The lower site improvements (approximately 0.5 acres) will not warrant any new constructed stormwater management facilities based on the management approach described below.

Arrowhead Creek Basin

The upper lot is located completely within the Arrowhead Creek drainage basin in an area that has been previously farmed. This lot is currently undeveloped with no measurable impervious area. The drainage basin contributing to Arrowhead Creek at the downstream end of the upper lot is approximately 0.5 square mile. (USGS StreamStats Analysis) and is mostly undeveloped.

Willamette River Basin

The lower segment of the project falls completely within the Willamette River Basin and currently drains to the Willamette River. The Willamette River Basin was delineated to be approximately 8,430 square miles at the lower site’s discharge location, and is also largely undeveloped. NMFS considers this to be a large water body, as it has a contributing drainage basin greater than 100 square miles at the point where it receives stormwater discharge from the project site.

Climate

The RWF 1.0 project is located within NOAA Climate Zone 2 – The Willamette Valley. This zone generally accommodates cool, wet winters and warm, dry summers. Approximately 50 percent of precipitation is experienced during the winter months of December through February, and total precipitation per year can vary from below 40 inches to upwards of 80 inches in the higher elevations within this zone. (*Erosion and Sediment Control Manual, DEQ. April 2005*)

Rainfall Depth

The following rainfall depths listed in Table 1 are provided in the City of Wilsonville's Public Works design standards.

Table 1 – 24-Hour Precipitation Depth

Recurrence Interval (Years)	Total Precipitation Depth (inches)
2	2.50
10	3.45
25	3.90
100	4.50

Pollutants of Concern

The pollutants of concern are those typically found in roadway runoff. These include sediment, oil and grease, polycyclic aromatic hydrocarbons (PAHs), metals such as Copper, Zinc, and Lead as well as pesticides and other nutrients (DEQ, 2012).

Table 2 lists each waterway affected by this project and DEQ listing status.

Table 2 – Pollutants of Concern

Waterway	Parameter	Listing Status
Arrowhead Creek	N/A	None
Willamette River (Middle)	Chlorophyll a	303(d), TMDL needed
Willamette River (Middle)	E. Coli	TMDL approved
Willamette River (Middle)	Mercury	303(d), TMDL needed
Willamette River (Middle)	Temperature	TMDL approved

Wetlands

According to a preliminary study and stormwater management plan completed by DEA in 2017, there are two wetlands within the Arrowhead Creek floodplain that fall within the project site.

Drainage

Each of the project site locations contribute runoff to two separate drainage basins. The northern (upper) site drains to Arrowhead Creek, while the southern (lower) site drains to the Willamette River. Development and redevelopment within the upper site will maintain current drainage patterns, utilizing new and existing storm pipe infrastructure to convey flows to the drainage outfall.

The proposed grading for the upper site will be designed to mimic the existing basin to uphold existing drainage patterns as much as possible. The upper site currently sheds stormwater runoff across the property and down the banks of Arrowhead Creek. Under proposed conditions the site will drain to an existing outfall on the south side of Arrowhead Creek Lane (ACL). Figure 1 shows the proposed upper site development and drainage system.

The lower site drains to the Willamette River and will only be disturbed by trenching activities, installation of seismic stabilization measures, and widening of the access path. Therefore, the lower site will not need new or upgraded stormwater management infrastructure, treatment, or flow control. Drainage patterns will remain as they are under existing conditions, and water from this access path will be shed to the adjacent vegetation.

Soils

The Web Soil Survey published by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) was referenced to determine the soil names, symbols, and hydrologic soil groups recorded on the project site. The USDA soil survey map and the corresponding hydrologic soil groups for the area of interest is attached to this memorandum.

The upper site and surrounding areas (where development is proposed) are comprised mainly of silt loams. Soil types identified within the project corridor were identified as primarily 53B Latourell loam 3 to 8 percent slopes and 86A Willamette silt loam, 0-3 percent slopes. These soils are classified as hydrologic type B, which generally exhibit moderate infiltration rates when thoroughly wet.

Geotechnical information will be consulted in future phases of site analysis and design.

Flood Hazard

The proposed development for both upper and lower sites is located outside the 100-year floodplain boundary designated by the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for Clackamas County, Oregon, Incorporated Areas, Panel 241D, June 17, 2008. See attached FIRMette of the proposed site (Figure 3).

Hydrologic Analysis

The stormwater system for the RWF 1.0 project site (upper site) was modeled using the following methods and design standards:

- *Flow control*: The City of Wilsonville has adopted a BMP Sizing Tool that was developed to aid in the design of flow control and water quality low impact development facilities. This tool provides the necessary calculations to design a facility to meet City flow duration matching standards whereby the "*duration of peak flow rates from post development conditions shall be less than or equal to the duration of peak flow rates from pre-development conditions for all peak flows between 42% of the 2-year storm peak flow rate up to the 10-year peak flow rate*." SLOPES V requires flow duration and frequency matching for 50 percent of the 2-year through the 10-year event, therefore, the more conservative City standard will be implemented using the BMP Sizing Tool to meet flow control requirements.

- *Water Quality*: While the City of Wilsonville requires capture and treatment of 80 percent of the average annual runoff (approximately 1-inch in 24 hours), SLOPES V guidelines require treatment of a volume equal to 50 percent of the rainfall produced by a 2-year, 24-hour storm. The City has adopted the BMP Sizing Tool for designing vegetated treatment facilities that meet City requirements, which produces results that do not have a direct correlation with SLOPES V guidelines. Correspondence with NMFS on August 24, 2017 indicated that the BMP Sizing Tool is acceptable to meet SLOPES V water quality standards for basins where the tool is used.

- *Conveyance*: The Rational Method was used for calculating peak discharge rates used in conveyance design. The City's design event for conveyance is the 25-year, 24-hour storm, requiring 1-foot of freeboard between the hydraulic grade line and finished grade at structure rims. Flows were calculated using the Rational Method within Hydraflow Storm Sewers Extension for Autodesk®, and routed through a pipe network within this modeling program.

The parameters described below were used in the hydrologic calculations:

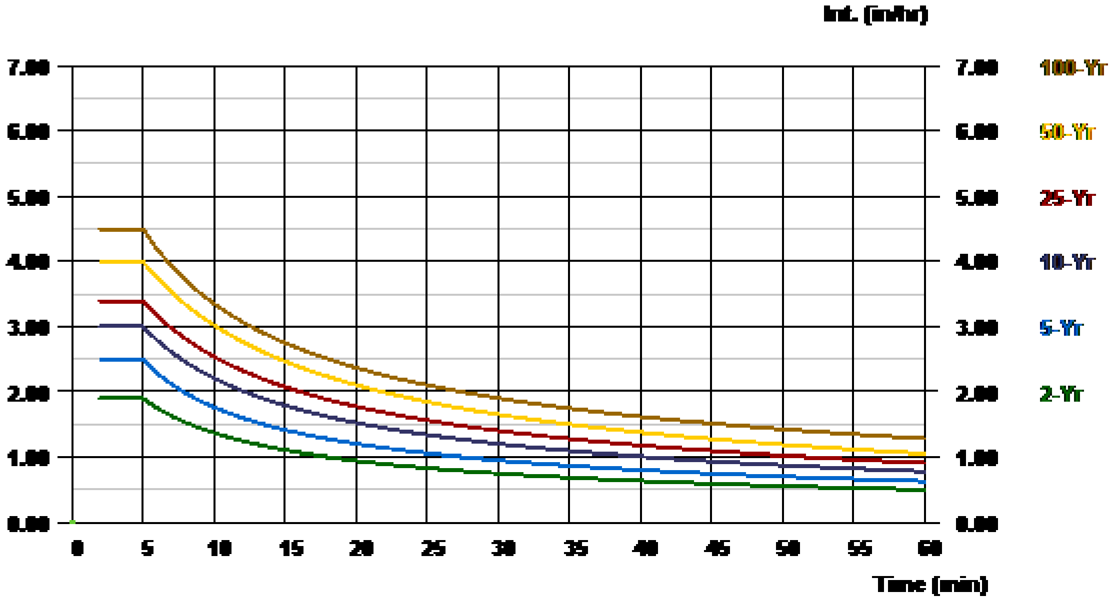
BMP Sizing Tool Hydrology

The BMP Sizing Tool was adopted by the City of Wilsonville to aid in designing low impact development facilities for treating stormwater runoff to meet City treatment standards, and controlling runoff by matching flow durations between target conditions and developed conditions. Both City standards and SLOPES V requirements consider target conditions to be pre-development, prior to any human settlement (forested, with respect to model input parameters). Due to SLOPES V criteria, target conditions use forested land cover with HSG type B soils. (see attached Hydrologic Soil Group map).

Proposed conditions for the upper site will include paved areas for an access road, building, driveway, and generator, HVAC, and transformer pad, and grassy conditions for landscaped and seeded areas within the project corridor. There will also be areas of gravel that will be modeled as crushed gravel under proposed conditions. The BMP Sizing Tool provides minimum facility footprint areas for each type of facility, with orifices sized for flow control.

Rational Method Hydrology

For the conveyance analysis, Hydraflow Storm Sewers Extension for Autodesk® was used to calculate flows and corresponding hydraulic grade line using the Rational Method. Areas were entered into the model based on drainage subbasins, assigning a runoff coefficient (C) of 0.9 to impervious areas and 0.2 to pervious areas. If a subbasin contained a combination of pervious and impervious area, a weighted runoff coefficient was calculated. Instead of precipitation depths, the Rational Method uses Intensity Duration Frequency (IDF) curves to calculate flow rates using the basic equation Q=CiA. Intensity is measured in inches per hour and duration is typically equal to the time of concentration, and the correlation assumes that the highest intensity occurs over a shorter period of time. The City of Wilsonville IDF curve shows the following correlations between intensities and time for the 2-year through 100-year storm events:



The City of Wilsonville requires that the 25-year storm event be used in conveyance design, therefore the 25-year event was the only curve used.

Water Quality

<u>Upper Site</u>
Stormwater management for the upper site will include two filtration swales (one along the northern boundary and along the south edge of the development) to treat runoff and provide flow control prior to discharging water through a new outfall into Arrowhead Creek. Predeveloped conditions were assigned a forested land cover, Hydrologic Soil Group C, to each corresponding sub-basin area listed below in Table 3. The BMP Sizing Tool uses predeveloped conditions to calculate targets for flow duration comparison.

The north swale facility was calculated to require a minimum footprint area of approximately 5,904 square feet, assuming all existing and new impervious area onsite drains to the facility. The south swale was calculated to require a minimum footprint area of approximately 7,183 square feet using the same assumptions, however in actuality there will be a small amount of area that won't physically be able to drain to these facilities. A soil infiltration rate of C2 (0.25-0.34)[1] was assumed for underlying soil conditions. For both swales, a reduction factor of 25% will be applied in exchange for deepening the water quality topsoil layer by 12". This reduction yields a required footprint area of 4,452 square feet for the north swale facility and 5,508 square feet for the south swale facility. See attached WES BMP Sizing Report for results.

Approximately 2,150 square feet of impervious area and approximately 24,358 square feet of pervious area will flow away from the site without being collected by the filtration swales. This area is assumed to be mitigated for by overdesigning the swales to account for all developed area, even though these areas don't physically drain to them.

---

[1] The BMP tool limits the types of facilities that can be used within Hydrologic Soil Group B areas, so in order to design a filtration swale with underdrain and orifice the model requires that HSG C be used as the underlying soil condition.

Table 3 – Drainage Basins			
Basin Name	**Area (sqft)**	**Predeveloped Landcover Type**	**Proposed Landcover Type**
Basins Draining to North Swale			
N1	9,414	Forested	Gravel
N2	7,853	Forested	Impervious
N3	7,752	Forested	Impervious
N4	18,532	Forested	Impervious
N5	314	Forested	Gravel
N6	21,543	Forested	Pervious
Basins Draining to South Swale			
S1	37,844	Forested	Impervious
S2	2,003	Forested	Impervious
S3	4,679	Forested	Gravel
S4	1,338	Forested	Impervious
S5	4,703	Forested	Impervious
S6	17,325	Forested	Pervious
Basins Draining Away from Site			
S7	755	Forested	Gravel
S8	2,527	Forested	Pervious
S9	2,539	Forested	Pervious
S11	2,150	Forested	Impervious
S10	2,435	Forested	Pervious
S12	10,611	Forested	Pervious
N7	3,341	Forested	Pervious

Lower Site

Stormwater drainage patterns within the lower site will remain the same under proposed conditions as they are under existing. Improvements to the access path will result in increased impervious area as the path will be reconstructed with a 12-foot width instead of the current 8-foot width. Runoff is proposed to naturally disperse toward the east into adjacent grassy and vegetated areas, away from the drainage feature located to the west of the path. Draining runoff through this vegetation will provide sufficient treatment for this area prior to discharging to the Willamette River, as the travel distance through vegetation is measured to be a minimum of 290 feet from the most downstream point where water exits the path to where it enters the river.

Drainage

The upper site is identified as part of the Arrowhead Creek drainage basin. Redevelopment within the project site will maintain current drainage patterns, utilizing new and replacement pipe infrastructure to convey flows to an existing outfall located on the south side of Arrowhead Creek Lane. Figure 1 shows proposed upper site drainage conditions and basin areas.

The lower site is within the Willamette River drainage basin, and all improvements associated with this part of the project will continue to drain to the Willamette River. Figure 2 shows proposed lower site drainage conditions and basin areas associated with the improvements.

Conveyance

Proposed development will include a new piped conveyance network that will convey flows to an existing outfall location into Arrowhead Creek. Pipes draining the project site to this location will be designed to meet City of Wilsonville conveyance standards. The existing outfall will need to be armored with a ditch inlet at the downstream end of the outfall pipe surrounded by riprap to dissipate energy. Outfall protection in the form of grouted riprap is also proposed to be installed between the ditch inlet and the bottom of the channel. This would functionally be a repair/replacement of the grouted riprap outfall protection shown in as-built drawings from when the outfall was initially constructed.

The Rational Method was used to calculate runoff rates generated under proposed conditions for contributing onsite drainage areas. Hydraflow Storm Sewers Extension for Autodesk® was used to perform the Rational Method hydrology and hydraulic calculations. The *City of Wilsonville Public Works Standards (2015)* identifies the 25-year, 24-hour storm to be used for conveyance design, maintaining 1-foot of clearance between the hydraulic grade line and conveyance structure rim elevations. An output of the Storm Sewers conveyance analysis is attached.

No new conveyance infrastructure will be required for the improvements within the lower site.

Flow Control

City of Wilsonville Public Works Standards (2015) requires the use of flow attenuation when a proposed development increases impervious surface area by more than 5,000 square feet. Therefore, this project site will provide mitigation for flow control prior to discharging site runoff to Arrowhead Creek to the maximum extent practicable. Per City requirements, “The duration of peak flow rates from post-development conditions shall be less than or equal to the duration of peak flow rates from pre-development conditions for all peak flows between 42% of the 2-year storm peak flow rate up to the 10-year peak flow rate”. This component of the stormwater management design was incorporated into the filtration swales using the WES BMP Sizing Tool. Output results are attached. This attachment provides calculations that demonstrate that the swale facilities meet both flow control and treatment requirements.

Conclusion

The proposed Raw Water Facilities (RWF 1.0) project includes improvements to two sites in the City of Wilsonville. The development will include construction of approximately 1.8 acres of new impervious area in the upper site and 0.5 acres of new and reconstructed and new impervious area in the lower site, and the stormwater system for the RWF 1.0 project will meet City of Wilsonville and SLOPES V requirements for stormwater management.

Two vegetated filtration swales were designed using the WES BMP Sizing Tool to provide treatment and flow control for the upper site. The swales are proposed to have a 25% smaller footprint area than what is shown in the output files from the BMP tool by deepening the water quality media 12 additional inches. They are designed to provide mitigation for 100% of the developed area even though some of the area will not physically be able to drain to them. Stormwater conveyance pipes will be designed to meet City conveyance standards. Improvements in the lower site a proposed to be treated by natural dispersion, and flow control is not required.

References

FEMA. “FEMA Map Service Center.” <http://msc.fema.gov/> Accessed: June 6, 2017.

NMFS. “Standard Local Operating Procedures for Endangered Species for Stormwater, Transportation or Utilities.” March 14, 2014.

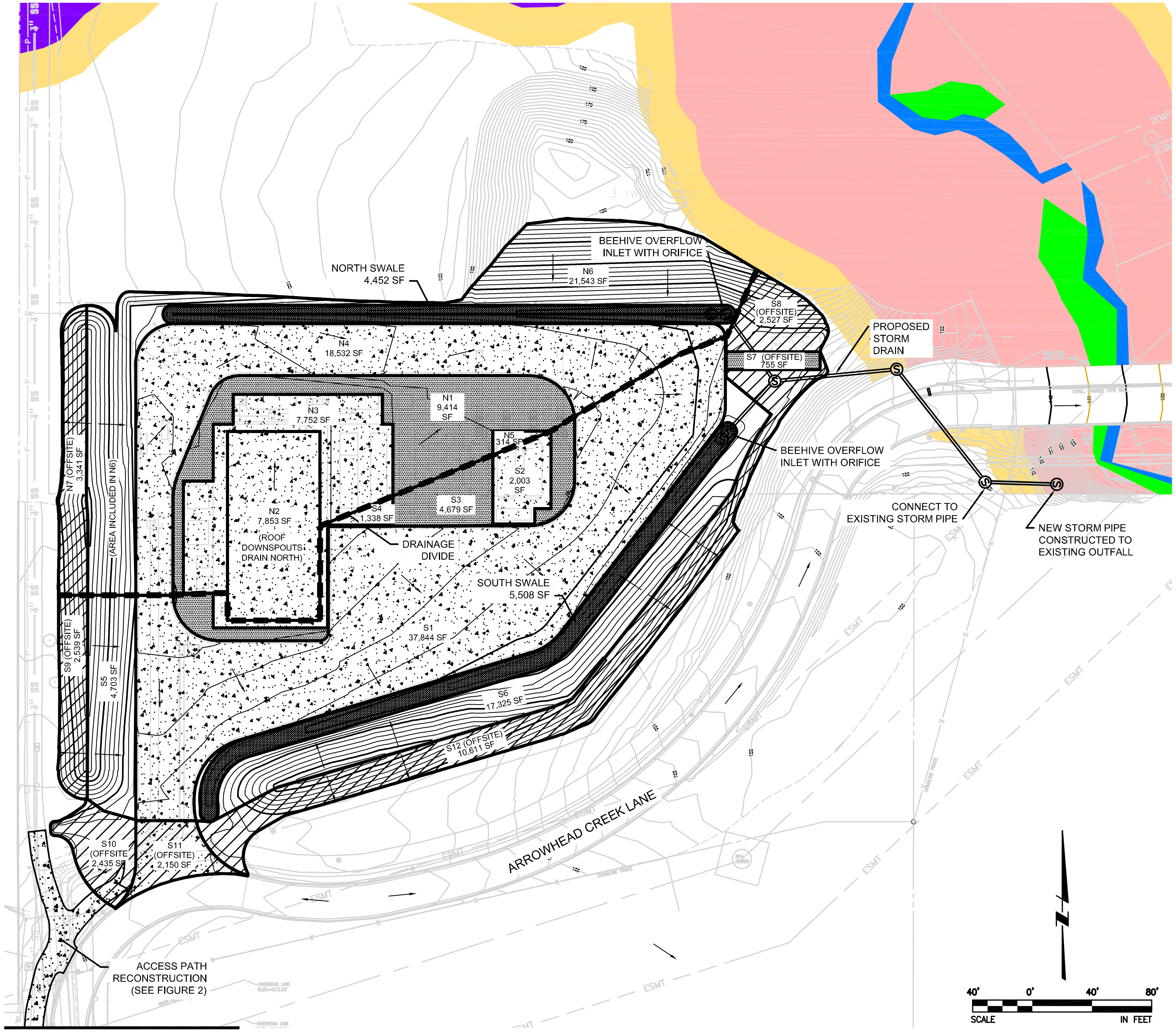
City of Wilsonville. “City of Wilsonville Public Works Standards. Section 3, Stormwater & Surface Water Design and Construction Standards” 2015; Revised December 2015.

National Resource Conservation Services, United States Department of Agriculture. “Web Soil Survey.” <http://websoilsurvey.nrcs.usda.gov/> Accessed: October 12, 2016.

Green Girl Land Development Solutions LLC . “Low Impact Development in Western Oregon: A Practical Guide for Watershed Health”. 2016.

Roadside Vegetated Treatment Sites (RVTS) Study, CALTRANS Division of Environmental Analysis, November 2003

Figures



MATCHLINE SEE FIGURE 2

TOTAL SITE AREA = 158,192 SF

DRAINAGE AREAS

IMPERVIOUS AREA TO NORTH SWALE = 34,451 SF
GRASS AREA TO NORTH SWALE = 24,884 SF
GRAVEL AREA TO NORTH SWALE = 9,414 SF

IMPERVIOUS AREA TO SOUTH SWALE = 97,726 SF
GRASS AREA TO SOUTH SWALE = 21,543 SF
GRAVEL AREA TO SOUTH SWALE = 4,585 SF

TOTAL PORTION OF DRAINAGE AREAS DRAINING AWAY FROM SITE
IMPERVIOUS = 2,150 SF
PERVIOUS = 24,358 SF

LEGEND

→	DRAINAGE DIRECTION
═	PROPOSED PIPE NETWORK
☐	DRAINAGE SUBBASIN BOUNDARY
🟨	SR HATCH
🟥	SROZ HATCH
🟩	WETLAND HATCH
🟦	STREAM HATCH
☐	PERVIOUS AREA
▦	GRAVEL AREA
⁙	IMPERVIOUS AREA
▨	AREA PHYSICALLY DRAINING AWAY FROM SITE

DSGN	____					
DR	####					
CHK	####					
APVD	####	NO.	DATE	REVISION	BY	APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

BLACK & VEATCH

SAFELY DELIVERED

Willamette Water Supply
Our Reliable Water
WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

UPPER SITE POWER BUILDING
FIGURE 1
(RWF_1.0 TO WTP)
PROPOSED STORM DRAINAGE

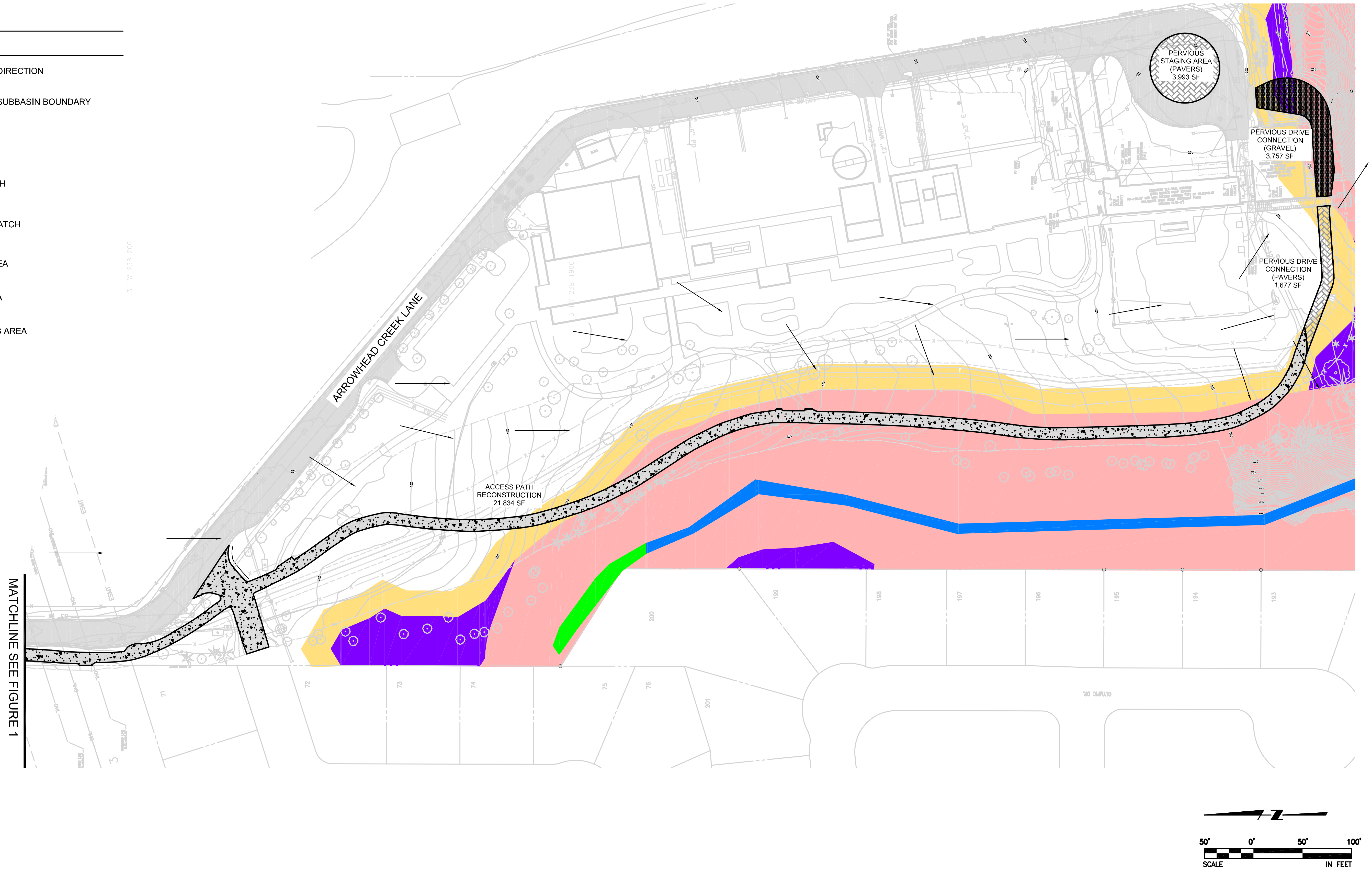
SHEET
DWG
DATE __
PROJ 196999

FILENAME: WNRFIGURE-REPORT_0625.DWG PLOT DATE AND TIME: 7/9/2019 10:31:30 AM

DWG FILE: L:\Project\18400\18439\CADD\ACAD\Dwg\Exhibits\WNRFigure-Report_0625.dwg PLOT DATE: Wednesday, October 03, 2018 BY: ASHLEYC

LEGEND

→	DRAINAGE DIRECTION
☐	DRAINAGE SUBBASIN BOUNDARY
🟨	SR HATCH
🟥	SROZ HATCH
🟩	WETLAND HATCH
▩	GRAVEL AREA
▨	PAVER AREA
⁘	IMPERVIOUS AREA



BLACK & VEATCH

Willamette Water Supply
Our Reliable Water
WILLAMETTE WATER SUPPLY PROGRAM
RWF_1.0

UPPER SITE POWER BUILDING
FIGURE 2
(RWF_1.0 TO WTP)
PROPOSED STORM DRAINAGE

DSGN ____							VERIFY SCALE
DR ####							BAR IS ONE INCH ON ORIGINAL DRAWING. 0 ▬ 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.
CHK ####							
APVD ####	NO.	DATE	REVISION	BY	APVD		

SHEET
DWG
DATE __
PROJ 196999

FILENAME: WNRFIGURE-REPORT_0625.DWG PLOT DATE AND TIME: 7/10/2019 9:20:58 AM

BY: ASHLEYC
PLOT DATE: Wednesday, October 03, 2018
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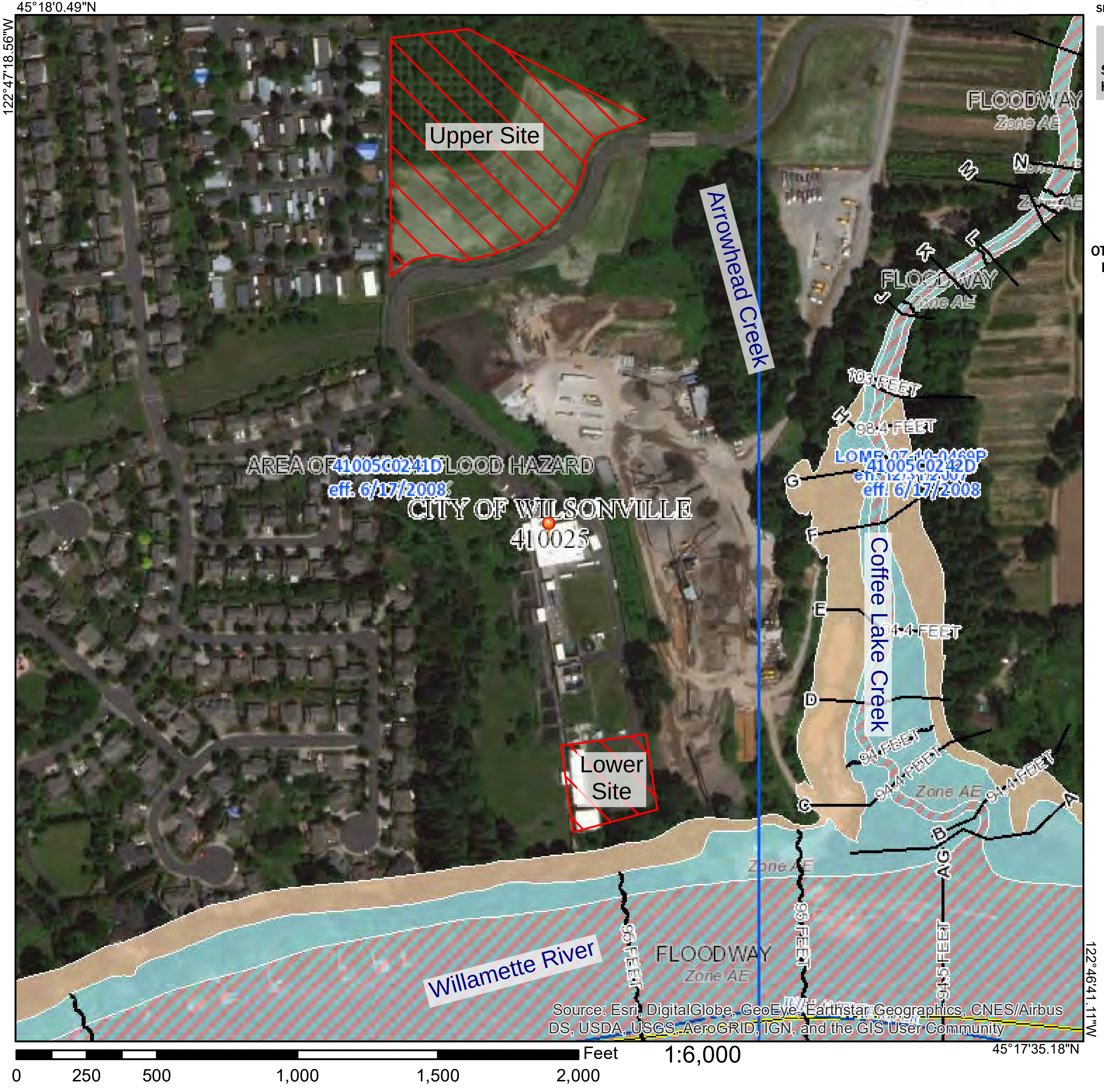
National Flood Hazard Layer FIRMette

FEMA



1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	🟦	Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
	▨	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	🟧	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
	▨	Future Conditions 1% Annual Chance Flood Hazard *Zone X*
	▨	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
	▨	Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
	▭	Effective LOMRs
	▭	Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	— — —	Channel, Culvert, or Storm Sewer
	IIIIIIIIIII	Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8 — —	Coastal Transect
	~~ 513 ~~~	Base Flood Elevation Line (BFE)
	—	Limit of Study
	—	Jurisdiction Boundary
	--- ---	Coastal Transect Baseline
	- —	Profile Baseline
	—	Hydrographic Feature
MAP PANELS	☐	Digital Data Available
	⬚	No Digital Data Available
	☒	Unmapped

N

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The base map shown complies with FEMA's base map accuracy standards

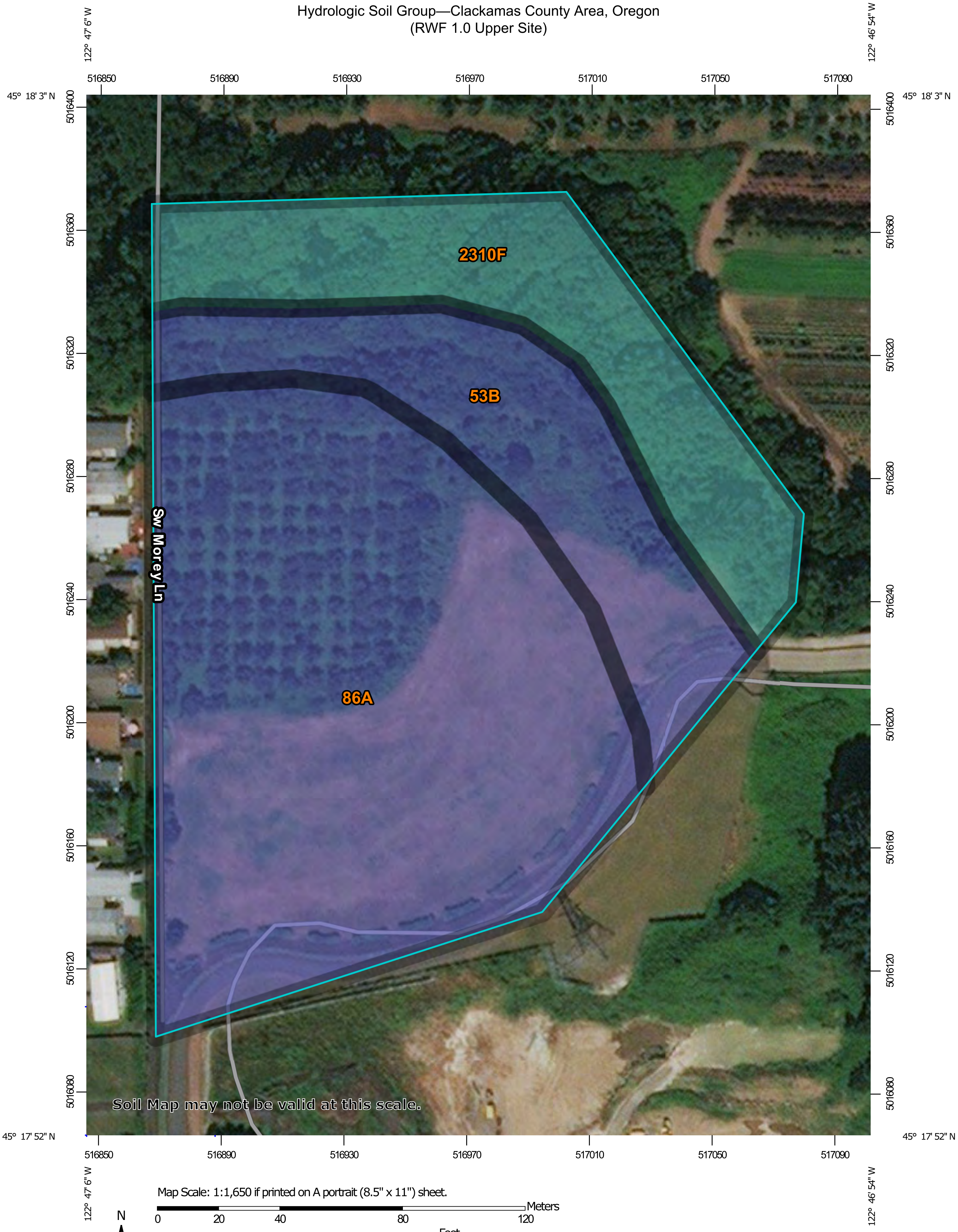
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/17/2018 at 4:53:00 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: base map imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

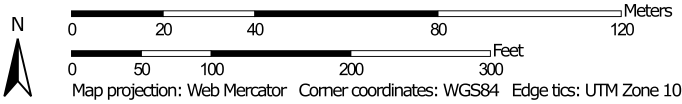
FIGURE 3

Attachments

Hydrologic Soil Group—Clackamas County Area, Oregon
(RWF 1.0 Upper Site)



Map Scale: 1:1,650 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

□ Area of Interest (AOI)

Soils

Soil Rating Polygons

■ A
■ A/D
■ B
■ B/D
■ C
■ C/D
■ D
□ Not rated or not available

Soil Rating Lines

〰 A
〰 A/D
〰 B
〰 B/D
〰 C
〰 C/D
〰 D
〰 Not rated or not available

Soil Rating Points

▣ A
▣ A/D
▣ B
▣ B/D
▣ C
▣ C/D
▣ D
▣ Not rated or not available

Water Features

〰 Streams and Canals

Transportation

┼┼┼ Rails
〰 Interstate Highways
〰 US Routes
〰 Major Roads
〰 Local Roads

Background

■ Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 14, Sep 18, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 19, 2015—Sep 13, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
53B	Latourell loam, 3 to 8 percent slopes	B	2.1	19.9%
86A	Willamette silt loam, 0 to 3 percent slopes	B	6.3	58.5%
2310F	Woodburn silt loam, 20 to 55 percent slopes	C	2.3	21.6%
Totals for Area of Interest			**10.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

WES BMP Sizing Software Version 1.6.0.2, May 2018

WES BMP Sizing Report

Project Information

Project Name	Raw Water Facilities
Project Type	PublicFacilities
Location	
Stormwater Management Area	200648
Project Applicant	
Jurisdiction	OutofDistrict

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
DMA-UpperImp-NorthSwale	34,451	Forested	ConventionalConcrete	C	BMP-Swale North
DMA-UpperImp-SouthSwale	43,873	Forested	ConventionalConcrete	C	BMP-Swale South
DMA-UpperPer-NorthSwale	24,884	Forested	Grass	C	BMP-Swale North
DMA-UpperPer-SouthSwale	40,140	Forested	Grass	C	BMP-Swale South
DMA-UpperGrav-NorthSwale	9,414	Forested	CrushedAggregate	C	BMP-Swale North
DMA-UpperGrav-SouthSwale	5,430	Forested	CrushedAggregate	C	BMP-Swale South

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
BMP-Swale North	FlowControlAndTreatment	Vegetated Swale - Filtration	C2	5,903.8	4,452.0	1.7
BMP-Swale South	FlowControlAndTreatment	Vegetated Swale - Filtration	C2	7,182.9	5,508.0	2.0

Pond Sizing Details

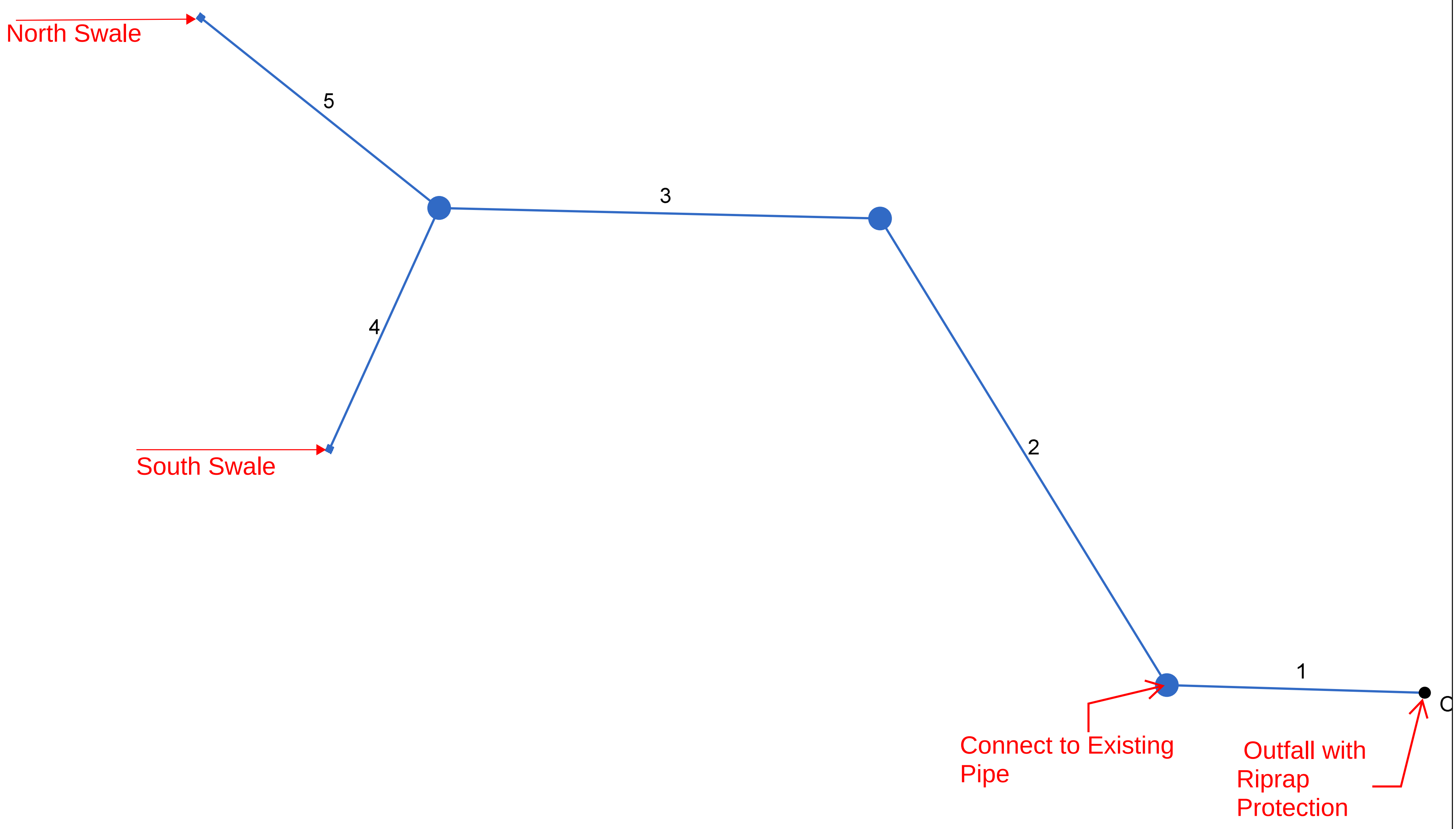
1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only

2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).

3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.

4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: RWF_UpperConvey-UPDATE.stm	Number of lines: 5	Date: 6/26/2019

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	48.000	-178.444	MH	0.00	0.00	0.00	0.0	139.51	1.56	140.26	18	Cir	0.013	0.85	149.76	Pipe - (8)
2	1	96.000	54.713	MH	0.00	0.00	0.00	0.0	140.26	0.46	140.70	18	Cir	0.013	0.85	147.47	Pipe - (7)
3	2	82.000	-55.000	MH	0.00	0.00	0.00	0.0	140.68	13.20	151.50	18	Cir	0.013	0.92	158.26	Pipe - (7)(2)
4	3	46.000	-65.000	DrGrt	0.00	1.32	0.76	5.0	151.50	2.87	152.82	18	Cir	0.013	1.00	157.80	Pipe - (4)
5	3	55.000	35.000	DrGrt	0.00	1.58	0.59	5.0	151.50	6.13	154.87	18	Cir	0.013	1.00	159.60	Pipe - (9)

Project File: RWF_UpperConvey-UPDATE.stm

Number of lines: 5

Date: 6/26/2019

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	48.000	0.00	2.90	0.00	0.00	1.94	0.0	6.3	3.1	6.00	13.13	6.19	18	1.56	139.51	140.26	140.22	141.20	141.00	149.76	Pipe - (8)
2	1	96.000	0.00	2.90	0.00	0.00	1.94	0.0	5.9	3.2	6.17	7.11	4.53	18	0.46	140.26	140.70	141.34	141.78	149.76	147.47	Pipe - (7)
3	2	82.000	0.00	2.90	0.00	0.00	1.94	0.0	5.5	3.3	6.33	38.15	4.48	18	13.20	140.68	151.50	142.05	152.47	147.47	158.26	Pipe - (7)(2)
4	3	46.000	1.32	1.32	0.76	1.00	1.00	5.0	5.0	3.4	3.40	17.79	3.50	18	2.87	151.50	152.82	152.47	153.52	158.26	157.80	Pipe - (4)
5	3	55.000	1.58	1.58	0.59	0.93	0.93	5.0	5.0	3.4	3.16	25.99	3.35	18	6.13	151.50	154.87	152.47	155.55	158.26	159.60	Pipe - (9)

Project File: RWF_UpperConvey-UPDATE.stm

Number of lines: 5

Run Date: 6/26/2019

NOTES:Intensity = 16.14 / (Inlet time + 4.60) ^ 0.69 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

Exhibit K: Lighting Exhibit

D-Series Size 1

LED Area Luminaire

Catalog Number

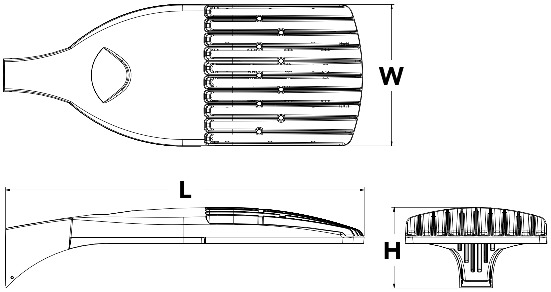
Notes

Type

Hit the Tab key or mouse over the page to see all interactive elements.

Specifications

EPA:	1.01 ft^2 (0.09 m^2)
Length:	33" (83.8 cm)
Width:	13" (33.0 cm)
Height:	7-1/2" (19.0 cm)
Weight (max):	27 lbs (12.2 kg)



A+ Capable options indicated by this color background.

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and system-level interoperability.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is A+ Certified when ordered with DTL® controls marked by a shaded background. DTL DLL equipped luminaires meet the A+ specification for luminaire to photocontrol interoperability1
- This luminaire is part of an A+ Certified solution for ROAM® or XPoint™ Wireless control networks, providing out-of-the-box control compatibility with simple commissioning, when ordered with drivers and control options marked by a shaded background[1]

To learn more about A+,
visit www.acuitybrands.com/aplus.

1. See ordering tree for details.
2. A+ Certified Solutions for ROAM require the order of one ROAM node per luminaire. Sold Separately: Link to Roam; Link to DTL DLL

Ordering Information

EXAMPLE: DSX1 LED P7 40K T3M MVOLT SPA DDBXD

DSX1LED

Series	LEDs			Color temperature		Distribution				Voltage	Mounting	
DSX1 LED	**Forward optics**			30K	3000 K	T1S	Type I short	T5S	Type V short	MVOLT[4,5]	**Shipped included**	
	P1	P4	P7	40K	4000 K	T2S	Type II short	T5M	Type V medium	120[6]	SPA	Square pole mounting
	P2	P5	P8	50K	5000 K	T2M	Type II medium	T5W	Type V wide	208[5,6]	RPA	Round pole mounting
	P3	P6	P9	AMBPC	Amber phosphor converted[2]	T3S	Type III short	BLC	Backlight control[2,3]	240[5,6]	WBA	Wall bracket
	Rotated optics					T3M	Type III medium			277[6]	SPUMBA	Square pole universal mounting adaptor[8]
	P10[1]	P12[1]				T4M	Type IV medium	LCCO	Left corner cutoff[2,3]	347[5,6,7]	RPUMBA	Round pole universal mounting adaptor[8]
	P11[1]	P13[1]				TFTM	Forward throw medium	RCCO	Right corner cutoff[2,3]	480[5,6,7]	**Shipped separately**	
						T5VS	Type V very short				KMA8 DDBXD U	Mast arm mounting bracket adaptor (specify finish)[9]

Control options				Other options		Finish *(required)*	
Shipped installed		PIRH1FC3V	Bi-level, motion/ambient sensor, 15-30' mounting height, ambient sensor enabled at 1fc[5,15,16]	**Shipped installed**		DDBXD	Dark bronze
NLTAIR2	nLight AIR generation 2 enabled[10]	BL30	Bi-level switched dimming, 30%[5,14,18]	HS	House-side shield[21]	DBLXD	Black
PER	NEMA twist-lock receptacle only (controls ordered separate)[11]	BL50	Bi-level switched dimming, 50%[5,14,18]	SF	Single fuse (120, 277, 347V)[6]	DNAXD	Natural aluminum
PER5	Five-wire receptacle only (controls ordered separate)[11,12]	PNMTDD3	Part night, dim till dawn[5,19]	DF	Double fuse (208, 240, 480V)[6]	DWHXD	White
PER7	Seven-wire receptacle only (controls ordered separate)[11,12]	PNMT5D3	Part night, dim 5 hrs[5,19]	L90	Left rotated optics[1]	DDBTXD	Textured dark bronze
DMG	0-10V dimming extend out back of honsing for external control (leads exit fixture)	PNMT6D3	Part night, dim 6 hrs[5,19]	R90	Right rotated optics[1]	DBLBXD	Textured black
DS	Dual switching[13,14]	PNMT7D3	Part night, dim 7 hrs[5,19]	**Shipped separately**		DNATXD	Textured natural aluminum
PIR	Bi-level, motion/ambient sensor, 8-15' mounting height, ambient sensor enabled at 5fc[5,15,16]	FAO	Field adjustable output[20]	BS	Bird spikes[22]	DWHGXD	Textured white
PIRH	Bi-level, motion/ambient sensor, 15-30' mounting height, ambient sensor enabled at 5fc[5,15,16]			EGS	External glare shield[22]		
PIRHN	Network, Bi-Level motion/ambient sensor[17]						
PIR1FC3V	Bi-level, motion/ambient sensor, 8-15' mounting height, ambient sensor enabled at 1fc[5,15,16]						

Ordering Information

Accessories

Ordered and shipped separately.

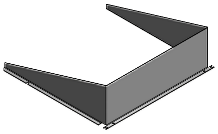
DLL127F 1.5 JU	Photocell - SSL twist-lock (120-277V) [23]
DLL347F 1.5 CUL JU	Photocell - SSL twist-lock (347V) [23]
DLL480F 1.5 CUL JU	Photocell - SSL twist-lock (480V) [23]
DSHORT SBK U	Shorting cap [23]
DSX1HS 30C U	House-side shield for 30 LED unit[21]
DSX1HS 40C U	House-side shield for 40 LED unit[21]
DSX1HS 60C U	House-side shield for 60 LED unit[21]
PUMBA DDBXD U*	Square and round pole universal mounting bracket (specify finish)[24]
KMA8 DDBXD U	Mast arm mounting bracket adaptor (specify finish) [8]

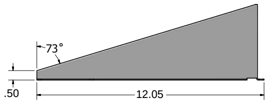
For more control options, visit DTL and ROAM online.

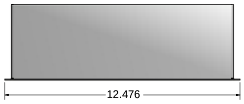
NOTES

1 P10, P11, P12 or P13 and rotated optics (L90, R90) only available together.
2 AMBPC is not available with BLC, LCCO, RCCO or P4, P7, P8, P9 or P13.
3 Not available with HS.
4 MVOLT driver operates on any line voltage from 120-277V (50/60 Hz).
5 Any PIRx with BL30, BL50 or PNMT, is not available with 208V, 240V, 347V, 480V or MVOLT. It is only available in 120V or 277V specified.
6 Single fuse (SF) requires 120V, 277V or 347V. Double fuse (DF) requires 208V, 240V or 480V.
7 Not available in P1 or P10. Not available with BL30, BL50 or PNMT options.
8 Existing drilled pole only. Available as a separate combination accessory; for retrofit use only: PUMBA (finish) U; 1.5 G vibration load rating per ANCI C136.31.
9 Must order fixture with SPA option. Must be ordered as a separate accessory; see Accessories information. For use with 2-3/8" mast arm (not included).
10 Must be ordered with PIRHN.
11 Photocell ordered and shipped as a separate line item from Acuity Brands Controls. See accessories. Not available with DS option. Shorting cap included.
12 If ROAM® node required, it must be ordered and shipped as a separate line item from Acuity Brands Controls. Not available with DCR. Node with integral dimming. Shorting cap included.
13 Provides 50/50fixture operation via (2) independent drivers. Not available with PER, PER5, PER7, PIR or PIRH. Not available P1, P2, P3, P4 or P5.
14 Requires (2) separately switched circuits.
15 Reference Motion Sensor table on page 3.
16 Reference PER table on page 3 to see functionality.
17 Must be ordered with NLTAIR2. For more information on nLight Air 2 visit this link.
18 Not available with 347V, 480V, PNMT, DS. For PER5 or PER7, see PER Table on page 3. Requires isolated neutral.
19 Not available with 347V, 480V, DS, BL30, BL50. For PER5 or PER7, see PER Table on page 3. Separate Dusk to Dawn required.
20 Not available with other dimming controls options
21 Not available with BLC, LCCO and RCCO distribution. Also available as a separate accessory; see Accessories information.
22 Must be ordered with fixture for factory pre-drilling.
23 Requires luminaire to be specified with PER, PER5 or PER7 option. See PER Table on page 3.
24 For retrofit use only.

External Glare Shield

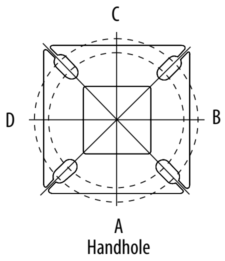






Drilling

HANDHOLE ORIENTATION

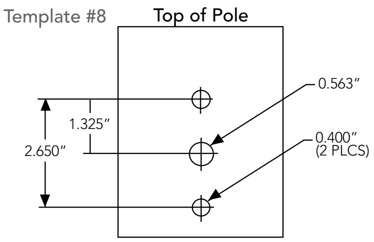


Tenon Mounting Slipfitter **

Tenon O.D.	Single Unit	2 at 180°	2 at 90°	3 at 120°	3 at 90°	4 at 90°
2-3/8"	AST20-190	AST20-280	AST20-290	AST20-320	AST20-390	AST20-490
2-7/8"	AST25-190	AST25-280	AST25-290	AST25-320	AST25-390	AST25-490
4"	AST35-190	AST35-280	AST35-290	AST35-320	AST35-390	AST35-490

Pole drilling nomenclature: # of heads at degree from handhole (default side A)

DM19AS	DM28AS	DM29AS	DM32AS	DM39AS	DM49AS
1 @ 90°	2 @ 280°	2 @ 90°	3 @ 120°	3 @ 90°	4 @ 90°
Side B	Side B & D	Side B & C	Round pole only	Side B, C, & D	Sides A, B, C, D
Note: Review luminaire spec sheet for specific nomenclature					



Pole top or tenon O.D.	4.5" @ 90°	4" @ 90°	3.5" @ 90°	3" @ 90°	4.5" @ 120°	4" @ 120°	3.5" @ 120°	3" @ 120°
DSX SPA	Y	Y	Y	N	-	-	-	-
DSX RPA	Y	Y	N	N	Y	Y	Y	Y
DSX SPUMBA	Y	N	N	N	-	-	-	-
DSX RPUMBA	N	N	N	N	Y	Y	Y	N
					*3 fixtures @120 require round pole top/tenon.			

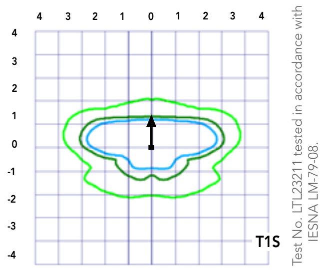
Photometric Diagrams

To see complete photometric reports or download .ies files for this product, visit Lithonia Lighting's D-Series Area Size 1 homepage.

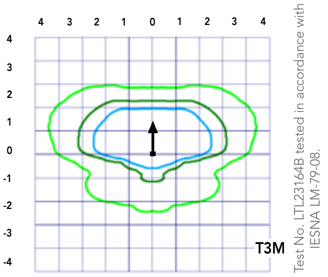
Isofootcandle plots for the DSX1 LED 60C 1000 40K. Distances are in units of mounting height (25').

LEGEND

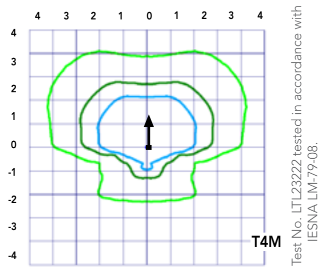
🟩	0.1 fc
🟩	0.5 fc
🟦	1.0 fc



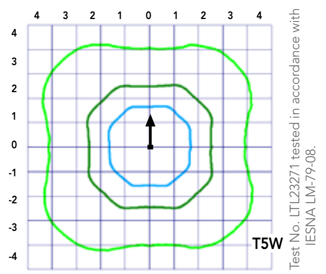
Test No. LTL23211 tested in accordance with IESNA LM-79-08.



Test No. LTL23164B tested in accordance with IESNA LM-79-08.



Test No. LTL23222 tested in accordance with IESNA LM-79-08.



Test No. LTL23271 tested in accordance with IESNA LM-79-08.

Performance Data

Lumen Ambient Temperature (LAT) Multipliers

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

Ambient		Lumen Multiplier
0°C	32°F	1.04
5°C	41°F	1.04
10°C	50°F	1.03
15°C	50°F	1.02
20°C	68°F	1.01
25°C	**77°F**	**1.00**
30°C	86°F	0.99
35°C	95°F	0.98
40°C	104°F	0.97

Projected LED Lumen Maintenance

Data references the extrapolated performance projections for the platforms noted in a **25°C ambient**, based on 10,000 hours of LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

Operating Hours	0	25000	50000	100000
Lumen Maintenance Factor	1.00	0.96	0.92	0.85

Electrical Load

	Performance Package	LED Count	Drive Current	Wattage	Current (A)					
					120	208	240	277	347	480
Forward Optics (Non-Rotated)	P1	30	530	54	0.45	0.26	0.23	0.19	0.10	0.12
	P2	30	700	70	0.59	0.34	0.30	0.25	0.20	0.16
	P3	30	1050	102	0.86	0.50	0.44	0.38	0.30	0.22
	P4	30	1250	125	1.06	0.60	0.52	0.46	0.37	0.27
	P5	30	1400	138	1.16	0.67	0.58	0.51	0.40	0.29
	P6	40	1250	163	1.36	0.78	0.68	0.59	0.47	0.34
	P7	40	1400	183	1.53	0.88	0.76	0.66	0.53	0.38
	P8	60	1050	207	1.74	0.98	0.87	0.76	0.64	0.49
	P9	60	1250	241	2.01	1.16	1.01	0.89	0.70	0.51
Rotated Optics (Requires L90 or R90)	P10	60	530	106	0.90	0.52	0.47	0.43	0.33	0.27
	P11	60	700	137	1.15	0.67	0.60	0.53	0.42	0.32
	P12	60	1050	207	1.74	0.99	0.87	0.76	0.60	0.46
	P13	60	1250	231	1.93	1.12	0.97	0.86	0.67	0.49

Motion Sensor Default Settings

Option	Dimmed State	High Level (when triggered)	Photocell Operation	Dwell Time	Ramp-up Time	Ramp-down Time
PIR or PIRH	3V (37%) Output	10V (100%) Output	Enabled @ 5FC	5 min	3 sec	5 min
*PIR1FC3V or PIRH1FC3V	3V (37%) Output	10V (100%) Output	Enabled @ 1FC	5 min	3 sec	5 min

*for use with Inline Dusk to Dawn or timer.

PER Table

Control	PER (3 wire)	PER5 (5 wire)		PER7 (7 wire)		
			Wire 4/Wire5		Wire 4/Wire5	Wire 6/Wire7
Photocontrol Only (On/Off)	✔	⚠	Wired to dimming leads on driver	⚠	Wired to dimming leads on driver	Wires Capped inside fixture
ROAM	⊘	✔	Wired to dimming leads on driver	⚠	Wired to dimming leads on driver	Wires Capped inside fixture
ROAM with Motion (ROAM on/off only)	⊘	⚠	Wires Capped inside fixture	⚠	Wires Capped inside fixture	Wires Capped inside fixture
Future-proof*	⊘	⚠	Wired to dimming leads on driver	✔	Wired to dimming leads on driver	Wires Capped inside fixture
Future-proof* with Motion	⊘	⚠	Wires Capped inside fixture	✔	Wires Capped inside fixture	Wires Capped inside fixture

✔ Recommended
⊘ Will not work
⚠ Alternate

*Future-proof means: Ability to change controls in the future.

Catalog Number	
Order Number SSS1644C D1 R3 BK 1 3 4	Type

SSS

SQUARE STRAIGHT STEEL POLES

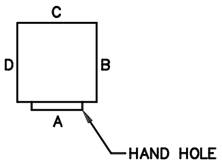
FEATURES & SPECIFICATIONS

CONSTRUCTION - Welds conform to applicable AWS structural welding code. Pole shaft is one piece, low carbon alloy steel per ASTM A595, Grade A or ASTM A500, Grade C with 50,000-PSI minimum yield strength. Pole base shall be per ASTM A36 and shall telescope pole shaft and be circumferentially welded top and bottom. Hand hole is 2" x 4" minimum, cover and fasteners are included. Base covers shall be two piece, interlocking construction. Finish shall match pole. Removable pole cap shall be provided with each drill pattern type pole. Non-structural fasteners shall be stainless steel.

FINISH – Galvanized poles per ASTM A123. Painted poles shall be semi-gloss powder paint.

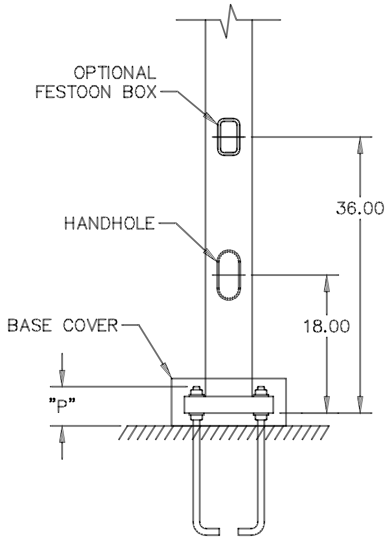
GROUNDING – Grounding provision shall be immediately accessible through hand hole, ½-13 threads.

ANCHOR BOLTS – Steel anchor bolts shall be per AASHTO M314 or ASTM F 1554 - Grade 55, hot dip galvanize. Nuts and washers shall be per AASHTO M314-90 or ASTM F 1554 – hot dip galvanized.



POLE TOP STYLE		ORIENTATION
D1	1 UNIT	C
D2	2 UNITS @ 180	B,D
D3	3 UNITS @ 90	B,C,D
D4	4 UNITS @ 90	A,B,C,D
D5	2 UNITS @ 90	B,C

DRILL PATTERN ORIENTATION



POLE ORDERING DATA

How to construct a catalog number for SSS poles:

EXAMPLE SSS2555C D1 R3 BZ 1 Fill in Catalog Number SSS2044C D1 R3 BK 3 4

1 2 3 4 5

STEP	CATALOG NUMBER	DESCRIPTION
1. BASE POLE	(SEE SHEET 2)	SQUARE STRAIGHT STEEL
2. POLE TOP STYLE	D1	DRILLING FOR 1 UNIT
	D2	DRILLING FOR 2 UNITS @ 180
	D3	DRILLING FOR 3 UNITS @ 90
	D4	DRILLING FOR 4 UNITS @ 90
	D5	DRILLING FOR 2 UNITS @ 90
	P2	TENON, 2.38 O.D. X 4" LG.
	P3	TENON, 3.50 O.D. X 6" LG.
	P4	TENON, 4.00 O.D. X 6" LG.
	P5	TENON 2.88 O.D. X 4" LG.
3. POLE TOP DRILL PATTERN	H1	PARKPACK, HORZ NO ARM
	H3	PARKPACK, HORZ WITH ARM
	J4	MIRROSTAR ONLY
	R2	MOD 600 & SOMERSET ONLY
	R3	MONGOOSE ONLY
	T3	POLESTAR ONLY
	W5	PARKPACK, VERT NO ARM
	ND	NO DRILL PATTERN
	AF1	AEL 53
	AF2	AEL 153
	AF3	AEL LS, LM
	AF5	AEL AVL W/A OPTION
	AF6	AEL ASA & AVL
4. FINISH	BK	BLACK PAINT
	BZ	BRONZE PAINT
	GN	GREEN PAINT
	GR	GRAY PAINT
	HG	HOT DIP GALVANIZED
	PP	PRIME PAINT
	WH	WHITE PAINT
5. OPTIONS	1	FESTOON BOX
	3	TAMPER RESISTANT SCREWS
	4	VIBRATION DAMPENER

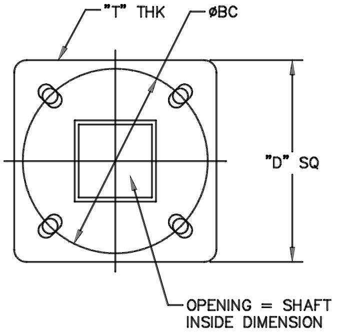
NOTES:

1. Pole top drill pattern types H1 - W5 are available on drilled pole tops only. ND is only available on tenon pole tops.
2. The Festoon Box is located on the same side as the hand hole, 36" above pole base. Receptacle / Cover are not included.

HOLOPHANE®

SSS Square Straight Steel Poles

Ref. Item No.	Base Pole Number	Nominal Pole Height	Nominal Shaft Size & Wall Thickness	EPA Vertical Offset from Top of Pole	NON-AASHTO Rating						Bolt Circle Dia.	Anchor Bolt Size
					90 mph + 1.14 gust		100 mph + 1.14 gust		110 mph + 1.14 gust			
					Max EPA	Max Wt.	Max EPA	Max Wt.	Max EPA	Max Wt.		
1	**SSS1044C**	10	4.0 Square x 11 Ga.	0"	30.5	763	23.5	588	18.5	463	8.50	.75 x 17 + 3
				30"	23.0	575	18.0	450	14.2	355		
1	**SSS1244C**	12	4.0 Square x 11 Ga.	0"	23.5	588	18.0	450	13.5	338	8.50	.75 x 17 + 3
				30"	19.1	478	14.5	363	11.0	275		
1	**SSS1444C**	14	4.0 Square x 11 Ga.	0"	19.9	498	15.0	375	11.5	288	8.50	.75 x 17 + 3
				30"	15.0	375	11.0	275	8.5	213		
1	**SSS1644C**	16	4.0 Square x 11 Ga.	0"	14.0	350	9.5	238	8.9	223	8.50	.75 x 17 + 3
				30"	11.5	288	8.0	200	7.1	178		
1	**SSS1844C**	18	4.0 Square x 11 Ga.	0"	12.0	300	8.5	213	5.5	138	8.50	.75 x 17 + 3
				30"	10.0	250	7.0	175	4.5	113		
1	**SSS2044C**	20	4.0 Square x 11 Ga.	0"	9.6	240	6.7	167	4.5	150	8.50	.75 x 17 + 3
				30"	8.1	203	5.6	140	3.7	93		
2	**SSS2044G**	20	4.0 Square x 7 Ga.	0"	16.9	423	12.5	313	9.0	225	8.50	.75 x 17 + 3
				30"	14.4	360	10.5	263	7.5	188		
3	**SSS2055C**	20	5.0 Square x 11 Ga.	0"	17.7	443	12.7	343	9.4	235	11.00	.75 x 17 + 3
				30"	14.0	373	10.9	273	8.0	200		
3	**SSS2055G**	20	5.0 Square x 7 Ga.	0"	28.1	703	21.4	535	16.2	405	11.00	.75 x 17 + 3
				30"	23.0	575	17.4	435	13.2	330		
1	**SSS2544C**	25	4.0 Square x 11 Ga.	0"	4.8	150	2.6	100	1.0	50	8.50	.75 x 17 + 3
				30"	4.3	108	2.4	60	na	na		
2	**SSS2544G**	25	4.0 Square x 7 Ga.	0"	10.5	263	7.0	175	4.5	113	8.50	.75 x 17 + 3
				30"	9.0	225	6.0	150	4.0	100		
3	**SSS2555C**	25	5.0 Square x 11 Ga.	0"	9.8	245	6.3	157	3.7	150	11.00	.75 x 17 + 3
				30"	8.8	220	5.6	140	3.4	85		
3	**SSS2555G**	25	5.0 Square x 7 Ga.	0"	18.5	463	13.3	333	9.5	238	11.00	.75 x 17 + 3
				30"	15.6	390	11.3	283	8.0	200		
2	**SSS3044G**	30	4.0 Square x 7 Ga.	0"	6.0	150	3.5	88	1.5	38	8.50	.75 x 17 + 3
				30"	5.5	138	3.0	75	1.0	25		
3	**SSS3055C**	30	5.0 Square x 11 Ga.	0"	4.7	140	2.0	50	na	na	11.00	.75 x 17 + 3
				30"	4.4	110	1.6	40	na	na		
4	**SSS3055G**	30	5.0 Square x 7 Ga.	0"	10.7	267	6.7	167	3.9	100	11.00	1.00 x 36 + 4
				30"	9.9	248	6.4	160	3.6	90		
5	**SSS3066G**	30	6.0 Square x 7 Ga.	0"	19.0	475	13.2	330	9.0	225	12.00	1.00 x 36 + 4
				30"	17.6	440	12.2	305	8.3	208		
4	**SSS3555G**	35	5.0 Square x 7 Ga.	0"	5.9	150	2.5	100	na	na	11.00	1.00 x 36 + 4
				30"	5.6	140	2.4	60	na	na		
5	**SSS3566G**	35	6.0 Square x 7 Ga.	0"	12.4	310	7.6	190	4.2	105	12.00	1.00 x 36 + 4
				30"	11.9	298	7.8	183	4.0	100		
6	**SSS3966G**	39	6.0 Square x 7 Ga.	0"	8.0	200	3.8	95	na	na	12.00	1.00 x 36 + 4
				30"	7.6	190	3.5	90	na	na		



BASE DETAIL

Item No.	Bolt Circle Dia.	Min. Base Size "D"	Base Thk. "T"	Bolt Projection	Anchor Bolt Set	Bolt Circle Template
1	8.50	8.00	0.75	3.25 - 3.75	AB-26-4	TMP-40
2	8.50	8.00	0.88	3.38 - 3.88	AB-26-4	TMP-40
3	11.00	11.00	1.00	3.50 - 4.00	AB-26-4	TMP-45
4	11.00	11.00	1.00	4.00 - 4.50	AB-27-4	TMP-45
5	12.00	12.50	1.00	4.00 - 4.50	AB-27-4	TMP-47
6	12.00	12.00	1.00	4.00 - 4.50	AB-27-4	TMP-47

Visit our web site at www.holophane.com

HOLOPHANE®
LEADER IN LIGHTING SOLUTIONS
An Acuity Brands Company

HOLOPHANE®
LEADER IN LIGHTING SOLUTIONS

Catalog Number

Notes

Type

HLWPC2

Wallpack® Full Cutoff LED

Mechanical
- Heavy grade A360 cast aluminum (aluminum with <1% copper)
- Exterior parts are protected by a zinc-infused Super Durable TGIC thermoset powder coat finish that provides superior resistance to corrosion and weathering
- Mounts to a standard junction box
- Swivel kit for pendant mount applications mounts to 4" square electrical box
- Wet location listed
- IP65 rated housing, down light only
- ¾" painted threaded entry(¾" - 14 NPT) on each side and on top, accepts ¾" and ½" condiut
- ¾" threaded plugs are painted on each side
- Vibe rating for surface mount: 3G
- Vibe rating for pendant mount: 3G at 1.5', excludes swivel kit
- Bird shroud for pendant mount

Electrical
- Certified by UL or CSA
- Rated for -40°C (-40°F) minimum ambient
- A programmable electronic driver with 0-10V control leads
- Available in: 120-277V 50/60 Hz and 347-480V 50/60 Hz,
- Standard LEDs shall have a minimum of 70 CRI available in 3000K, 4000K and 5000K CCT
- Optional LEDs shall have a minimum of 80 CRI available in 3000K, 4000K and 5000K CCT
- Amber LED option shall limited wavelength amber and no phosphor corrected amber (8 week lead-time)
- Internally mounted emergency battery backup for operation in an ambient temperature ranging from -20°C (-4°F) to 30°C (86°F), available with P10 thru P40 performance packages, non CEC compliant
- The electrical system for a single circuit shall be designed to meets ANSI/IEEE C62.41.2 and includes a 20kV/10kA (standard) with an optional 10kV/5kA surge protection

Optical

The light engine housing is IP66 rated. The acrylic optical system consist of the following I.E.S. distributions:
- Typ V: E (entry), M (medium), R (rectangle) & W (wide)
- Asymmetric

Controls
- Field adjustable output (AO)
- Button style photocontrol (PE)
- Motion sensor & ambient photocontrol combination for mounting low (8-15') (MASL) and high (15-30') (MASH) mounting heights

Certification and Standards
- Luminaire shall be UL or CSA listed per CSA luminaire standard CSA
- Suitable for operation in an ambient temperature up to 40°C/104°F per UL or CSA certification
- Design lights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.
- LM-79 compliant
- The projected LED Lumen Maintenance shall be based only on IES LM-80-08 and TM-21

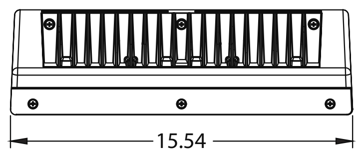
Warranty

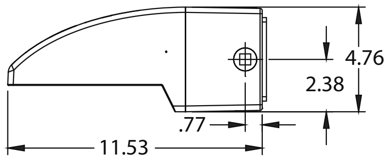
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_Conditions.aspx.

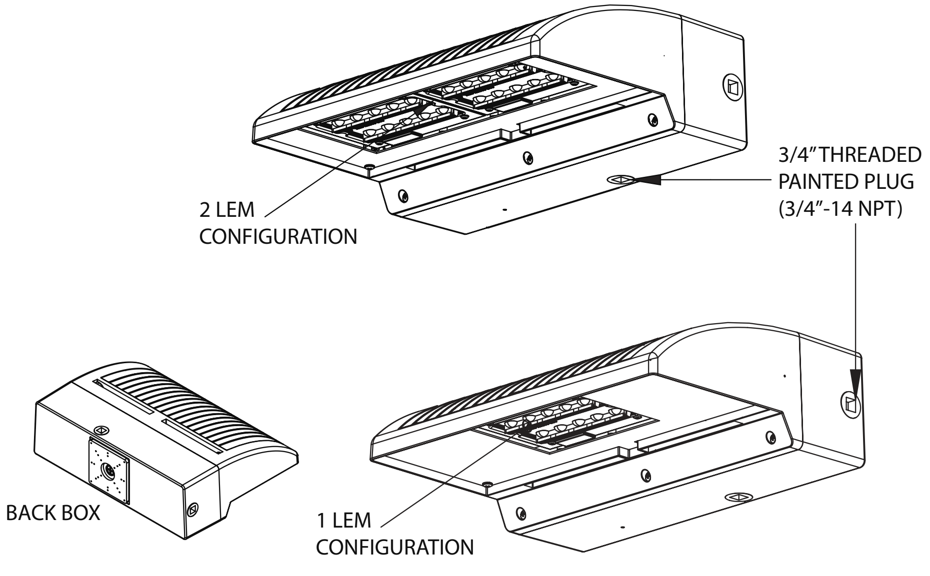
Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25 °C.

Specifications subject to change without notice.







ORDERING INFORMATION

Example: HLWPC2 P20 40K AS T3M BZSDP

Series	Lumen Package	Color Temperature	Voltage	Optics	Color	CRI
HLWPC2 Wallpack Full Cutoff LED	1 LEM Package P10 3,100 lm P20 5,600 lm 2 LEM Package P30 7,800 lm P40 9,900 lm P50 11,700 lm (Nominal Lumens, 4000K)	30K 3,000 K CCT 40K 4,000 K CCT 50K 5,000 K CCT	AS Auto-Sensing Voltage (120V-277V) 50/60HZ AH Auto-Sensing Voltage (347V-480V) 50/60HZ 12 120V 20 208V 24 240V 27 277V 34 347V 48 480V	T2S Type 2 Short T2M Type 2 Medium T3S Type 3 Short T3M Type 3 Medium T4M Type 4 Medium TFTM Forward Throw Medium ASYDF Asymmetric Diffuse SYMDF Symmetric Diffuse	BKSDP Black BZSDP Bronze GYSDP Grey WHSDP White	Blank 70 CRI (STD) 80CRI 80 CRI

Options:

Adjustable/Programmable Options

AO	Field Adjustable Output

Circuit Options

2CI	2 Independent Circuits

Control - Motion Sensor Options

MASL	Motion / Ambient Sensor, 8-15' Mounting Height Ambient Sensor Enabled at 1 FC
MASH	Motion / Ambient Sensor, 15-30' Mounting Height Ambient Sensor Enabled at 1 FC

Control - Photocontrol Options

PE	Button Style Photocontrol
P3	N.E.M.A. Twistlock Recepactle Mount -3 PIN
P7	N.E.M.A. Twistlock Recepactle Mount -7 PIN
PCLL	DTL Long Life Twistlock Photocontrol for Solid State
PND	0-10V Part-night Dimming, Includes BLC2 & N.E.M.A. Twistlock Photocontrol Receptacle
PSC	Shorting Cap

Fuse Option

SF	Single Fuse
DF	Double Fuse

Safety Option

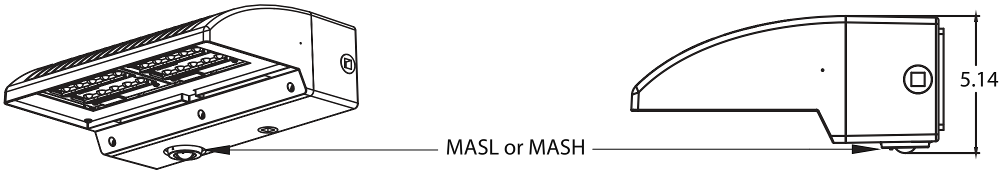
EM	Integral Emergency Battery
TP	Tamper Resistant Hardware

Surge Protection Option - 20kV/10kA is Standard

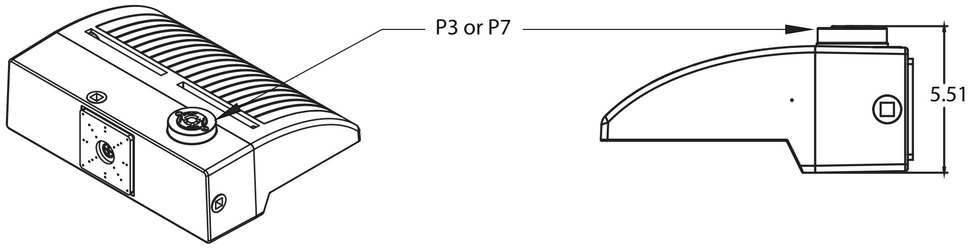
10KV	10kV/5kA Surge Protection, in place of 20kV/10kA

Options Location

Motion/Ambient Sensor mount options for Low (8-15') (MASL) and Height (15-30') (MASH) applications

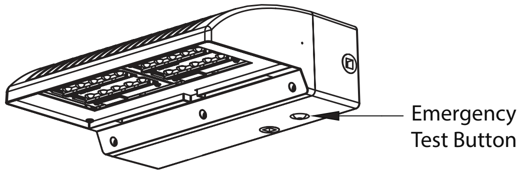


N.E.M.A. Twistlock Receptacle P3 and P7 Options, P7 Shown

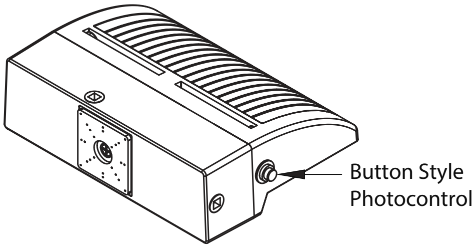


Internal Emergency Battery Test Button - EM Option

Test Button - EM Option



Button Style Photocontrol - PE Option

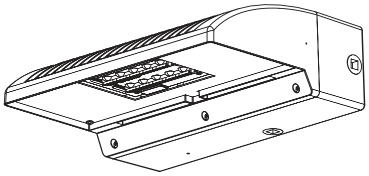


Rev. 12/17/18 Specifications are subject to change without notice.

Driver & LEM Configuration Based on Circuit Options

Number of LEMs & Drivers / Circuit		Sinlge Circuit (std.)		Two Circuit (2CI option)	
		LEMs	Drivers	LEMs	Drivers
Lumen Maintenance Factor	P10	1	1	-	-
	P20	1	1	2	2
	P30	2	1	2	2
	P40	2	1	2	2
	P50	2	1	-	-

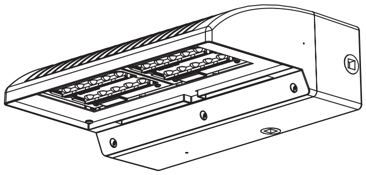
1 LEM Luminaire



SPD Based on Circuit Options

Number of LEMs & Drivers / Circuit		Sinlge Circuit (std.)				Two Circuit (2CI option)			
		LEMs	Drivers	No. of SPDs	SPD	LEMs	Drivers	No. of SPDs	SPD
Lumen Maintenance Factor	P10	1	1	1	20kV/10kA	-	-	-	-
	P20	1	1	1	20kV/10kA	2	2	2	10kV/5kA
	P30	2	1	1	20kV/10kA	2	2	2	10kV/5kA
	P40	2	1	1	20kV/10kA	2	2	2	10kV/5kA
	P50	2	1	1	20kV/10kA	-	-	-	-

2 LEM Luminaire



Projected LED Lumen Maintenance

Data references the extrapolated performance projections for the platform noted in a 25°C ambient, based on 6,000 hours of LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

The italicized data is extrapolated beyond the TM-21 standard.

E = (LM) x (CU) x (LAT) x (LLD)
LM and CU are obtained from published photometry.

Operating Hours		0	25,000	30,000	36,000	45,000	50,000	60,000	75,000	100,000
Lumen Maintenance Factor	P10	1	0.98	0.97	0.96	0.96	0.95	0.95	0.94	0.92
	P20	1	0.97	0.95	0.94	0.93	0.92	0.90	0.88	0.85
	P30	1	0.98	0.97	0.96	0.96	0.95	0.95	0.94	0.92
	P40	1	0.97	0.95	0.94	0.93	0.92	0.90	0.88	0.85

Operating Hours		0	25,000	30,000	36,000	45,000	50,000	60,000	75,000	100,000
Lumen Maintenance Factor	P10	1	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
	P20	1	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
	P30	1	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
	P40	1	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97

Lumen Ambient Temperature (LAT) Multipliers

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

Single Circuit Application

Ambient		P10	P20	P30	P40	P50
0ºC	32ºF	1.02	1.03	1.03	1.04	1.05
10ºC	50ºF	1.01	1.02	1.02	1.03	1.03
20ºC	68ºF	1.01	1.01	1.01	1.01	1.01
25ºC	77ºF	1.00	1.00	1.00	1.00	1.00
30ºC	86ºF	0.99	0.99	0.99	0.99	0.99
40ºC	104ºF	0.98	0.97	0.98	0.97	0.97

Optional Two Independent Circuit (2CI) Application

Ambient		P20	P30	P40
0ºC	32ºF	1.02	1.02	1.02
10ºC	50ºF	1.01	1.01	1.02
20ºC	68ºF	1.00	1.01	1.01
25ºC	77ºF	1.00	1.00	1.00
30ºC	86ºF	0.99	0.99	0.99
40ºC	104ºF	0.98	0.98	0.98

Electrical Load

Single Circuit Application

LEDs	Drive Current (mA)	System Watts/ Circuit	Current (A)					
			120	208	240	277	247	480
P10	700	28	0.23	0.13	0.12	0.10	0.08	0.06
P20	1400	47	0.41	0.24	0.20	0.18	0.14	0.10
P30	1050	71	0.63	0.37	0.32	0.29	0.22	0.18
P40	1420	95	0.78	0.45	0.40	0.35	0.27	0.20
P50	1720	115	0.95	0.55	0.48	0.42	0.33	0.24

Optional Two Independent Circuit (2CI) Application

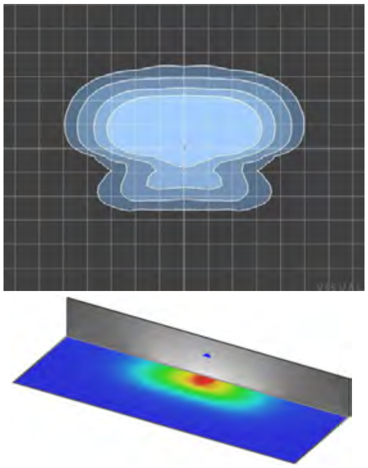
LEDs	Drive Current (mA)	System Watts/ Circuit	Current (A)					
			120	208	240	277	247	480
P10	-	-	-	-	-	-	-	-
P20	700	22	0.10	0.06	0.05	0.04	-	-
P30	1000	32	0.14	0.08	0.07	0.06	-	-
P40	1250	47	0.18	0.10	0.09	0.08	-	-
P50	-	-	-	-	-	-	-	-

Photometric Diagrams

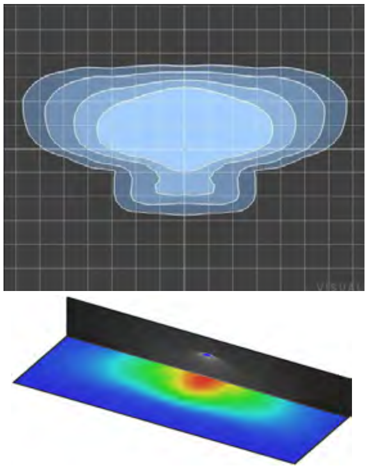
To see complete photometric reports or download .ies files for this product, visit the Holophane's Wallpack FCO LED homepage.
Isofootcandle plots for the HLWPC2 P30 40K. Distance are in units of mounting height (12"). Grid is 10'x10'.

0.1 fc	1 fc	0.2 fc	0.5 fc

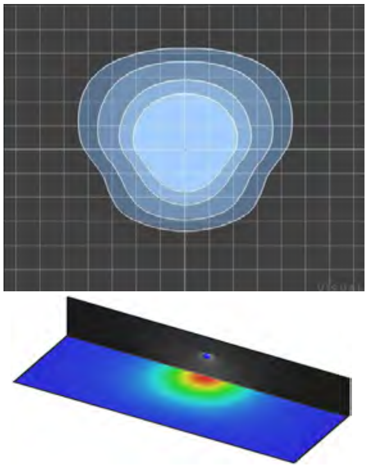
HLWPC2 P30 40K XX T2S



HLWPC2 P30 40K XX T2M



HLWPC2 P30 40K XX ASYDF



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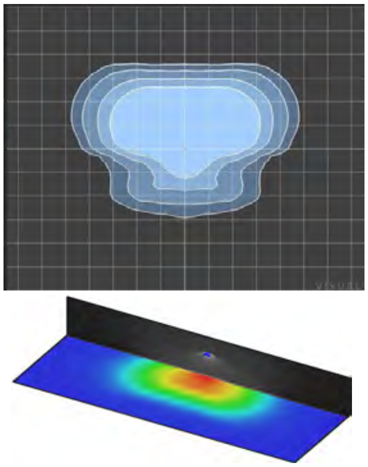
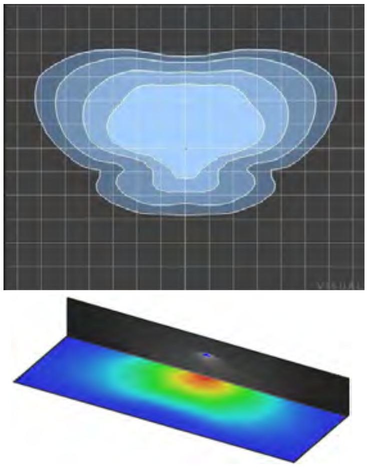
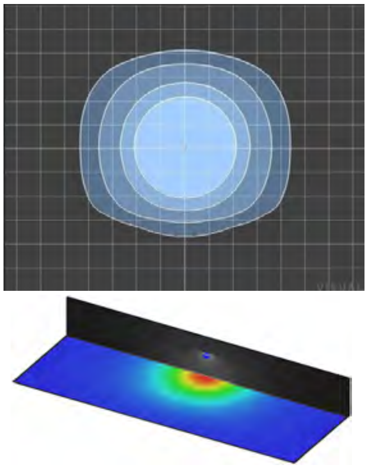


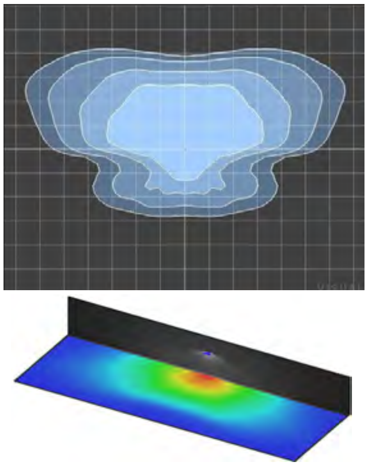
HLWPC2 P30 40K XX T3M



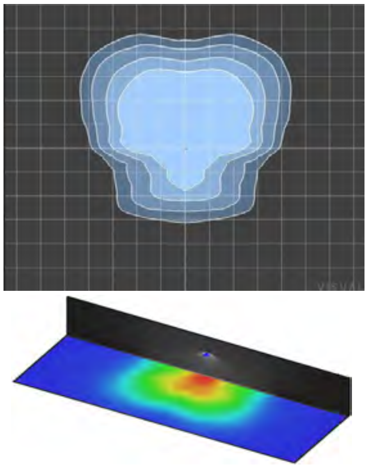
HLWPC2 P30 40K XX SYMDF



HLWPC2 P30 40K XX T4M



HLWPC2 P30 40K XX TFTM



COM*check* Software Version 4.1.1.0

Exterior Lighting Compliance Certificate

Section 1: Project Information

Energy Code: **2014 Oregon Energy Efficiency Specialty Code**
Project Title:
Project Type: New Construction
Exterior Lighting Zone: 2 (Light industrial area with limited nighttime use)

Construction Site:
10350 Arrowhead Creek Ln
Wilsonville, OR 97070

Owner/Agent:
Willamette Water Supply

Designer/Contractor:
Black & Veatch
8400 Ward Parkway
Kansas City, MO 64114

Section 2: Exterior Lighting Area/Surface Power Calculation

A Exterior Area/Surface	B Quantity	C Allowed Watts / Unit	D Tradable Wattage	E Allowed Watts (B x C)	F Proposed Watts
Site Lighting (Driveway)	103405 ft2	0.06	Yes	6204	2302
			Total Tradable Watts* =	6204	2302
			Total Allowed Watts =	6204	
			Total Allowed Supplemental Watts** =	600	

* Wattage tradeoffs are only allowed between tradable areas/surfaces.

** A supplemental allowance equal to 600 watts may be applied toward compliance of both non-tradable and tradable areas/surfaces.

Section 3: Exterior Lighting Fixture Schedule

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
Site Lighting (Driveway 103405 ft2): Tradable Wattage				
LED 1: Other:	1	17	102	1734
LED 2: Other:	1	8	71	568
			Total Tradable Proposed Watts =	2302

Section 4: Requirements Checklist

In the following requirements, blank checkboxes identify requirements that the applicant has not acknowledged as being met. Checkmarks identify requirements that the applicant acknowledges are met or excepted from compliance. 'Plans reference page/section' identifies where in the plans/specs the requirement can be verified as being satisfied.

Controls, Switching, and Wiring:

☑ 1. Lighting designated to operate more than 2000 hours per year for Uncovered Parking Areas shall be equipped with motion sensors that will reduce the luminaire power by thirty-three percent or turn off one-third the luminaires when no activity is detected.

Plans reference page/section: *RWF_1.0 LUP-28, RWF_1.0 GEE-03*

Exterior Lighting Restrictions and Exceptions:

☐ 2. Mercury vapor and incandescent lighting is not permitted for use as exterior lighting.
Exception(s):

- ☐ Incandescent lighting controlled by motion sensors and having total power less than 150 watts.
- ☐ Incandescent lighting used in or around swimming pools, water features, or other locations subject to the requirements of Article 680 of the National Electric Code.

☐ 3. Exempt lighting fixtures are equipped with a control device independent of the control of the nonexempt lighting and are identified in Section 3 table above.

Plans reference page/section: ________________________________

Exterior Lighting PASSES: Design 66% better than code.

Section 5: Compliance Statement

Compliance Statement: The proposed exterior lighting design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed lighting system has been designed to meet the 2014 Oregon Energy Efficiency Specialty Code requirements in COM*check* Version 4.1.1.0 and to comply with the mandatory requirements in the Requirements Checklist.

Name - Title	Signature	Date

Wilsonville Oregon 2015 City Development Code

Section 4.199
Exempt according to: Section 4.199.20(.02)Q

Section 4.199.10
Exempt according to: Section 4.199.20(.02)Q

Section 4.199.20
Exempt according to: Section 4.199.20(.02)Q

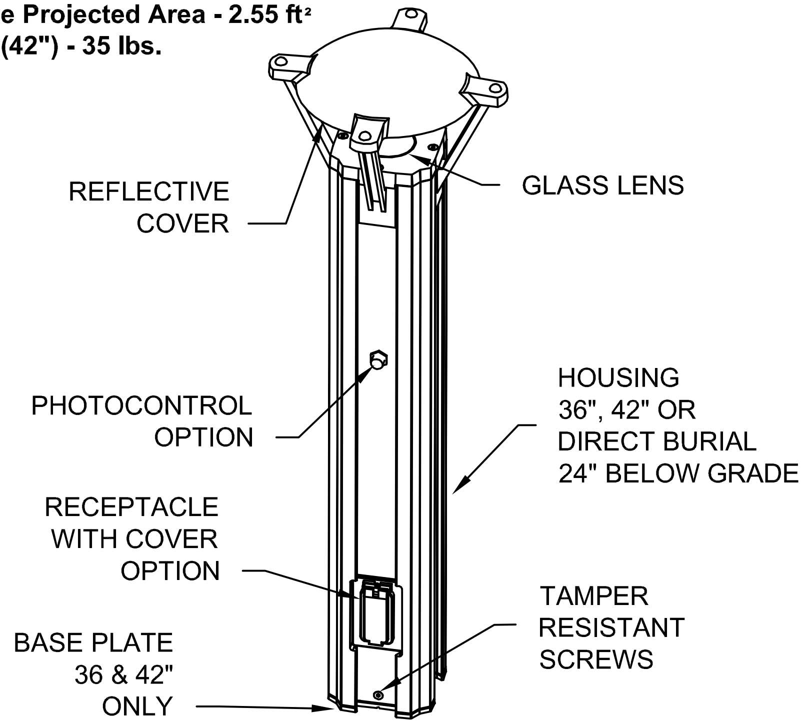
Section 4.199.30
Exempt according to: Section 4.199.20(.02)Q

Section 4.199.40
Exempt according to: Section 4.199.20(.02)Q

Section 4.199.50
Exempt according to: Section 4.199.20(.02)Q

Section 4.199.60
Exempt according to: Section 4.199.20(.02)Q

Maximum Effective Projected Area - 2.55 ft^2
Maximum Weight (42") - 35 lbs.



ORDERING INFORMATION:

SLB _ _ _ _ _ _ _

LUMINAIRE
SLB = SiteLink TracBollard

HEIGHT
3 = 36" Above Grade
4 = 42" Above Grade

SHAFT TYPE
F = Fluted
T = Track

SOURCE and WATTAGE
LEDW = LED White, 4000K
UNLT = Not internally lighted

VOLTAGE
NL = No Light
UV = Universal (120V,208V, 240V,277V)

FINISH
BK = Black
BZ = Bronze
DB = Dark Blue
GH = Graphite
GN = Green
GR = Gray
PP = Prime Paint
WH = White
CMC = Customer Matched Color
TDC = Tiger Drylac Color

OPTIONS
A = GFCI duplex receptacle with not-in-use weather proof cover
B = Direct Burial for mounting 24" below grade without a base plate
C = Button photocontrol (120V)
D = Button photocontrol (208V-277V)

ACCESSORIES
TPD 1= Tamper Proof Driver

SPECIFICATIONS:
Indirect Bollard
Four sided TracLoc Shaft

GENERAL DISCRIPTION
One piece extruded housing with integral TracLoc grooves. The exterior of the TracLoc profile is constructed for modular accessory attachments which shall be moved or changed after installation. The interior of the TracLoc profile allows for five independent wire raceways for initial assembly and post installation flexability.

OPTICS
The optical assembly is a borosilicate glass lens seated in a gasket and fastened to the Lens Cover to create a water resistant seal. The Reflective Cover is painted on the underside with a high reflective white and provides diffuse indirect light distribution.

MOUNTING
The housing is mounted to an anchor base plate with four tamper proof screws. All external hardware is stainless steel and tamper proof. The base plate consists of three
⅜" x 12" x 2" galvanized bolts with washer's and nut's to be embedded into a concrete foundation. (By others) A direct burial option is embedded 24" below grade without base plate assembly.

FINISH
The TracBollard is is finished with polyester powder paint applied after a pretreatment process to insure maximum durability.

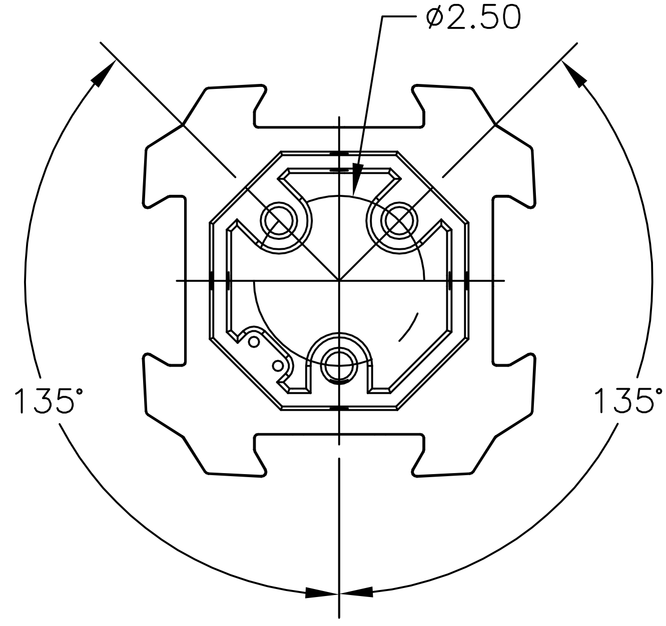
UL LISTING
The TrackBollard is UL Listed and suitable for wet locations (IP-56) at a maximum 25 degree C ambient temperature.

SiteLink®
TracBollard

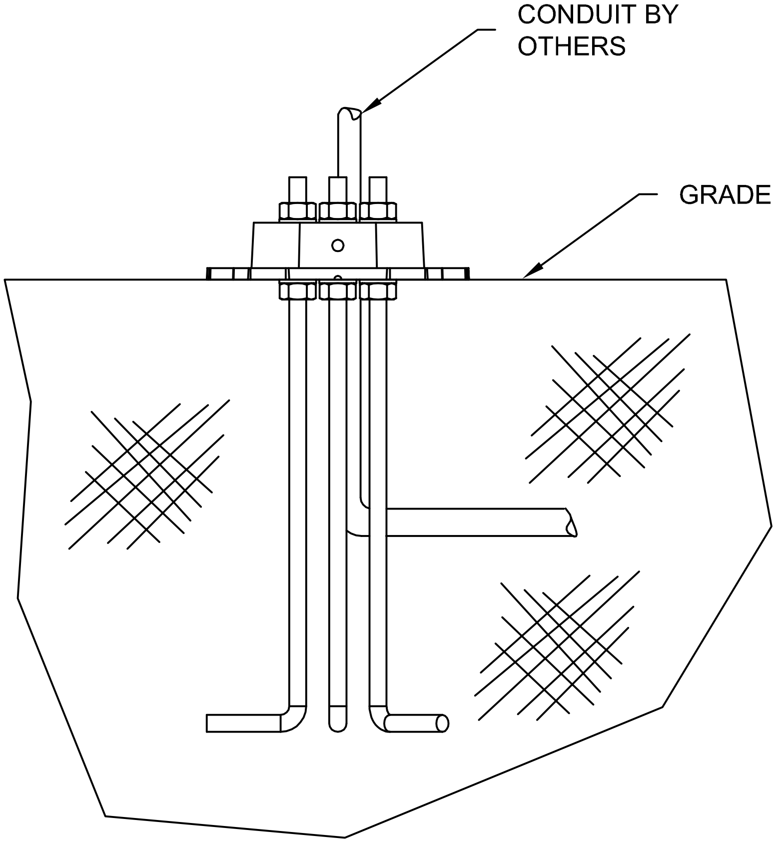
DECORATIVE
OUTDOOR

HOLOPHANE®
LEADER IN LIGHTING SOLUTIONS
An AcuityBrandsCompany

ORDER #:
TYPE:
DRAWN: KRW
DATE: 2-2-16
DWG NO: 925S



3/8" BASE PLATE
ANCHOR BOLT PATTERN



MOUNTING DETAIL

SiteLink®
TracBollard

DECORATIVE
OUTDOOR

HOLOPHANE®
LEADER IN LIGHTING SOLUTIONS
An AcuityBrands Company

THIS DRAWING, WHEN APPROVED, SHALL BECOME THE COMPLETE SPECIFICATION FOR THE MATERIAL TO BE FURNISHED BY HOLOPHANE ON THE ORDER NOTED ABOVE. A UNIT OF SIMILAR DESIGN MAY BE SUPPLIED, BUT ONLY AFTER APPROVAL BY THE CUSTOMER IN WRITING. ON POLE ORDERS AN ANCHOR BOLT TEMPLATE PRINT WILL BE SUPPLIED WITH EACH ANCHOR BOLT ORDER TO MATCH THE POLE PROVIDED. THIS PRINT IS THE PROPERTY OF HOLOPHANE AND IS LOANED SUBJECT TO RETURN UPON DEMAND AND UPON EXPRESS CONDITION THAT IT WILL NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO OUR INTERESTS, AND ONLY IN CONNECTION WITH MATERIAL FURNISHED BY HOLOPHANE.

ORDER #:
TYPE:
DRAWN: KRW
DATE: 2-2-16
DWG NO: 925S

Exhibit L: Willamette Water Supply System Biological Assessment (April 2017)

[excerpts]

Willamette Water Supply
Our Reliable Water

WILLAMETTE WATER SUPPLY SYSTEM

Biological Assessment

Prepared for:

Tualatin Valley Water District

Hillsboro
OREGON

Prepared by:

DAVID EVANS
AND ASSOCIATES INC.

David Evans and Associates, Inc.
2100 SW River Parkway
Portland, Oregon 97201

April 2017

EXECUTIVE SUMMARY

This Biological Assessment was prepared in accordance with Section 7(c) of the Endangered Species Act (ESA) to address potential effects of the proposed Willamette Water Supply System (WWSS or Project). This document also provides an assessment of the Project's effects on Essential Fish Habitat (EFH) as required under the Magnuson-Stevens Act (MSA). The U.S. Army Corps of Engineers (USACE) is the lead federal agency; the federal nexus for the Project includes Section 404 of the Clean Water Act (CWA), Rivers and Harbors Act Section 10, and the Bonneville Power Administration (BPA) right-of-way permit for electrical utility crossings.

Population size and municipal water needs in Washington County are expected to double in the next 50 years, with new source supplies needed as early as 2026. Tualatin Valley Water District (TVWD) and the City of Hillsboro (Hillsboro), collectively referred to as the Project Participants, have identified the Willamette Water Supply System (WWSS or Project) as the best option for future delivery of drinking water to their service areas in Washington County. There are four primary components of the WWSS: the Raw Water Facilities (RWF), the WWSS Water Treatment Plant (WTP), the Reservoir Facilities, and the Transmission Pipelines, described below. The RWF will be built in partnership with the Project Participants and the cities of Wilsonville, Sherwood, Tigard, and Beaverton, collectively referred to as the Partners. Those communities will design, permit, and construct any related water infrastructure facilities separately from the WWSS or will have to buy capacity from the WWSS at a later date. The Willamette River at Wilsonville will be the water supply source for the WWSS. Developing this additional water supply through a partnership supports the region's plans for responsible growth within the urban growth boundary (UGB).

There are four primary components of the WWSS:

The **Raw Water Facilities (RWF)** are located immediately adjacent to the Willamette River near the Willamette River Water Treatment Plant (WRWTP). The RWF encompasses the proposed modifications to the existing Willamette River intake, seismic stability improvements, raw water pump station upgrades, new electrical and hydraulic surge control facilities for the pump station, stormwater management facilities, and associated raw water pipelines that will convey water from the Willamette River through the upgraded raw water pump station. The withdrawal capacity will be 150 million gallons per day (mgd). The RWF will be located on two parcels in the city of Wilsonville. The terrestrial action area encompasses areas to be cleared and graded by the proposed construction and operation of the RWF. The aquatic action area for the RWF water withdrawal extends from the existing WRWTP intake downstream to the Willamette Falls. The aquatic action area for stormwater extends from the RWF site down the Willamette and Columbia rivers to the Pacific Ocean. The aquatic action area for the use of an impact hammer for the screen protection pile installation extends 1,640 feet upstream and downstream from the existing intake.

The **WWSS Water Treatment Plant (WWSS WTP)** refers to the proposed water treatment plant, including a finished water pump station, that will be located in Washington County near the city of Sherwood. The initial capacity will be 60 mgd, with phased construction anticipated to expand the capacity to 120 mgd. The terrestrial action area for the WTP consists of the 20-acre proposed construction site. The aquatic action area for stormwater runoff includes Hedges Creek, a tributary to the Tualatin River, and extends down the Willamette and Columbia rivers to the Pacific Ocean.

The **Reservoir Facilities** will contain two aboveground water storage tanks proposed to be located in the Cooper Mountain area. The storage capacity will be 30 million gallons (mg) and will be distributed between two water storage tanks. The terrestrial action area includes the 7-acre construction area and the 7-acre staging area. The aquatic action area for stormwater runoff includes McKernan Creek, a tributary to the Tualatin River, and extends down the Willamette and Columbia rivers to the Pacific Ocean.

Transmission Pipelines will connect the RWF, WWSS WTP, and Reservoir Facilities, and ultimately tie into TVWD's and the Hillsboro's existing water distribution systems. The capacity within individual pipeline sections will vary by location, but the overall system will provide approximately 105.7 mgd of water transmission capacity. The terrestrial action area includes the width of the work area described in the main text of this Biological Assessment, below. The aquatic action area will extend approximately 0.5 mile downstream for stream crossings. There is no aquatic action area for stormwater runoff associated with the Transmission Pipelines, because they will not create new impervious surface. Construction of the Transmission Pipelines will largely utilize open-trench construction methods. At resource crossings, construction will include open-trench as well as trenchless methods.

This document serves, in part, as consultation with National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS). Avoidance and minimization measures would be incorporated into the proposed Project to eliminate or reduce effects to listed and proposed species. These measures would address in-water work; erosion control; containment and handling of construction materials (e.g., fuel, oil, automotive-derived pollutants); sound attenuation; and disturbance of upland, wetland, and riparian vegetation. Best Management Practices (BMPs) would be employed to avoid and minimize the effects from those Project activities. Also included in this document is an assessment of the Project effects on EFH as required under the MSA.

In assessing potential effects of the proposed Project on listed fish, wildlife, and plant species and their habitats, the environmental baseline was documented, proposed actions were evaluated to assess the effect on the environmental baseline, and results of these evaluations were used to arrive at a determination of effect. The primary effects of the Project include temporary and localized increases in turbidity and potential contaminant release during construction; fish salvage at open-trench waterway crossings; and short-term impacts to stream channel, streambanks, and riparian vegetation. Indirect, interrelated, interdependent, and cumulative effects of the various Project components were also considered.

Based on the analysis of effects and consideration of conservation measures that would be implemented to avoid and reduce effects, the following determinations were made:

Listed Aquatic Species

The Project is within the Upper Willamette River (UWR) Evolutionarily Significant Unit (ESU) of federally listed Chinook salmon (*Oncorhynchus tshawytcha*) and Distinct Population Segment (DPS) of federally listed steelhead trout (*Oncorhynchus mykiss*). The Lower Columbia River, Columbia River, and Snake River ESUs are also addressed, because NMFS extends the action area to the Pacific Ocean in order to address the potential effects of stormwater discharge. These anadromous fish are under the jurisdiction of NMFS.

Based on the evaluation of the potential effects and available scientific and commercial data discussed in this Biological Assessment, the proposed action is **"likely to adversely affect" UWR steelhead and UWR Chinook salmon**. The proposed Project will result in temporary and localized increases in turbidity and potential contaminant release during construction; fish salvage at open-trench waterway crossings; behavioral disturbance and/or injury from impact hammer installation of the screen protection piles; and short-term impacts to stream channel, streambanks, and riparian vegetation. The proposed withdrawal of 150 mgd will not, however, result in noticeable or measurable changes to the water surface elevation, temperature, or water quality of the Willamette River, due to the small portion of flow being diverted, and the backwater influence of the Newberg pool upstream from the Willamette Falls and the Portland General Electric (PGE) dam. Consequently, the additional withdrawal will not likely be measurable, and the effect on UWR Chinook salmon, UWR steelhead, and their habitat availability will be undetectable.

The proposed Project will increase impervious surface on the RWF, WWSS WTP, and Reservoir Facilities sites for a total of 1.4 acres draining to the Willamette River Basin and a total of 13.6 acres draining to the Tualatin River Basin. Although the impervious surface is anticipated to generate low levels of automotive-derived pollutants and the Project will meet NMFS Standard Local Operating Procedures for Endangered Species (SLOPES V) stormwater criteria, the Project **"is likely to adversely affect"** listed fish species occurring downstream in the Willamette and Columbia rivers (as discussed in Section 4) due to changes in stormwater flow and quality.

The proposed Project would not result in the "destruction or adverse modification" of designated UWR Chinook or UWR steelhead critical habitat. No significant cumulative, interrelated or interdependent effects on listed salmonids or their critical habitats were identified with the proposed Project.

Listed Terrestrial Species

The listed, proposed, and candidate terrestrial species that may occur within the Project action areas include streaked horned lark (*Eremophila alpestris strigata),* Nelson's checkermallow *(Sidalcea nelsoniana)*, and water howellia (*Howellia aquatilis*).

The proposed action will have "no effect" on streaked horned lark, Nelson's checkermallow, or water howellia. Impacts to streaked horned lark can be avoided by scheduling construction in potential habitat outside of the nesting season. If construction is planned during the nesting season, then surveys will be conducted to confirm that the species is not present. Construction will be delayed if streaked horned larks are nesting. There is a low potential for Nelson's checkermallow and water howellia to occur in the Transmission Pipelines, WWSS WTP, and Reservoir Facilities action areas where surveys have not been conducted. Surveys of potential habitat will be coordinated with USFWS before construction begins.

Essential Fish Habitat

Based on consideration of the EFH requirements of the Pacific salmon fishery, the potential direct, indirect, and cumulative effects of the proposed action would adversely affect EFH for Chinook and coho (*Oncorhynchus kisutch*) in the short term. The conservation measures described in this Biological Assessment are adequate to prevent long-term adverse effects on EFH for these species.

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Acronyms and Abbreviations

BA	Biological Assessment
BMP	Best Management Practice
BPA	Bonneville Power Administration
CFR	Code of Federal Regulations
cfs	cubic feet per second
CHART	Critical Habitat Analytical Review Team
CWA	Clean Water Act
CWS	Clean Water Services
°C	degrees Celsius
°F	degrees Fahrenheit
DEQ	Department of Environmental Quality
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act of 1973
ESU	Evolutionarily Significant Unit
fps	feet per second
FR	Federal Register
HDD	horizontal directional drilling
HGM	Hydrogeomorphic Method
HUC	Hydrologic Unit Code
JPA	Joint Removal-Fill Permit Application
LEDPA	Least Environmentally Damaging Practicable Alternative
LID	Low Impact Development
mg	million gallons
mgd	million gallons per day
MSA	Magnuson-Stevens Act
MTBM	microtunnel boring machine
NAVD88	North American Vertical Datum of 1988
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWR	National Wildlife Refuge
OAR	Oregon Administration Rule
ODA	Oregon Department of Agriculture
ODFW	Oregon Department of Fish and Wildlife
OHW	Ordinary High Water
ORBIC	Oregon Biodiversity Information Center
PCE	Primary Constituent Elements
PFMC	Pacific Fisheries Management Council
PGE	Portland General Electric
RM	River Mile
SLOPES V	Standard Local Operating Procedures for Endangered Species
SBUH	Santa Barbara Urban Hydrograph

TMDL	Total Maximum Daily Load
TRT	Technical Recovery Team
TRUST	Tualatin River Urban Stormwater Tool
TVWD	Tualatin Valley Water District
U.S.	United States
UGB	urban growth boundary
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
UWR	Upper Willamette River
WRWTP	Willamette River Water Treatment Plant
WWSS WTP	Willamette Water Supply System Water Treatment Plant
WWSS	Willamette Water Supply System

the water (the relevant water quality-related state regulation is the Beneficial Uses, Policies, and Criteria for Oregon (OAR 340-041-0036)). Alkalinity adjustments may also be required to meet regulatory requirements for the discharge. Discharge rates at each dewatering location will be controlled by dewatering pumps or throttling valves at the dewatering locations. Discharge rates will not exceed the bankfull discharge rates for the receiving channel, in order to prevent soil or channel erosion. Bankfull discharge rates will be estimated using local stream gage data, previous drainage studies, or published regional regression equations. If discharge is to stormwater systems, discharge rates will be coordinated with the jurisdictional utility agency to avoid overloading the downstream system.

3.4.4 Operational Dewatering of the Pipeline

Dewatering the Transmission Pipelines will be part of the regular operations and maintenance of the pipeline. Dewatering will rarely occur during the service life of the pipe; typically, it will occur during extraordinary or emergency circumstances that require access to the interior of the pipeline for repairs or inspection. If the pipeline is dewatered for maintenance or inspection over the service life of the pipe, the pipeline owners will coordinate with regulatory authorities to determine the allowable rates of discharge to drain the pipeline. Residual chlorine that may remain in the water will be removed if necessary by adding ascorbic acid (vitamin C) or sodium bisulfate to the water (the relevant, water quality-related state regulation is the Beneficial Uses, Policies, and Criteria for Oregon (OAR 340-041-0036)). Discharge rates at each drain location will be controlled by throttling valves installed on the drain locations. As discussed above, discharge rates will not exceed the bankfull discharge rates for the receiving channel, in order to prevent soil or channel erosion. Bankfull discharge rates will be estimated using local stream gage data, previous drainage studies, or published regional regression equations. If discharge is to stormwater systems, discharge rates will be coordinated with the jurisdictional utility agency to avoid overloading the downstream system.

3.5 PROPOSED CONSERVATION MEASURES

Avoidance and minimization measures would be incorporated into the Project to eliminate or reduce effects to listed and proposed species. These measures would address in-water work; erosion control; containment of construction materials; handling of contaminants or hazardous materials; and disturbance of upland, wetland, and riparian vegetation. BMPs would be employed to avoid and minimize the effects from those Project activities. Such measures would include:

- Perform any in-water work (any construction activities below OHW elevation) during the following ODFW-designated and NMFS-approved windows:
  - Willamette River: June 1–October 31
  - Willamette River tributaries: July 15–October 15
  - Tualatin River tributaries: July 15–September 30
- Have a biologist qualified to conduct fish salvage on-site during work area isolation to assist in implementing conservation measures. Remove any fish present from the isolated work area

by electrofishing and/or netting. Identify any captured fish and then release them unharmed, outside of the work area.

- Install and remove work area isolation measures so that downstream water flows are maintained. Maintain and control water flow for the duration of the diversion to prevent downstream dewatering.
- Minimize alteration or disturbance of streambanks and existing riparian vegetation.
- Flag the Permitted Work Area (also referred to as the in-water work area, OHW elevation, and jurisdictional waters or wetlands) before mobilizing equipment on-site.
- Locate areas for storage of equipment and vehicles, other than track-mounted vehicles, outside of work hours, at least 150 feet away from the Permitted Work Area, unless developed areas are available for staging and appropriate containment measures are in place to ensure containment and isolation of equipment and vehicles from the work area.
- Locate areas for storing fuels and other potentially hazardous materials, and areas for refueling and servicing construction equipment and vehicles at least 150 feet away from the Permitted Work Area, unless developed areas are available for staging, and appropriate containment measures are in place to ensure containment and isolation of potentially hazardous materials, equipment, and vehicles from the work area.
- For track-mounted equipment, large cranes, and other equipment whose limited mobility makes it impractical to move them for refueling, take all feasible precautions to prevent and minimize the risk of fuel reaching the Permitted Work Area; implement appropriate spill prevention measures and provide fuel containment systems designed to completely contain a potential material spill, as well as other pollution control devices and measures adequate to provide complete containment of hazardous material; and perform refueling operations to minimize the amount of fuel remaining in vehicles stored during non-work times.
- Maintain hazardous material containment booms and spill containment booms on-site to facilitate the cleanup of hazardous material spills. Install hazardous material containment booms in areas where there is a potential for release of petroleum or other toxicants.
- Prohibit underwater blasting.
- Implement containment measures adequate to prevent pollutants or construction materials (such as waste spoils, petroleum products, concrete cured less than 24 hours, concrete cure water, silt, and welding slag and grindings,) from entering the Permitted Work Area or any regulated waters.
- If flooding of the work area is expected to occur within 24 hours, evacuate all potential pollutants, equipment, and fuel from the anticipated inundation area.
- Do not permit any equipment in the wetted channel (other than the Willamette River in order to modify piles and fish screen), unless the work to be performed using such equipment is isolated from the wetted channel.
- Do not discharge contaminated or sediment-laden water from the Project or water contained within a cofferdam directly into any waters of the state until the water is satisfactorily treated

(for example, by bioswale, filter, settlement pond, pumping to vegetated upland location, bio-bag, or dirt-bag), as appropriate.

- Do not use treated timbers within the Permitted Work Area for any purpose.
- Do not apply fertilizer within 50 feet of any wetland or waterbody.
- Before operating within 150 feet of the Permitted Work Area, inspect and clean all construction equipment; check all construction equipment for fluid leaks; remove external oil, grease, dirt, and caked mud; do not discharge untreated wash and rinse water into the Permitted Work Area; and establish temporary impoundments to catch water from equipment cleansing (which may only be performed at least 150 feet from the Permitted Work Area and in a location that does not contribute untreated wastewater to any waters of the state unless otherwise noted).
- Place waste materials and spoils above bank lines and away from any wetlands. If necessary, temporarily locate waste materials and spoils, before their removal from the Project site and disposal, above bank lines and away from any wetlands. Construction spoils will be disposed of in accordance with applicable regulations.
- Minimize the operation of equipment in or on the water to the extent feasible.
- For construction access roads and work areas near waterways and wetlands, use a rock work pad or other measures to minimize soil compaction from heavy equipment. Place a geotextile fabric, chain link fence, or other equally effective material under the temporary rock to protect existing ground and assist in removal of temporary work pad fill rock. Following construction, remove all of the temporary work pad materials, and regrade and restore the area according to the revegetation plans.
- Mandate that “diapering” of vehicles and stationary equipment to catch any toxicants (for example, oils, greases, and brake fluid) be used when the vehicles have any potential to contribute toxic materials into aquatic systems.
- Implement the following BMPs for trenchless (drilling, boring, or jacking) resource crossings:
    - Design, build, and maintain facilities to collect and treat construction and drilling discharge water using the appropriate technology applicable to site conditions. Provide treatment to remove debris, nutrients, sediment, petroleum hydrocarbons, metals, and other pollutants likely to be present. Use collection and proper disposal off-site as an alternative to treatment.
    - Isolate drilling operations from wetted stream to prevent drilling fluids from contacting waters of the state and U.S.
    - Prevent loss of drilling fluid to the subsurface formation. If necessary, use drill casing. If drilling fluid or waste is released to surface water, wetland or other sensitive environment, cease drilling operations until approval from the Owners’ Representative is received to resume drilling. The Owners’ Representative will notify the appropriate regulatory agencies of inadvertent release.
    - Recover, recycle, or dispose of drilling fluids and waste as needed to prevent entry into flowing water.

    - The contractor will submit its anticipated slurry operating pressures for review by the Owners' Representative, according to technical specifications, before construction begins.
- The contractor will implement an Erosion Control Plan to prevent the discharge of sediment to surface waters and ensure that turbidity does not exceed 10 percent above existing background conditions. General sediment and erosion control measures are shown in Appendix K. The Project will comply with the National Pollutant Discharge Elimination System (NPDES) permit requirements.
    - Identify and isolate sensitive areas before construction begins. Install erosion and sediment control measures around and on the site.
- Implement the following BMPs when using a barge:
    - Before moving the barge to the project site, unless the barge is transported solely by water from within the state of Oregon, inspect the barge and ballast for invasive species to prevent introduction of invasive species to the Project site. Contact the Oregon State Marine Board if invasive species are found.
    - Prohibit barge grounding. Do not at any time allow barges to be grounded on the bed or banks of the waterway.
    - Do not use impact hammers for barge support/anchor (spud) placement.
    - Install and maintain containment measures to prevent barge surface runoff from flushing oil, fuel, or other contaminants into the water.
    - Secure all equipment, as well as containers with fuel, hazardous materials, or waste, to the barge deck.
    - If a fuel container is used on the barge, provide a double-walled fuel container and place an absorbent containment boom around the container when it is on the barge.
    - Provide individual containment for each piece of equipment on the barge, including containment pans or absorbent booms to contain minor spills locally.
    - Develop a spill mitigation plan prior to the start of work.

- Implement one of the following sound attenuation methods when using an impact hammer to install the screen protection piles:
    - If the water velocity is 1.6 feet per second (fps) or less, surround the pile being driven by a confined or unconfined bubble curtain that will distribute small air bubbles around 100 of the pile perimeter for the full depth of the water column (see, e.g. NMFS and USFWS (2006), Wursig et al. (2002), and Longmuir and Lively (2001)).
    - If water velocity is greater than 1.6 fps, surround the pile being driven with a confined bubble curtain (e.g., surrounded by a fabric or non-metallic sleeve) that will distribute small air bubbles around 100 percent of the pile perimeter for the full depth of the water column.

classified as depressional wetlands according to the Hydrogeomorphic Method (HGM) classification system (DEA, 2017).

5.4.3 Reservoir Facilities

The south and east sides of the Reservoir Facilities property are bordered by rural land uses, including pasture/grassland and forested land, most of which occurs within the Cooper Mountain Nature Park. The site currently contains a private residence and several outbuildings. The site contains extensive Himalayan blackberry (*Rubus armeniacus*) thickets, as well as some grassy areas. A few small, wooded patches are present on-site, and a more extensive forested riparian corridor occurs along the eastern portion of the property. The riparian corridor is associated with a tributary stream that flows off-site to join McKernan Creek near Cooper Mountain Nature Park.

5.4.4 Transmission Pipelines

The 30-mile Transmission Pipelines route is located primarily in urban and agricultural areas, which contain some remnant forest and other patches of habitat. Urban habitat includes primarily medium-density and low-density housing. Undisturbed areas are rare; however, isolated wetlands, stream corridors, open spaces, and greenbelts are present along the pipeline alignment.

6 EFFECTS OF THE ACTION

This section includes an analysis of the direct and indirect effects of the proposed action on the species and/or critical habitat, and its interrelated and interdependent activities. Direct effects are those that occur at the time of the proposed action. Potential direct effects of the proposed action are limited to the construction phase, and are associated with jurisdictional resource-related construction and the resulting potential disturbance to wildlife. Indirect effects are those caused by the action, but occurring later in time. The primary potential indirect effects of the proposed action to aquatic habitat are associated with water withdrawal and stormwater runoff. The proposed action may have indirect adverse effects, following construction, to the fish species addressed in this BA. These indirect adverse effects could include water quality alteration and stormwater flow alteration. The primary potential indirect effects of the proposed action to terrestrial species are associated with temporary impacts to habitat. Factors considered in the analysis include proximity of the action; distribution; timing; nature of the effect; duration; and disturbance frequency, disturbance intensity, and disturbance severity. The direct and indirect impacts are discussed for each Project component below. Conservation measures that will be used to minimize direct and indirect impacts are described in Section 3.5.

6.1 RAW WATER FACILITIES

Modifications to the RWF located on the Willamette River in Wilsonville will include modifications to the existing WRWTP intake, site seismic improvements, and modifications to the existing raw water pump station at the WRWTP, including construction of associated facilities.

6.1.1 In-water Construction

At the RWF, in-water work includes modification of the intake screens and protection piles, and construction of one of the streambank seismic stabilization drilled shafts below OHW elevation. All construction activities below OHW of the Willamette River will occur during the approved in-water work window of June 1 to October 31, when fish abundance is anticipated to be low.

6.1.1.1 **Intake Screens and Seismic Stabilization**

As described in Section 3.1.1, the replacement of the screens will be accomplished by a contractor working from a barge. No disturbance to the streambed is anticipated with the actual removal of the existing screens and the installation of the new screens. The only anticipated disturbance to the streambed associated with this work is from the spud placement to anchor the barge. No detectable disturbance to the streambed or turbidity is anticipated to result from the barge anchoring. The barge will be anchored to avoid grounding and disturbance to the streambank. To minimize the potential for pollutants entering the waterway, the fuel containment and spill prevention BMPs outlined in Section 3.5 will be implemented.

Construction of only one of the sixteen 4-foot-diameter tangent piles for the seismic stabilization will occur below OHW elevation. All construction activities are anticipated to occur in the dry. However, if water levels are higher than anticipated, work area isolation and fish salvage will be implemented, as discussed in Section 6.4.2. Appropriate containment measures will be implemented to prevent sediment, drill spoils, green concrete, and other construction-related pollutants from leaving the RWF site and entering the river. The potential impacts to fish from increased turbidity and contaminant release are discussed below.

6.1.1.2 **Screen Protection Piles**

As described in Section 3.1.1, two construction methods are under consideration to modify up to ten of the existing screen protection piles. If the option to cut the existing H-piles and attach brackets is selected, localized short-term turbidity is anticipated if the pile removal requires cutting the pile 2 feet below riverbed. If the option to replace the existing H-piles is selected and the piles are driven with an impact hammer, biological impacts are likely to result from the high sound pressures produced by striking the pile. These impacts include potential behavioral changes and/or injury, such as damage to fish internal organs and their auditory system. To reduce sound impacts, a vibratory hammer will be used to install the pile, and sound attenuation measures will be used if an impact hammer is needed to set the pile (see Section 3.5). The number of screen protection piles that will need to be modified and the construction method will be determined in final design.

The screen pile modifications will occur from the barge used to replace the intake screens (see impact discussion above in Section 6.1.1.1). Localized, short-term turbidity is anticipated to occur during the initial use of the sound attenuation measures (bubble curtains) if an impact hammer is used.

6.1.2 Increased Turbidity and Contaminant Release

In general, during construction in and near waterways, there is a risk of increased sediment and contaminant-laden surface water runoff, and contaminant release.

6.1.2.1 **Increased Turbidity**

During construction at the RWF, disturbance to uplands and riparian vegetation could result in sediment and contaminant-laden surface water runoff entering the Willamette River. Implementation of: (1) conservation measures to minimize soil compaction from heavy equipment (as described in Section 3.5), (2) effective erosion and sediment control measures (as described in Appendix K), and (3) effective revegetation plans (as described in Appendix H) will minimize the risk of sediment or contaminants from entering the river.

Because of the presence of riparian vegetation between the work area and the river, and as a result of the implementation of BMPs, it is unlikely that suspended sediment will enter the Willamette River and increase turbidity. If suspended sediment reaches the river, fish species would likely respond by moving to locations with lower concentrations of fine sediment.

6.1.2.2 **Contaminant Release**

Fisheries habitats could be adversely affected if petroleum-based products were accidentally released into aquatic environments. Products likely to be present during construction include diesel fuel, lubricants, hydraulic fluid, and other contaminants contained in construction equipment. Inadvertent spills in and near waterways could potentially result in negative impacts to fish and critical habitat. In addition, long-term effects could also result if a spill is not properly remediated. The effects of any contaminant release from construction equipment to listed fishes is anticipated to be negligible, because spills would most likely be small and be cleaned up quickly. To minimize the potential for spills, conservation measures such as storing hazardous materials and refueling at least 150 feet from the Permitted Work Area will be implemented.

Concrete and grout are associated with the construction of the seismic stabilization measures, as discussed in Section 3, Description of the Action. Concrete will be contained within the drill shafts. Conservation measures (as described in Section 3.5) will be implemented to prevent concrete or concrete cure water being released to the water. Grout may be injected to stabilize soils around the pipe near the top of the slope. Conservation measures and construction means and methods to control grout placement will be implemented to prevent the release of grout to the water.

6.1.3 Riparian Vegetation Removal

Construction of the seismic stabilization measures at the RWF will result in the removal of 0.5 acre of riparian vegetation on the north bank of the Willamette River. The removal or disturbance of streamside vegetation can decrease the amount of vegetation that is effectively shading the water. The loss of effective shade allows more solar radiation to reach the surface of the water and deliver more energy to the stream. Loss of shade has a greater effect on temperatures in smaller, more narrow river systems than in larger streams such as the Willamette River. As the channel width increases, vegetation blocks less solar radiation and effective shade levels decrease (ODEQ, 2006). The riparian vegetation that will be removed is located on the north bank and therefore provides limited shading. The seismic stabilization measures will be buried to facilitate replanting of the disturbed areas according to the revegetation plans (as described in Appendix H). The removal of the riparian vegetation will result in some limited intermediate-term adverse effects to salmon habitat function, primarily related to the reduction of large woody debris. Because of the large size of the system, the effects of the Newberg Pool on temperature fluctuations (see Section 5.1.3.1), and the north–south aspect of the channel, the loss of riparian vegetation will not result in a measurable change in stream temperature.

6.1.4 Fish Passage

The Project has developed a preliminary design concept for the WRWTP intake that meets the NMFS and ODFW fish passage criteria (as described in Appendix C). The preliminary design includes a proposed intake screen for a maximum design flow of 150 mgd, which would maximize the screen capacity without requiring changes to the existing intake pipeline. The 150 mgd screen capacity would be reached by replacing the existing screens with two, 78-inch-diameter elongated cylindrical tee-screens. Screen manufacturers were contacted to further develop conceptual design details for the 150 mgd screen capacity, and to confirm options that meet the size, capacity, and approach velocity required (see Appendix C for details). Approach velocities at design capacity for the intake screens are dictated by the screen design, and are summarized in Table 8 based on the intake configurations corresponding to the existing and proposed design capacity. Sweeping velocities at the low-flow condition (90 percent exceedance during August) are also summarized in the table, and the actual sweeping velocity would also need to be confirmed by field tests (see Appendix C for details). As the preliminary design and specifications are developed, the Project Participants will continue to meet with NMFS and ODFW to ensure compliance with regulatory requirements.

Table 8: Approach and Sweeping Velocities at the RWF Intake Under Existing and Proposed Design Capacity

Intake Design Capacity	Screen Type	Approach Velocity at Design Capacity (feet per second (fps)) criteria = ≤0.40 fps	Sweeping Velocity at 95% Exceedance Flow during August (fps)
70 mgd	66-inch diameter (existing)	0.28	0.41
150 mgd	78-inch diameter, elongated (proposed)	0.37	0.40

Based on the results documented by MWH (2016) in Appendix C, the approach and sweeping velocity criteria are met at the existing and the proposed intake design capacity. Sweeping velocity will be greater than approach velocity under each level of demand, and approach velocity will be at or below 0.40 fps under each scenario evaluated, as required by the regulatory standards.

6.1.5 Terrestrial Listed Species and Habitat

Based on the level of disturbance and lack of suitable habitat described in Sections 4 and 5, the construction and operation of the RWF will not have direct or indirect impacts on the ESA-listed terrestrial species and habitat discussed in this document.

6.1.6 Stormwater

Construction of the RWF will occur on two parcels: one that drains to Arrowhead Creek (northern parcel), and one that drains to an unnamed tributary and then immediately into the Willamette River (southern parcel). Construction on the northern parcel will result in a total of 0.7 acre of new impervious surface from roofs, parking areas, and an access road. Construction on the southern parcel will result in a total of 0.7 acre of new impervious surface from roofs and parking areas. Stormwater runoff from impervious roadway surfaces can carry toxic levels of automotive-derived pollutants, including petroleum-based compounds and dissolved metals. The access road and parking areas will have low use and, therefore, are anticipated to generate low levels of automotive-derived pollutants. The two bioretention ponds, as described above in Section 3, Description of the Action (Section 3.1, Raw Water Facilities), will be designed to meet the stormwater quality requirements from NMFS SLOPES V. Treatment is described in the Stormwater Management Plan in Appendix E.

A related potential indirect effect of the Project on fish habitat is changes to stream hydrology caused by increases in impervious surface area. Stormwater runoff increases significantly in volume and intensity with increased impervious surface, causing increased level and/or duration of peak streamflows. These hydrologic changes can degrade aquatic habitats, particularly salmonid habitat. The Project has been designed to minimize these effects by providing stormwater quantity control to meet NMFS standards, as described above in Section 3, Description of the Action (Section 3.1, Raw Water Facilities).

6.1.7 Water Withdrawal

6.1.7.1 **Willamette River Flows**

Increasing the RWF intake capacity from 70 mgd to 150 mgd will result in a minor reduction in flows in the Willamette River. The GSI Memo in Appendix C details the maximum percentage of the Willamette River streamflow that would be diverted at an intake capacity of 150 mgd for a range of flow conditions.

Most of the water rights with points of diversion at the existing WRWTP intake have fish persistence conditions recommended by ODFW. These conditions are developed to maintain the persistence of fish species that are listed as sensitive, threatened, or endangered under state or federal law. Permits S-49240, S-54940, and S-45565 (see Appendix C) all have fish persistence conditions that reduce or, in the case of Beaverton's permit (Permit S-54940), prohibit access to water when streamflow at Salem is below the fish flow targets. Fish persistence conditions govern 91 percent of the combined maximum authorized rate of diversion at the existing intake. These water rights and their fish persistence conditions are described in more detail in the GSI Memo in Appendix C.

The existing, federally authorized diversion of 70 mgd at the existing WRWTP intake is generally less than 2 percent of the summer period streamflow in both “dry” and “average” years (when compared to the 90 percent exceedance flows). Without fish persistence conditions, the percent of streamflow diverted at a rate of 150 mgd would be up to 3.70 percent of streamflow in “average” years and up to 4.33 percent in “dry” years during the summer period. However, because of the fish persistence conditions associated with the water rights at the existing intake, access to water is reduced when fish flow targets are not met (generally spring and summer), and the resulting percent of streamflow diverted will range from 1.14 percent (April 16 through April 30) to 3.70 percent (August) of streamflow in “average” years and from 1.30 percent (April 1 through April 15) to 3.86 percent (September) of streamflow in “dry” years. See the GSI Memo in Appendix C for greater detail.

6.1.7.2 Water Surface Elevation

As discussed in Section 5.1.1, water surface elevations and velocity within the RWF action area are influenced primarily by the operation of the PGE Willamette Falls Hydroelectric Project and the associated Newberg Pool.

The HEC-RAS model and scenarios used to simulate the sweeping velocities at a range of exceedance flows and stages during August (see Section 6.1.4) were also used to evaluate whether the withdrawals from the river at the proposed diversion rates would result in any change in river stage/water surface elevation (see Appendix C for details). A conservative approach was taken for this evaluation: The simulated water surface elevations at the intake for the 70 mgd (baseline) and 150 mgd (Project) diversion rates were compared to water surface elevations with no (zero) intake withdrawals. The results of this evaluation are summarized in Table 9(see Appendix C for details).

Table 9: Water Surface Elevation Results for Change in River Stage

	August Exceedance Flow				
	95%	**90%**	**80%**	**50%**	**10%**
Date	8/12/2001	8/3/2007	8/4/1986	8/31/2000	8/22/2012
Flow at Newberg Gage (cfs)	5,718	5,940	6,410	7,018	8,310
Water Surface at RWF Intake (feet NAVD 88) *Zero Diversion*	57.56	58.33	58.61	58.42	59.79
Water Surface at RWF Intake (feet NAVD 88) *70 mgd (108 cfs) Diversion*	57.56	58.33	58.60	58.42	59.79
Water Surface Change from Zero Diversion (feet)	0.00	0.00	-0.01	0.00	0.00

	August Exceedance Flow				
	95%	**90%**	**80%**	**50%**	**10%**
Water Surface at RWF Intake (feet NAVD 88) *150 mgd (232 cfs) Diversion*	57.56	58.33	58.60	58.41	59.78
Water Surface Change from Zero Diversion (feet)	0.00	0.00	-0.01	0.00	0.00
River Velocity at RWF Intake (fps) *Zero Diversion*	0.42	0.42	0.45	0.49	0.55
River Velocity at RWF Intake (fps) *70 mgd (108 cfs) Diversion*	0.41	0.41	0.44	0.49	0.54
Velocity Change from Zero Diversion (fps)	-0.01	-0.01	-0.01	0.00	-0.01
Velocity at RWF Intake (fps) *150 mgd (232 cfs) Diversion*	0.40	0.40	0.43	0.48	0.54
Velocity Change from Zero Diversion (fps)	-0.02	-0.02	-0.02	-0.01	-0.01

Note: Water surface elevations and changes are shown to two decimal places, because observed stage is reported to two decimal places; however, the "water surface change from zero diversion" of -0.01 feet for the 80 percent exceedance value is considered to be 0.0 feet (as with all exceedance flow values), and it is not considered appropriate to differentiate and imply precision of the results to 0.01 feet (less than 1/8 inch).

The results of this initial evaluation illustrate that water surface elevation does not change with withdrawals of 70 mgd (baseline) or 150 mgd (Project) compared to conditions with no (zero) intake withdrawals at the given flow and stage conditions in the HEC-RAS scenarios. The results also show very small and insignificant velocity changes (decreases) from no (zero) diversion to 70 mgd of 0.00 fps to 0.01 fps and from no (zero) diversion to 150 mgd of 0.01 fps to 0.02 fps. These findings are consistent with the water surface being controlled by the dam at the Willamette Falls, and with the very small proportion of the river flow being withdrawn.

6.1.7.3 **Temperature**

As discussed in Section 5.1.3.1, temperature within the RWF action area is influenced primarily by the existing operation of the PGE Willamette Falls Hydroelectric Project and formation of the Newberg Pool. The Newberg Pool slows down the velocity and heating/cooling process, which decreases the temperature variability in the reach of the WRWTP intake (ODEQ, 2006). The withdrawal of 150 mgd does not change the surface water elevation, as is noted above. Because of the influence of the Newberg Pool and the immeasurable change in surface water elevation, changes in temperature are not expected to be measurable in the RWF action area or downstream.

6.5 IMPLEMENTATION OF CONSERVATION MEASURES

The proposed conservation measures for the Project, described in Section 3.5, will prevent most of the potential direct adverse effects discussed above. These measures would address in-water work; erosion control; containment of construction materials; handling of hazardous materials; sound attenuation; and disturbance of upland, wetland, and riparian vegetation.

6.6 CUMULATIVE EFFECTS

Cumulative effects, as defined by the rule adopted by NMFS, “are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation” (50 CFR Part 402.02). A standard of “reasonably certain to occur” is clarified as “those actions that are likely to occur, bearing in mind the economic, administrative, or legal hurdles which remain to be cleared.” Additionally, NMFS provides that “speculative actions that are factored into the cumulative effects analysis add needless complexity into the consultation process…” (51 FR 19933). Future federal actions are not analyzed for cumulative effects, because they require separate ESA consultation.

A large variety of land uses and development activities occurs in the Project action areas, such as agriculture; forestry activities; commercial and residential development; and transportation and utility infrastructure development, maintenance, and upgrading. Additional development projects are expected to occur in the future in accordance with anticipated population growth and land use planning (this water supply project is planned to respond to the growth anticipated by Metro—the regional government—as a result of recent UGB expansions and urban reserve land use designations). These activities will contribute to cumulative effects predominately as a result of their impacts on stormwater quality and quantity. Future development projects would be subject to local design and construction standards and would, therefore, need to meet environmental standards.

Gradual habitat and water quality improvements may also occur over time within the action areas, such as conservation measures, riparian plantings, and habitat enhancement. Such improvements would likewise contribute to cumulative effects through their beneficial impacts on ESA-listed salmonid habitat. The specific impacts of the above-referenced activities, individually or in aggregate, are unknown at this time and therefore speculative.

Future private or municipal water diversions affecting the action area surrounding the RWF would result in cumulative effects, because increased water withdrawals could have the potential to lower streamflows in ESA-listed salmonid habitat below current levels. Streamflows in the action area are already affected, in part, by water supply and water withdrawal projects that appropriate water from the Willamette River and its tributaries above or within the vicinity of the existing WRWTP intake, as described in Section 5, Baseline Conditions.

In addition to the proposed Project, the Project Participants have identified 52 existing water use permits for municipal purposes with authorized points of diversion above Willamette Falls. These permits represent authorizations to use water that are generally not fully developed (construction is not complete and/or the full amount of water authorized is not being used). The portions of these municipal use permits that could reasonably be expected to be developed, and therefore would have a reasonably foreseeable impact on future streamflow, were determined through review of publicly available state and local government documents. These documents included water system master plans and water management and conservation plans, which typically have a 20-year planning period. It is unknown how many of these water use projects would have a federal nexus, and therefore ESA consultation. Evaluating all of these permits for cumulative effects is a conservative approach.

If all of the reasonably foreseeable portions of the permits discussed above were developed, it would result in the diversion of approximately 99.4 cfs to 104.9 cfs, depending on the month. The rate varies by month, because two of the permits identified do not authorize water use year-round. These rates of diversion would not correspond to combined flow reductions at the Newberg gage, however, because after water is used for municipal purposes, the water is typically treated and returned to the stream.

The impact to streams (the amount of overall reduction in streamflow) is the portion of the diverted water that is consumptively used (i.e., lost to evapotranspiration, evaporation, etc.). According to the Oregon Water Resources Department, the typical consumptive use for municipal water suppliers in the Willamette River Basin is considered to be 45 percent during the summer months (June through September) and 15 percent the remainder of the year (GSI, 2017). As a result, the combined reduction in streamflow that would result from reasonably foreseeable municipal water diversions (not associated with this Project) would range from 15.58 cfs in February to 47.2 cfs in June. These reasonably foreseeable diversions result in a maximum reduction in streamflow of 0.76 percent. When these reasonably foreseeable diversions are combined with the estimated streamflow reduction (in a dry year) from the Project's 150 mgd intake capacity, the maximum overall reduction in streamflow is estimated to be 4.62 percent (0.76 percent + 3.86 percent in the month of September, as described in Section 6.1.7.1). The anticipated impact to streamflow from the proposed 150 mgd intake capacity is described in further detail in the GSI Memo in Appendix C.

As described in Section 5.1.1, flows in the Willamette are managed by the USACE's Willamette Project. The project is authorized, in part, by NMFS's Willamette Biological Opinion and the associated Reasonable and Prudent Alternatives, which include providing fish passage at three dams, temperature improvements, improvements in downstream flows, and habitat improvement projects (NMFS, 2008).

As described in Section 5.1.1, during low-flow conditions, water surface elevation at the WRWTP intake site is essentially controlled by operations at the PGE dam at Willamette Falls, and there is little correlation between flows at the Newberg gage and the stage at Willamette Falls. As a result, no cumulative reductions in wetted area or increases in temperature associated with lower water levels are anticipated.

The Project Participants have determined that the cumulative effects of the above actions and the proposed Project would result in the same effects on listed species as summarized in Sections 6.1 through 6.4 of this BA.

6.7 EFFECTS DETERMINATION

The USFWS and NMFS have published guidelines for making determinations of effect for listed species and critical habitats protected under the federal ESA. A determination of "no effect" is the appropriate conclusion when "the proposed action will not affect (i.e., harm or harass) listed species or critical habitat." "Harm" is an act that actually injures or kills listed species (50 CFR 17.3). "Harassment" is defined as an "intentional or negligent act or omission which creates the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR 17.3).

A determination of "is not likely to adversely affect" is "the appropriate conclusion when effects on listed species or critical habitats are expected to be discountable, or insignificant, or completely beneficial." The guidelines offer further clarification, indicating that "insignificant effects relate to the size of impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur." A "likely to adversely affect" determination is "the appropriate conclusion if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial" (NMFS, 1996).

Based on the evaluation of the potential effects and available scientific and commercial data discussed in the sections above, the proposed action is **"likely to adversely affect" UWR steelhead and UWR Chinook salmon**. The construction of the proposed action will result in temporary and localized increases in turbidity and potential contaminant release during construction; fish salvage at open-trench crossings; behavioral changes and/or injury from impact hammer installation of the screen protection piles; and short-term impacts to stream channel, streambanks, and riparian vegetation. However, the proposed withdrawal of 150 mgd will not result in noticeable or measurable changes to the water surface elevation, temperature, or water quality of the Willamette River, due to the small portion of flow being diverted and the backwater influence of the Newberg Pool upstream from the Willamette Falls and PGE dam. Because the change due to the additional withdrawal is unlikely to be measurable, the resulting effect on UWR Chinook salmon, UWR steelhead, and their habitat availability due to the proposed water withdrawal will be undetectable.

The proposed action will increase impervious surface on the RWF, WWSS WTP, and Reservoir Facilities for a total of 1.4 acres draining to the Willamette River Basin and a total of 13.6 acres draining to the Tualatin River Basin. Although the impervious surface is anticipated to generate low levels of automotive-derived pollutants and the final designs will meet NMFS SLOPES V stormwater criteria, the proposed action **"is likely to adversely affect"** listed fish species occurring downstream in the Willamette and Columbia rivers, as discussed in Section 4, due to changes in stormwater flow and quality.

The proposed action would not result in the "destruction or adverse modification" of designated UWR Chinook or steelhead critical habitat. No significant cumulative, interrelated or interdependent effects on listed salmonids or their critical habitats were identified with the proposed action.

The proposed action will have "**no effect**" on streaked horned lark, Nelson's checkermallow, or water howellia. Impacts to streaked horned lark can be avoided by scheduling construction in potential habitat outside of the nesting season. If construction is planned during the nesting season, then surveys will be conducted to confirm that the species is not present. Construction will be delayed if streaked horned larks are nesting. There is a low potential for Nelson's checkermallow and water howellia to occur in in the Transmission Pipelines, WWSS WTP, and Reservoir Facilities action areas where surveys have not been conducted. Surveys of potential habitat will be coordinated with USFWS before construction begins. If the species is detected and impacts cannot be avoided, mitigation will be determined in coordination with USFWS and could include transplanting.

7 ESSENTIAL FISH HABITAT

Public Law 104-267, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act, or MSA) to establish new requirements for Essential Fish Habitat (or EFH) descriptions in federal fishery management plans and to require federal agencies to consult with NMFS on activities that may adversely affect EFH. "Essential Fish Habitat" means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" as defined by the Magnuson-Stevens Act (PFMC, 1998). The Pacific Fisheries Management Council (PFMC) has recommended an EFH designation for the Pacific salmon fishery that would include those waters and substrate necessary to ensure the production needed to support a long-term sustainable fishery.

The consultation requirements of section 305(b) of the Magnuson-Stevens Act (16 United States Code (USC) 1855(b)) provide that:

- Federal agencies must consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH;

- NMFS shall provide conservation recommendations for any federal or state activity that may adversely affect EFH;
- Federal agencies shall, within 30 days after receiving conservation recommendations from NMFS, provide a detailed response in writing to NMFS regarding the conservation recommendations. The response shall include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations of NMFS, the federal agency shall explain its reasons for not following the recommendations.

The Pacific salmon management unit includes Chinook, coho, and pink salmon (*Oncorhynchus gorbuscha*). Of these, Chinook are present in the Willamette River and coho are present in the Willamette River, and the Tualatin River and tributaries (as shown in Appendix M). In September 2000, NMFS approved the PFMC's Amendment 14 of the Pacific Coast Salmon Plan. Appendix A to Amendment 14 defines freshwater EFH for Chinook salmon and coho salmon as including all streams, lakes, ponds, wetlands, tributaries, and other waterbodies currently viable and most of the habitat historically accessible to these species in Washington, Oregon, and California within specific hydrologic units.

The direct effects of the Project have been thoroughly described in Section 6 of this BA. Based on this analysis, the proposed Project would adversely affect EFH for Chinook and coho in the short term. The conservation measures described in this BA are adequate to prevent long-term adverse effects on EFH for these species.

8 PREPARERS AND CONTRIBUTORS

Kristine Marshall, DEA Biologist, is the primary author of this report. John Macklin, DEA Biologist, and Jennifer Miller, DEA Project Manager, provided Total Quality Management reviews. Christine Immroth, DEA Technical Editor, and Dawn Afman, DEA Project Assistant, prepared the report drafts. Melissa Foltz, DEA Project Assistant, prepared the EFH graphics.

Exhibit M: Geotechnical Design Report (April 2, 2019)

Final Geotechnical Design Report

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Willamette Water Supply Program
Raw Water Facility 1.0
Wilsonville, Oregon

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April 2, 2019

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1.0 INTRODUCTION AND PROJECT DESCRIPTION

1.1 General

As requested, GRI performed geotechnical investigations and analyses to support proposed improvements to the raw-water facilities (RWF) for the Willamette Water Supply Program (WWSP) in Wilsonville, Oregon. The proposed RWF will serve as an expansion of the existing raw water facilities at the Willamette River Water Treatment Plant (WRWTP). The Vicinity Map, Figure 1.1, shows the general location of the site, which includes the property currently occupied by the WRWTP and its associated park facilities.

The purpose of our investigations and analyses is to evaluate subsurface conditions at the site and develop conclusions and recommendations for design and construction of the proposed RWF improvements. The investigation includes a review of available geologic and geotechnical information for the project area, subsurface explorations, and laboratory testing. The results of the primary and 70% phases of drilling are summarized in our October 26, 2018, report titled "Geotechnical Data Report, Willamette Water Supply Program, Raw Water Facility 1.0, Wilsonville, Oregon," completed for the Willamette Water Supply Program.

1.2 Project Description

Development of the proposed facility will require extensive modification and expansion of the existing WRWTP facility to generate an initial WWSP pumping capacity of 60 MGD. For discussion purposes, the WRWTP property has been divided into two sites: the upper site and the lower site, as described in Section 2. Based on our understanding of the conceptual design, these modifications will include construction of new vertical turbine pumps, electrical facilities, water-surge protection, a raw-water pipeline, backup-power infrastructure, stormwater management, and seismic improvements to WRWTP. Our review of conceptual drawings indicates the electrical facilities, surge protection, and raw-water pipeline will require construction outside the footprint of existing WRWTP facilities. The planned electrical facilities will be constructed at both the upper site, where the existing stockpile is located, and the lower site, north of the existing paved loop at the southern end of the plant. Surge-protection tanks are currently planned for construction at the upper site adjacent to the new electrical facilities. The preferred location of the new raw-water pipeline is along the western border of the lower site within the existing WRWTP park area and extending through the upper site, crossing Arrowhead Creek. The raw-water pipeline will cross Arrowhead Creek on the north side of the existing bridge. As currently planned, we understand the proposed raw-water facilities will increase the WRWTP capacity and new pipeline construction will facilitate the connection from the raw-water source at the Willamette River to the PLM_1.1 Phase of the Willamette Water Supply System (WWSS).

Black and Veatch (B&V) is the prime consultant for the RWF_1.0 project. Staheli Trenchless Consultants (Staheli) is supporting B&V with the trenchless-crossing design and preparation of the Geotechnical Baseline Report (GBR) for this aspect of the project. Kiewit is the CM\GC contractor for the project. The geotechnical project team for this effort includes Dr. Stephen Dickenson from New Albion Geotechnical, Inc., and Dr. Michael Beaty from Beaty Engineering, LLC.

1.3 Performance Criteria and Seismic Basis of Design

The June 8, 2018, WWSP Seismic Guidelines and Minimum Design Requirements (WWSP, 2018) outlines level of service (LoS) goals for the project. Based on review of Table 4-2 of this document, the LoS goals for the project for the intake and RWF are as follows:

- 25% capacity within 24 hours of a magnitude (M_W) 9.0 Cascadia Subduction Zone earthquake
- 50% capacity within 48 hours of a M_W 9.0 Cascadia Subduction Zone earthquake
- 90% to full capacity when power transmission and transportation are restored
- 5 days of self-sufficiency for all consumables required for operations
- Fire-suppression systems shall be autonomous and fully operable at 90 – 100% capacity immediately after a M_W 9.0 Cascadia Subduction Zone earthquake

In Technical Memorandum 2.1.2 (GRI, 2018a), for structures subjected to seismically induced horizontal and vertical permanent movements, B&V recommends designing mitigation that will limit the total movement of structures to less than 2 in. (horizontal) and 1 in. (vertical). A target permanent differential displacement of less than 7 in. was identified for the raw-water pipeline and duct bank, assuming pipe joints will be butt-welded.

The basis of design is in accordance with the following codes, standards, and project specific requirements:

- The seismic evaluation for the existing facilities is being completed in accordance with the American Society of Civil Engineers (ASCE) publication "Seismic Evaluation and Retrofit of Existing Buildings (41-17)" (ASCE 41-17).
- The seismic design for new facilities is being completed in accordance with the ASCE publication "Minimum Design Loads and Associated Criteria for Buildings and Other Structures (7-16)" (ASCE 7-16), with modifications specified by the WWSP and the peer-review team. These modifications include increasing the Risk-Targeted Maximum Considered Earthquake (MCE_R) spectral acceleration developed in accordance with ASCE 7-16 by 50% for analysis of new structures.
- All geotechnical-deformation analyses are still being completed in accordance with the project-specific, probabilistic, 2,475-year, seismic hazard level (S&W, 2017).

2.0 SITE DESCRIPTION

2.1 Overview

The 37.5-acre site is currently occupied by the existing WRWTP, located on the northern bank of the Willamette River in Wilsonville, Oregon. For discussion purposes, the WRWTP property has been divided into two sites: the lower site and the upper site.

2.2 Lower Site

The lower site encompasses the southern portion of the property bounded by the Willamette River to the south, a residential development to the west, and a rock quarry to the north and east. Figure 2.2.1 shows the existing conditions at the lower site and locations of completed explorations. Otak completed a topographic survey of the lower site for the project in January 2018 using the National Geodetic Vertical Datum of 1929 (NGVD 29). Unless specified otherwise, all elevations in this report reference NGVD 29. At the lower site, the riverbank slopes steeply up from south to north to an approximate crest elevation of 125 ft. In general, slopes range from about 2H:1V (Horizontal to Vertical) to 3H:1V, with steeper localized sections. The surface-water level of the Willamette River varies but is typically near elevation 60 ft. Bathymetric survey data completed by the U.S. Geological Survey (USGS) are not available at the project site. However, based on closest available upstream and downstream USGS surveys, we estimate elevations of the river thalweg range from about 20 to 53 ft. A small ravine is located on the west side of the project site and is known as the "west ravine" for the remainder of this report. Several existing WRWTP facilities are present at the lower site at the crest of the riverbank slope. Existing WRWTP facilities include the raw-water intake, clearwell storage, high-service pump station, and administration building. The raw-water intake system consists of a buried, pile-supported intake pipeline and its associated pump station. Raw water is collected from the Willamette River via a 76-in.-diameter pipeline. The portion of the intake pipeline above the riverbed is supported on steel HP 14x89 piles. The remainder of the intake pipeline is buried and extends 350 ft north, connecting to the pump station via a 56-ft-diameter caisson at approximate elevation 37 ft. The caisson, which extends to 90 ft below the crest of the slope (or approximate elevation 30 ft), carries the raw-water intake pipeline to the treatment plant. The buried clearwell is located in the southwest corner of the WRWTP and supported by a mat foundation at approximately 25 to 30 ft below existing grade. The remaining WRWTP facilities, such as chemical storage, ballasted coagulation, waste wash-water equalization, ozonation, sludge thickener, and filtration structures, are supported by shallow foundations at depths of 10 to 20 ft below existing site grades.

2.3 Upper Site

The upper site encompasses the northern portion of the WRWTP property and sits directly north of the lower site. The site is bounded on the north and east by Arrowhead Creek and a gravel pit, on the south by a paved road connecting to the lower site, and on the west by a residential development. Figure 2.3.1 shows the existing conditions at the upper site and locations of completed explorations. Otak completed a topographic survey of the upper site for the project in January 2018 using the NGVD 29. The upper site includes a bridge crossing of Arrowhead Creek, which sits in a 20- to 25-ft-deep ravine ranging in elevation from approximately 122 to 147 ft. Side slopes of the ravine are densely vegetated and estimated to be 3H:1V or steeper. Based on our review of previous construction activity, we understand excavation spoils from the construction of the WRWTP facilities were stockpiled in the southern portion of the upper site. The fill stockpile follows the northern edge of the paved access road to the lower site and is approximately 500 ft long, 200 ft wide, and 15 to 20 ft high, with a top elevation of approximately 176 ft. We understand slope-stability issues were observed near the northeastern corner of the fill stockpile during original construction of the facility.

2.4 Geology

A detailed geologic discussion is included in the Geotechnical Data Report for the project (GRI, 2018b) and is summarized briefly in this section. The site is underlain by alluvial deposits of Willamette Silt. Willamette Silt typically consists of deposits from the Catastrophic Missoula Floods, where multiple massive floods swept from Montana across the Idaho panhandle, eastern Washington, and Oregon through the Columbia River Gorge during the last Ice Age. Miocene- to Pliocene-age Sandy River Mudstone underlies the Willamette Silt and consists of thin-bedded micaceous and tuffaceous sandstone and siltstone, carbonaceous claystone, and local gravel lenses. Locally, the Sandy River Mudstone is interbedded with the Troutdale Formation, and for the purpose of this report, they are considered equivalent (Evarts et al., 2009). The Troutdale Formation typically consists of weathered siltstone with interbedded sandstone and claystone, which are frequently weathered to the consistency of stiff soil. The Troutdale Formation is a weakly cemented, gray and brown silt and clay with mottled yellow and reddish-brown, silty, fine sand and occasional pebble conglomerate beds.

3.0 SUBSURFACE DESCRIPTION

A detailed discussion of subsurface conditions is included in the Geotechnical Data Report for the project (GRI, 2018b). The following sections include brief summaries of the subsurface conditions for the lower and upper sites.

Subsurface materials and conditions at the site were evaluated between November 6, 2017 and August 22, 2018, with 16 mud-rotary and sonic borings, 14 cone penetration test (CPT) probes, and two dilatometer test (DMT) soundings. The explorations were advanced to depths of 36.3 to 176.5 ft below the existing ground surface. The explorations have been divided into two groups based on their locations. The first group, designated “lower site explorations,” includes borings B-1 through B-8, CPTs C-1 through C-9, and DMTs D-1 and D-2. The subsurface conditions disclosed by the explorations completed at the lower site are summarized by cross section A-A′ on Figure 3.1. The second group, designated “upper site explorations,” includes mud-rotary borings B-9 through B-11, sonic borings S-1 through S-5, and CPTs C-10 through C-14. The subsurface conditions disclosed by the explorations completed at the upper site are summarized by cross section B-B′ on Figure 3.2. In accordance with the RWF_1.0 statement of work, all explorations completed for this phase have the “RWF 1.0” prefix. However, to simplify discussions in this report, the “RWF 1.0” prefix will be dropped within the body of the report but will remain on all figures and exploration logs.

The approximate locations of the explorations are shown on Figures 2.2.1 and 2.3.1. Schematic cross sections of the lower and upper sites are shown on Figures 3.1 and 3.2, respectively.

3.1 Lower Site Conditions

For the purpose of discussion, the materials disclosed by the lower site explorations have been grouped into categories based on their physical characteristics and engineering properties. To aid in the review of subsurface conditions at the site, listed as they were encountered from the ground surface downward, the major soil units disclosed by the explorations are as follows:

PAVEMENT and BASE COURSE
FILL and POSSIBLE FILL

SILT and SAND (Willamette Silt)
GRAVEL and SAND (Troutdale Formation)
SILT and CLAY (Troutdale Formation)

PAVEMENT and BASE COURSE. Asphaltic-concrete (AC) pavement over crushed-rock base course was encountered at the ground surface in borings B-4 and B-5 and in CPTs C-8 and C-9. The pavement is generally about 4 in. thick. The underlying base course ranges from about 18 to 20 in. thick and is typically 18 in. thick.

FILL and POSSIBLE FILL. Crushed-rock surfacing was encountered at the ground surface in boring B-3 and extends to a depth of approximately 12 in. A layer of crushed-rock fill was encountered in boring B-4 at a depth of 1.8 ft and extends to a depth of 4 ft below the ground surface. Possible sand fill was also encountered in boring B-1 to a depth of 10 ft below the ground surface.

SILT and SAND (Willamette Silt). Native alluvial silt and sand were encountered beneath pavement in boring B-5 and CPTs C-8 and C-9, beneath crushed-rock surfacing in boring B-3, beneath crushed-rock fill in boring B-4, beneath possible fill in boring B-1, and at the ground surface in the remaining borings. The sand and silt unit exhibited a variable, layered structure across the site; however, the silt and sand unit at the lower site generally consists of silt with a variable sand content and interbedded sand layers. Overall, north of the slope, the alluvial silt and sand unit extends to elevations of about 56 to 79 ft; these elevations generally correspond to depths of 60 to 70 ft below the ground surface.

GRAVEL and SAND (Troutdale Formation). Interbedded layers of gravel and sand were encountered beneath the alluvial silt and sand in borings B-3 through B-8 and CPTs C-3 through C-9. The elevation of the gravel and sand unit contact ranges from 56 ft in boring B-4 to 79 ft in boring B-8 and generally increases moving south to north from the Willamette River. CPT C-5 encountered refusal in the gravel and sand unit at elevation 62 ft. Our drilling for this project and experience in the vicinity of the site indicate this deposit usually contains cobbles and boulders and may contain layers or zones of gravel that exhibit slight to moderate cementation. The sand and gravel unit extends to elevations of about 55 to 73 ft. CPTs C-3, C-4, and C-6 through C-9 as well as DMTs D-1 and D-2 encountered refusal at elevations of 62 to 79 ft at the estimated contact with the gravel and sand unit. Borings B-5 and B-6 were terminated in the gravel and sand at elevations ranging from about 56 to 60 ft.

SILT and CLAY (Troutdale Formation). Interbedded layers of silt and clay were encountered beneath the silt and sand unit in borings B-1 and B-2 and CPTs C-1 and C-2 and beneath the gravel and sand unit in borings B-3, B-4, B-7, and B-8 and CPT C-5. The clay and silt unit was encountered at elevations ranging from 55 to 73 ft. The unit is characterized by highly variable silt and clay contents. In general, the clay layers are silty and the silt layers are clayey. Silt and clay layers up to 60 ft thick were observed within the unit. Borings B-1 through B-4, B-7, and B-8 and CPT C-5 were terminated in the silt and clay unit at elevations ranging from -52 to 72 ft.

3.2 Upper Site Conditions

For the purpose of discussion, the materials disclosed by the upper site explorations have been grouped into categories based on their physical characteristics and engineering properties. To aid in the review of subsurface conditions at the site, listed as they were encountered from the ground surface downward, the major soil units disclosed by the explorations are as follows:

PAVEMENT and BASE COURSE
FILL and POSSIBLE FILL
SILT and SAND (Willamette Silt)
GRAVEL, COBBLES, SAND, SILT, and CLAY (Troutdale Formation)

PAVEMENT and BASE COURSE. AC pavement over crushed-rock base course was encountered at the ground surface in boring B-9 and CPTs C-10 and C-13. The pavement is generally about 2 in. thick. The underlying base course ranges from about 18 to 20 in. thick and is typically 18 in. thick.

FILL and POSSIBLE FILL. Fill was encountered at the ground surface in borings B-10 and S-1 and possible fill was encountered at the ground surface in borings S-3 through S-5. The fill and possible fill range from silt with a trace of fine-grained sand to silty sand and is generally brown. The fill in boring B-10 is generally medium stiff and contains a trace of clay. The fill in boring S-1 and S-3 is generally medium dense and contains a trace of subrounded to subangular gravel. The possible fill in borings S-3 and S-4 contains fine roots. The fill extends to elevations varying from about 143 to 163 ft.

SILT and SAND (Willamette Silt). Native alluvial silt and sand were encountered beneath the pavement in boring B-9 and CPTs C-10 and C-13; beneath the fill or possible fill in borings B-10, S-1, and S-3 through S-5; and at the ground surface in the remaining explorations. The explorations completed within the upper site area typically disclosed a relatively silty profile, with a highly variable sand content and interbedded sand layers. The alluvial silt and sand unit extends to elevations varying from about 76 to 132 ft.

GRAVEL, COBBLES, SAND, SILT, and CLAY (Troutdale Formation). The Troutdale Formation was encountered beneath the alluvial silt and sand in borings B-9 through B-11 and S-1 through S-5. At the upper site, the sequence and layering of the Troutdale Formation soils were significantly more variable than at the lower site and have therefore been described as a single unit. The approximate elevation of the contact with the Troutdale formation ranges from 76 ft in boring B-9 to 132 ft in boring S-5 and generally increases moving south to north from the Willamette River. Our drilling for this project and experience in the vicinity of the site indicate this deposit usually contains cobbles and may contain layers or zones of gravel that exhibit slight to moderate cementation. Although not noted on the boring logs, it is common for this unit to contain boulders, and we understand boulders were encountered during the trenchless crossing for the existing pipeline. CPTs C-10 through C-14 encountered refusal in the alluvial sand and silt at approximate elevations ranging from 78 to 115 ft near the estimated contact with the Troutdale Formation. Borings B-9 through B-11 and S-1 through S-5 were terminated in the Troutdale Formation at elevations ranging from 73 to 105 ft.

3.3 Groundwater and Willamette River Levels

To monitor groundwater levels at the site, vibrating-wire piezometers were installed in borings B-2, B-3, B-6, B-8, B-9, B-11, and S-3. As noted in our data report, the piezometer in boring B-2 is not functioning and data from that piezometer are not being presented. Standpipe piezometers were also installed in sonic borings S-1, S-2, S-4, and S-5 and adjacent to boring B-4. Vibrating-wire piezometers were later installed in sonic borings S-1 and S-2 to monitor groundwater levels on a daily basis. Data from the piezometers in borings S-4 and S-5 have not been collected, as the piezometers have been inaccessible since the time of installation. In general, the elevation of the groundwater table decreases moving south toward the Willamette River. The groundwater elevations measured by the piezometers at the lower site range from approximate elevation 78 ft in boring B-3 and the standpipe piezometer adjacent to boring B-4 to approximately elevation 122 ft in boring B-8. Vibrating-wire piezometer data collected at the upper site indicate the groundwater table typically ranges in elevation from about 113 ft in boring S-3 to about 131 ft in boring B-11. Data collected from borings S-1 through S-5 suggest the groundwater table at the upper site also slopes down to the east. It should be noted that groundwater levels at the site will fluctuate in response to seasonal rainfall as well as the levels of the Willamette River and Arrowhead Creek. Approximate groundwater table elevations for both the lower and upper sites can be found on Cross Section Figures 3.1 and 3.2.

The surface-water level of the Willamette River varies but is typically near elevation 60 ft. The ordinary high water and 100-year flood elevations for the Willamette River are 70.5 and 91.1 ft, respectively.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Section 4 of this report provides design recommendations regarding seismicity and seismic hazards, foundation support, subdrainage considerations, embedded structures, pipeline designs, trenchless-crossing considerations, and pavement design. Section 5 discusses seismic mitigation for the pipeline and caisson in additional detail. Section 6 provides construction recommendations regarding earthwork, dewatering, and seismic-mitigation construction.

4.1 General

The subsurface explorations indicate the lower site is mantled with about 70 ft of Willamette Silt overlying the Troutdale Formation. Subsurface conditions in the upper site include significant thicknesses of fill from the existing facility construction overlying the Willamette Silt.

Groundwater depths vary significantly across the lower site from approximately elevation 78 ft near the crest of the slope adjacent to the Willamette River to about 122 ft at the north end of the site. Groundwater also varies from about 113 to 131 ft across the upper site. General stratigraphic cross sections showing schematic subsurface conditions and groundwater levels are provided on Figures 3.1 and 3.2.

In our opinion, the seismic performance of the sand and silt deposits overlying the deeper Troutdale Formation is the primary geotechnical consideration for the project. In this regard, the potential for cyclic strength loss (e.g., liquefaction and/or cyclic degradation) and its consequences at the site are significant considerations for pipe, caisson, foundation, and floor-slab support.

4.2 Seismicity Background

As discussed in Section 1.3, existing structures are being designed in accordance with ASCE 41-17 and new structures are being designed in accordance with ASCE 7-16 with modifications specified by WWSP. ASCE 41-17 requires seismic evaluation for various hazard levels depending on the owner's sensitivity to risk. To be consistent with the hazard and performance requirements outlined in the June 2018 WWSP Seismic Guidelines and Minimum Design Requirements (WWSP, 2018), the BSE-2N hazard level, which represents the Basic Performance Objective Equivalent to New Building Standards (BPON), will be utilized. The BSE-2N seismic hazard level is defined by the ground shaking based on the MCE_R ground motions consistent with ASCE 7-16. Site-specific seismic hazard evaluations were conducted at the project site in accordance with ASCE 7-16, which is a reference standard in the 2018 International Building Code (2018 IBC). It should be understood ASCE 41-17 references Chapter 21 of ASCE 7-16 for requirements pertaining to site-response analysis that exceed those described in Section 2.4 of ASCE 41-17. Like its predecessor, ASCE 7-10, ASCE 7-16 requires evaluation of seismic hazards based on the probabilistic MCE_R, which is defined in Chapter 21 of ASCE 7-16 as the response spectrum expected to achieve a 1% probability of building collapse within a 50-year period. The risk-targeted ground motions are developed by applying adjustment factors of directivity and risk coefficients to the 2% probability of exceedance in 50 years (2,475-year return period hazard level) ground motion developed from the recently updated 2014 USGS National Seismic Hazard Maps (NSHMs). The risk-targeted probabilistic values are also subject to a deterministic check computed from the models of earthquake sources and ground-motion propagation that form the basis of the 2014 USGS NSHMs. ASCE 7-16 defines the site-specific deterministic MCE_R ground motions in terms of 84th-percentile, 5%-damped response spectral acceleration in the direction of maximum horizontal response. The MCE_R ground motions are taken as the lesser of the probabilistic and deterministic spectral acceleration.

As directed in the June 2018 WWSP Seismic Guidelines and Minimum Design Requirements (WWSP, 2018), we utilized the project-specific Probabilistic Seismic Hazard Analysis (PSHA) completed by Shannon & Wilson, Inc., (S&W, 2017) in lieu of the 2014 USGS NSHMs and corresponding 2014 USGS PSHA. For clarity reasons, unless otherwise specified, all references to PSHA in the remainder of this report refer to the S&W 2017 PSHA noted above, whereas "2014 PSHA" refers to the 2014 USGS PSHA. The PSHA developed for WWSP is associated with a 2,475-year return period and was evaluated for two geographical areas, named "Site A" and "Site B." The PSHA was evaluated considering multiple soil profiles consistent with National Earthquake Hazards Reduction Program (NEHRP) Site Classes BC, C, CD, D, and E conditions. We reviewed the PSHA report and analysis methodology and compared them to the methodology provided in the 2014 USGS PSHA. Our review indicated the PSHA is generally consistent with the 2014 PSHA, with a few key differences. These differences include modifying the fault geometry of the Cascadia Subduction Zone, adding several nearby shallow crustal faults that the USGS does not consider seismogenically active, and removing one of the subduction zone ground-motion prediction equations (GMPE). Considering these differences, the program's PSHA generally results in higher short-period accelerations (up to 20% higher) than those provided by USGS. Detailed results of the PSHA for the various site classes are available in the project's PSHA report (S&W, 2017).

Based on the site location (project area south of latitude 45.44° N), the "Site B" PSHA was selected for evaluation at the WWSP RWF facility. The shear-wave velocity profile of the upper 100 ft obtained from the subsurface exploration program completed for the project indicates the site is designated as Site Class D. The peak ground acceleration (PGA) for Site Class D, PGA = 0.57 g, was adopted for simplified assessments of the potential for liquefaction and soil strength loss at the project site. In addition to PGA, the cyclic stress-based evaluations of liquefaction potential require the magnitude of the earthquake that controls the seismicity at the site. The WWSP program requires evaluation of the liquefaction hazard using the mean PGA from the site-specific PSHA. The deaggregation results from the S&W 2017 report for the mean 2,475-year return period indicate the mean magnitude (M_w) and mean source-to-site rupture distance for the site at PGA are 8.0 and 64 km, respectively.

4.3 Site-Specific Response Spectral Values

The site-specific response spectral values at the ground surface were developed based on the site-response modeling completed for the project. The recommended response spectra for structural design were developed by comparing the site-specific spectral values with the code-based spectra for Site Class D and the associated site-amplification factors. The code-based Site Class D spectrum was derived based on the 0.2- and 1-sec spectral-acceleration values (S_s and S_1) at the bedrock and corresponding site coefficients, F_a and F_v, in accordance with Chapter 21 of ASCE 7-16. For Site Class D, F_a is determined using Table 11.4-1 of ASCE 7-16, while F_v is taken as 2.4 for $S_1 < 0.2$ g or 2.5 for $S_1 \geq 0.2$ g per Section 21.3 of ASCE 7-16. The bedrock spectral values corresponding to 0.2 and 1 sec are 0.82 and 0.38 g, respectively. The site coefficients, F_a and F_v, of 1.17 and 2.5 were applied in developing the Site Class D spectrum. The site-specific response spectral values were observed to be higher than the code-based 80% Site Class D spectrum (i.e., minimum values allowed by ASCE 7-16) at periods less than about 1.8 sec and fall below 80% of Site Class D values at periods greater than 1.8 sec. Additional details regarding the site-response modeling is provided in Appendix A. The corresponding recommended spectral values (for both the upper and lower site) are summarized in Table 4.1, below. It should be noted that site response was performed for subsurface profiles at the upper and lower sites, results of which were generally consistent with each other. These spectral values also represent the BSE-2N hazard level defined by ASCE 41-17. It should be understood the recommended spectral values are intended for use with multi-period structural analysis and not appropriate for determining S_{MS} and S_{M1} directly. This table provides MCE_R spectral values that include modifications to reflect incorporation of risk and directivity factors as requested in a May 2, 2018, e-mail from the WWSP program.

Table 4.1: WWSP MCER/BSE-2N RESPONSE SPECTRAL VALUES, 5% DAMPING

Period, sec	Spectral Acceleration Values, g[1]
0.01	0.51
0.18	1.29
0.92	1.29
1.00	1.21
1.88	0.42
2.00	0.38
2.50	0.31
3.00	0.25
3.50	0.22
4.00	0.19
5.00	0.15

Notes:

The MCE_R hazard level spectral acceleration values do not include the WWSP-specified 50% increase for consideration of structural spectral-analysis design.

The spectral values in Table 4.1 represent analysis for free-field conditions. On a preliminary basis, we have compared the above results to spectral-acceleration outputs from numerical modeling at the top of the caisson. In general, the results indicate the free-field values provide reasonable agreement with the caisson spectra. These spectral values should be confirmed during the 50%-design process after the final mitigation technique is selected.

4.4 Liquefaction and Cyclic Softening

4.4.1 General

Liquefaction is a process by which loose, saturated, granular soils and some low-plasticity silts temporarily lose stiffness and strength during and immediately after a seismic event. This degradation in soil properties may be substantial and abrupt, particularly in loose sands. Liquefaction occurs as seismic shear stresses propagate through a saturated soil and distort the soil structure, causing loosely packed groups of particles to contract or collapse. If drainage is impeded and cannot occur quickly, the collapsing soil structure causes the pore-water pressure to increase between the soil grains. If the pore-water pressure becomes sufficiently large, the inter-granular stresses become small and the granular layer temporarily behaves as a viscous fluid rather than a solid. The ratio of excess pore-water pressure to pre-cyclic loading effective stress is defined as Ru, and as Ru values increase, there is an increased risk of settlement, loss of bearing capacity, lateral spreading, and/or slope instability, particularly along waterfront areas. Liquefaction-induced settlement occurs as the elevated pore-water pressures dissipate and the soil consolidates after the earthquake.

The term "cyclic softening" is typically associated with fine-grained soils and describes a relatively gradual and progressive increase in shear strain with load cycles. Excess pore pressures may increase due to the cyclic loading but will generally be less than the effective overburden stress (i.e., Ru < 1). Shear strains accumulate with additional loading cycles, but an abrupt or sudden decrease in shear stiffness is not typically observed. Settlement due to post-seismic consolidation can occur, particularly in lower-plasticity silts. Large shear strains can develop, and strength loss related to soil sensitivity may be a concern.

4.4.2 Seismic Soil Characterization

A key aspect of site characterization for evaluating seismic hazards involves categorizing the identified soil units into groups based on the above anticipated seismic behavior (i.e., susceptible to liquefaction or cyclic softening). The field investigation and laboratory testing programs indicate the soils encountered at the site consist of both granular sandy soils with varying silt content and fine-grained silt soils of varying plasticity (termed "transitional" soils for the sake of characterizing seismic behavior).

The process used to categorize the soil units was based on a combination of published procedures modified by the results of site-specific testing. For example, the recommendations adopted by the Greater Vancouver Task Force (Anderson et al., 2007) for seismic-behavior screening of fine-grained soils were used. This approach is largely based on the plasticity index (PI) of the soil unit. Robertson (2009) has shown the CPT-based Soil Behavior Index, I_c, can be correlated to site-specific soil index properties such as PI. Based on our review of the Atterberg limits testing for the site and its relationship to I_c, a project-specific correlation of PI to I_c was developed and used for seismic-behavior screening of the CPT logs. Cyclic direct simple shear (DSS) testing indicates the silt soils with low plasticity are deemed "transitional" and have attributes of both clay-like and sand-like behavior. For the analyses, soils otherwise classified as moderate to high plasticity (e.g., fine-grained soils with a PI value of 10% or more) were considered to behave in a clay-like manner. Silt soils with PI values less than 10% were classified as transitional, exhibiting attributes of both sand-like and clay-like behavior. This was based on the laboratory testing program (which included transitional soils with PI values as low as 3%), recommendations of the Greater Vancouver Task Force (Anderson et al., 2007), and the recommendations of Idriss and Boulanger (2008).

The following table summarizes the soil index values associated with the soil categorization for seismic behavior. The table also indicates the general potential for seismic-induced settlement associated with each category for the considered design loading.

Table 4.2: SOIL CHARACTERIZATION FOR SEISMIC BEHAVIOR

Preliminary Soil Characterization for Seismic Behavior	Plasticity Index, PI	CPT Soil Behavior Index, I_c	Basis for Evaluating Liquefaction or Cyclic-Softening Potential	Susceptibility to Seismic-Induced Strength Loss
Granular	Less than 10%	Less than 2.3	SPT and CPT, fines content	High
Fine-grained, transitional	Less than 10%	2.3 to 2.8	Undrained shear strength and cyclic DSS	Moderate
Fine-grained, clay-like	Greater than 10%	Greater than 2.8	Undrained shear strength and cyclic DSS	Low

4.4.3 Liquefaction Susceptibility of Sand-Like Soils

The standard-of-practice method for liquefaction-triggering analysis (often termed the Simplified Procedure) compares estimates of the cyclic shear stresses induced within a soil profile during an earthquake with the cyclic resistance of the soil. The induced seismic stresses can be estimated from site-response analyses or using simplified relationships. The cyclic resistance of the soil is estimated using published relationships based on semi-empirical databases of historical liquefaction. These relationships estimate the cyclic resistance of the soil based on the Standard Penetration Test (SPT) N-value or CPT tip resistance, with various corrections to account for earthquake magnitude, overburden stress, and fines content. Liquefaction is considered likely when the ratio of cyclic resistance (CRR) to cyclic stress (CSR), also called the factor of safety (FS) against liquefaction, approaches 1.0, with smaller FS indicating greater risk of liquefaction. Soils with an FS between 1.0 and about 1.4 are considered capable of generating significant pore pressure during seismic loading and may consolidate after shaking, resulting in ground-surface settlement. For sandy soils, estimation of liquefaction-induced, post-shaking settlement is typically based on the FS against liquefaction and the relative density of the soil.

The potential for liquefaction triggering of sand-like soils has been evaluated using the Boulanger and Idriss (2014) Simplified Procedure as implemented in the computer program CLiq, produced by GeoLogismiki, which compares the cyclic shear stresses induced within a soil profile during an earthquake with the ability of the soil to resist these stresses. The CSR was developed based on the PGA value at the ground surface of 0.57 g and a mean earthquake magnitude of M_W 8.0. The cyclic resistance of the soil was evaluated based on the borings (B-1 through B-11) and CPT soundings (CPT-1 through

CPT-14) completed as part of the subsurface-exploration program. Our analysis indicates the native silty-sand layers (Willamette Silt) are typically not saturated to a depth of about 45 ft below the existing ground surface and as such are not susceptible to liquefaction during the design-level earthquake. However, the Willamette Silt present below this depth is typically saturated and can be considered potentially susceptible to localized liquefaction. The results of the simplified liquefaction-potential evaluations based on CPTs are provided in Appendix B of this report.

4.4.4 Cyclic Softening of Clay-Like Soils

The cyclic resistance of fine-grained soils is dependent on soil characteristics such as plasticity, natural moisture content, stress history, depositional environment (fabric), and composition. In practice, the cyclic resistance of these soils is commonly evaluated using simplified correlations based on undrained shear strength, overconsolidation ratio (OCR), and soil sensitivity. In general, we anticipate the silt and clay of the Troutdale Formation will exhibit clay-like behavior and undergo limited cyclic degradation or straining.

4.4.5 Transitional Soils

To supplement the practice-oriented approaches and better understand the seismic behavior of the low-plasticity silts at the project site, a laboratory testing program was performed to evaluate the cyclic resistance, degradation potential, and post-cyclic behavior of the low-plasticity silts. The laboratory testing program focused on a series of cyclic DSS tests, with supporting standard index and consolidation tests.

The cyclic DSS laboratory testing program was completed by GRI. The laboratory test results indicate the low-plasticity silts may generate excess pore pressures in response to cyclic loading, but they exhibit a lower potential for strength loss and shear strain potential when compared to sands. This is consistent with our experience with similar laboratory testing programs and provides a site-specific method for evaluating the behavior of the silt soils with respect to site response and foundation design. A summary of the results can be found in Appendix E of this report.

For the purpose of evaluating the potential for cyclic softening of the fine-grained soils at the site, we have reviewed the results of the cyclic DSS testing and defined an FS of 1.0 as the uniform cyclic shear stress required to produce a single-amplitude shear strain of approximately 3%. The cyclic resistance of the fine-grained soils was then evaluated based on the Stress History and Normalized Soil Engineering Properties (SHANSEP) methods presented by Idriss and Boulanger (2008), which are based on stress history, overburden stress, and the undrained shear strength of the soil. Undrained shear strengths were estimated based on the results of the DSS testing program and CPT explorations using correlations developed by Robertson (2009).

The results of these analyses indicate the soft to medium-stiff silts below the groundwater level at the site demonstrate attributes of both sand-like and clay-like behavior and will likely exhibit significant cyclic softening during the design-level earthquake.

4.5 Seismic Deformations

4.5.1 Post-Seismic Reconsolidation Settlement

Post-seismic vertical settlement generally occurs when the excess pore pressures generated during the earthquake dissipate and the soil (both sand-like and clay-like) reconsolidates. For sand-like soils, reconsolidation settlement can be estimated based on the strain potential approach detailed by Ishihara and Yoshimine (1992) and later updated by Yoshimine et al. (2006). This method estimates the volumetric strains of post-liquefaction reconsolidation as a function of the maximum shear strains developed during undrained cyclic loading and the initial relative density of the sand layers. Using the simplified Yoshimine et al. (2006) methodologies, we estimated free-field, ground-surface, seismically induced settlements in the range of 1 to 8 in. for the existing conditions. The CPT-based estimates of liquefaction-induced settlements are provided in Appendix B. The spatial distributions of the estimated reconsolidation settlements are provided on Figures 4.5.1 and 4.5.2. It should be emphasized these estimated settlements do not include additional vertical deformations associated with lateral spreading or seismically induced slope failure.

4.5.2 Lateral Spreading Estimates

Lateral spreading involves the horizontal displacement of large volumes of soil as a result of seismically induced strength loss and inertial loading. Lateral spreading can develop on gently sloping ground or near a moderately to steeply sloping free face, such as a river channel. Differential internal movements within the spreading mass usually create surface features, such as ground cracks, or fissures, scarps, and grabens in overlying unsaturated or non-liquefied soils. Lateral displacement may range from a few inches to many feet depending on soil conditions, the steepness of the slope, and the magnitude, duration, and source-to-site distance of the earthquake. Associated differential vertical movements, or ground-surface subsidence, generally range from one-third up to about half of the total horizontal movement.

For preliminary screening purposes, the empirical regression model developed by Youd et al. (2002) was used to estimate the lateral spreading deformations at the site. The basic inputs for the Youd et al. (2002) method include characterization of the soil profile in terms of grain size, fines content, and SPT N-values; the overall geometry of the slope; and the magnitude and epicentral distance from the design-basis earthquake. Based on the results of our preliminary screening evaluations, we estimate lateral spreading deformations at the crest of the slope on the order of 1 to 6 ft at the upper (Arrowhead Creek) and lower (caisson) sites. Based on the depth of the liquefiable layer and slope geometry along the west ravine, we do not anticipate lateral spreading in this area. However, due to the strong levels of ground shaking, some seismically induced slope movements are still anticipated. It should be noted that the Youd et al. (2002) regression method is based on case histories that do not incorporate the extensive knowledge gained from laboratory studies of liquefaction and consequently do not provide a precise estimate of the actual ground movement that may occur at a given location. This methodology also approximates the vulnerable portion of the soil profiles as a single layer, and layer profiles are difficult to assess with this methodology.

4.5.3 Limit Equilibrium and Newmark Slope Deformation Analyses

Simplified, practice-oriented methods for estimating the likely range of seismic deformation are commonly performed using a pseudo-static representation of seismic demand in which a destabilizing horizontal seismic coefficient is utilized within a conventional limit equilibrium slope-stability calculation. The seismic coefficient represents the fraction of the weight of the sliding mass applied as an equivalent horizontal force acting through the centroid of the slide mass to simulate inertia forces due to the earthquake. Various horizontal-force coefficients are input into the model to determine the yield acceleration (K_y) where the models indicate FS = 1.0.

The stability evaluations for the project were conducted using the SLIDE program version 2018 and produced by Rocscience, Inc., located in Toronto, Canada, by employing the Spencer method of slices which satisfies both moment and force equilibrium. The program generates potential slip surfaces using a grid of circle centers and a series of tangent lines. The stability analyses were evaluated for representative cross sections at the caisson, west ravine, and Arrowhead Creek sites. The cross sections evaluated for slope stability are shown on Figure 1C. The figure shows the cross sections designated as A-A′, B-B′, C-C′, and D-D,′ which are assumed to be representative of the conditions in the caisson (lower), west ravine, and Arrowhead Creek (upper) sites. The soil types, zones of potentially liquefiable soil, and geometries of the cross sections used for seismic-stability modeling were based on the results of the subsurface explorations, laboratory testing, and liquefaction evaluations completed for the project. The post-cyclic shear strengths of the prevalent soils were estimated based on published trends and the cyclic DSS testing completed on selected samples of soils.

The Newmark sliding-block method (Jibson et al., 2013) is widely used to estimate the seismically induced slope displacements from acceleration time histories. The acceleration time histories are computed along the critical failure surface, under consideration of previously discussed site-response modeling, in the form of a horizontal shear-stress time history normalized by the total vertical overburden stress (Kramer and Smith, 1997). Then, the normalized stress time history is input directly into a Newmark seismic-displacement analysis to calculate the permanent seismic displacement as a function of the seismic yield acceleration.

4.5.3.1 Willamette River Slope

Along the Willamette River, adjacent to the caisson, the seismic slope deformation for the existing condition was computed by applying a seismic coefficient that yields a pseudo-static FS of 1.0. Figure 2C shows the slip surfaces estimated with a K_y of 0.14. For comparison with the Fast Lagrangian Analysis of Continua (FLAC) deformation analyses, the Newmark analysis indicates the average slope deformation for $K_y = 0.14$ is about 1 ft.

Supplemental Newmark deformation analyses were completed to evaluate alternatives to reduce the potential mitigation for the proposed raw-water pipeline exiting the caisson to the west. One of the concepts includes locating the pipeline far enough away from the exposed slope to a location where liquefaction-induced lateral spreading is within the pipeline-deformation tolerances. Based on review of the seismic-design guidelines, a range of total lateral deformations ranging from about 5 to 10 in. were analyzed. Results of the analyses were completed for cross sections at the caisson and approximately 150 ft west, where the topography varies, with the crest of the slope extending farther south and a steeper slope below the crest.

Table 4.3: APPROXIMATE CREST OF SLOPE OFFSETS FOR VARYING ACCEPTABLE DEFORMATIONS (NEWMARK ESTIMATES)

Acceptable Lateral Deformation (in.)	Cross Section at Caisson	Cross Section 150 ft West of Caisson
	Offset (ft)	Offset (ft)
10	90	140
7	120	180
5	150	210

4.5.3.2 West Ravine and Arrowhead Creek

At the west ravine and Arrowhead Creek sites, an initial soil/pipeline target allowable lateral displacement of 2 in. was selected for preliminary screening purposes. A seismic coefficient of 0.26 was obtained from Newmark analysis corresponding to the preliminary 2 in. of allowable displacement. This seismic coefficient value was applied to the stability models during the seismic slope-stability modeling. Figures 3C, 4C, and 5C show the results of the pseudo-static analyses. The computed FS against instability is defined as the ratio of the forces (or moments) tending to resist failure to the forces (or moments) tending to cause failure. Computed FS less than 1.0 represents potentially unstable conditions (i.e., more than 2 in. of displacement). For 2 in. of lateral target displacement, the analyses indicate seismic slope instability could extend approximately 50 and 120 ft back from the crest of the slope for the west ravine and Arrowhead Creek slopes, respectively.

Following this initial analysis, the team was requested to evaluate another alternative for the west ravine site where the combined vertical and horizontal differential deformations would be less than the criteria outlined in the new Section 7.8 of the June 2018 WWSP Seismic Guidelines and Minimum Design Requirements (WWSP, 2018). It should be noted the maximum allowable differential deformations in Table 7-6 of the guidelines specifically apply to differential vertical settlements; however, we assumed they are applicable to all differential deformations regardless of direction (both free-field post-seismic reconsolidation settlements and seismic-induced lateral deformation). To evaluate reducing the required slope offset, the team was requested to evaluate butt-welded joints (rather than lap joints) for 66-in.-diameter pipe. The draft differential-settlement criteria for $^3/_8$-in. wall pipe indicates an allowable differential settlement of about 7 in. over 150 ft of pipe length.

The post-seismic reconsolidation settlements along the west ravine site vary from about 2 to 8 in. and generally increase from south to north. Consequently, the depth of the ravine generally increases from south to north, which tends to reduce the risk of seismically induced lateral deformations at the north end of the ravine (where post-seismic reconsolidation settlements are estimated to be highest). To investigate this, we assumed the vertical differential settlement is about ½ to $^2/_3$ of the free-field post-seismic reconsolidation settlements and the differential lateral movements would be about ½ of the estimated lateral deformations. Based on these assumptions and additional Newmark slope-stability analyses, the pipe should be offset from the top of the slope a minimum of 10 to 15 ft for an allowable differential pipe deformation of about 7 in.

Additional discussion of pipeline-mitigation alternatives is provided in Section 5 of this report.

4.5.4 FLAC Deformation Estimates for Untreated Ground

In addition to the limit-equilibrium and Newmark-deformation estimates, GRI performed a more-rigorous numerical analysis of the WRWTP in the vicinity of the caisson and the Willamette River to provide a more-refined evaluation of the seismic performance of the facility and evaluate mitigation alternatives. The finite-difference computer program Fast Lagrangian Analysis of Continua version 8.0 (FLAC) was selected as the software package for these efforts. FLAC is a widely used program for performing complex, two-dimensional analyses of geotechnical structures based on the explicit finite difference method for modeling nonlinear static and dynamic problems. Additional details regarding the FLAC modeling are presented in Appendix D.

The FLAC-model geometry considered a combination of project explorations, current site survey, Oregon Department of Geology and Mineral Industries (DOGAMI) lidar data, as-built drawings, and historical bathymetry. Static and cyclic soil parameters were developed based on site-specific correlations between laboratory tests conducted on relatively undisturbed samples and in-situ test results. Cyclic DSS tests were used to calibrate the user-defined PM4Sand and PM4Silt constitutive models selected to represent the upper and lower Willamette Silt layers, respectively. The Troutdale unit that underlies the Willamette Silt formation was modeled utilizing an elastic Mohr-Coulomb model. The existing caisson was represented in complementary analyses as (i) a structural pile element based on beam theory, and (ii) a collection of two-dimensional finite difference elements with material properties that represent the stiffness, mass, and strength of the caisson.

Free-field and quiet boundaries were incorporated into the FLAC model to minimize boundary-condition effects. The seven input acceleration time histories summarized in Appendix A were applied to the base of the model. The analyses included both “free-field” conditions to model the site east and west of the caisson and “with-caisson” conditions to consider the interaction of the slope with the caisson.

The conceptual design for the project assumed relatively stiff, non-liquefiable, clayey soils (Troutdale Formation) extend linearly to the riverward extent of the intake pipe and the pipe is embedded in this layer. To evaluate uncertainty with this assumption and bracket the potential range of soil movements near the raw-water intake screens, we conservatively assumed, based on field observations, construction reports, and experience at local riverfront sites, a deposit of soft, alluvial silt up to 7 ft deep may be present on the slope above the Troutdale Formation. The initial analysis indicates more than 5 ft of movement could occur in this alluvial silt, if present.

Free-field analyses of the existing conditions estimated permanent lateral ground-surface displacements at the location of the caisson for crustal and subduction-zone motions to range from 0.5 to 1.5 ft. Permanent lateral deformations of the top of the caisson in the “with-caisson” models also ranged from about 0.5 to 1 ft. Permanent deformations on the order of 5 ft were observed on the crest of the slope. These deformations are also generally consistent with the limit equilibrium modeling and exceed the performance objectives established by the program.

Additional FLAC details are provided in Appendix D. Design considerations and recommendations for mitigation of the lateral spreading in the vicinity of the caisson are discussed in Section 5.

4.6 Foundation and Slab Support

Significant portions of the upper site are currently mantled with un-engineered fill from construction of the original WRWTP. This uncontrolled fill is in excess of 10 ft thick and not suitable for shallow foundation support without ground improvement or removal and replacement. In addition to static settlement considerations, the estimated seismically induced settlements across the project site vary from about 1 to 8 in.

While the majority of the fill material on the upper site will likely be removed, additional improvements will be required to mitigate the seismically induced settlements at the upper and lower sites to meet the performance goals for structures. Foundation alternatives considered include mat foundations, stone column or deep soil mixing (DSM) ground improvement and shallow foundations, driven piles, and continuous flight auger (CFA) piles. The non-pile-supported alternatives were considered less favorable because of the potential for differential and total settlements across the structure. Of the pile alternatives, driven piles were considered less favorable due to noise and potential vibration considerations adjacent to the neighborhood to the west. CFA piles were therefore selected as the preferred alternative for the majority of the site. Based on discussions with B&V, we understand all new building slabs will also be pile supported to meet the project performance requirements.

Factored loads for the electrical facilities are approximately 175 kips and still being developed for the surge tanks, air-receiver pad, and valve vault. We estimated capacities for CFA pile diameters of 24, 30, and 36 in. to support the electrical facilities, surge tanks, air-receiver pad, and valve vault. The subsurface conditions vary somewhat across the upper site, and the recommendations presented in Table 4.4 are intended to apply to the conditions in the general vicinity of the electrical facilities and surge tanks, which are currently planned on the western portion of the upper site, as well as the valve vault and air-receiver pad located adjacent to the caisson structure on the lower site. Based on review of the logs, the interface between the Willamette Silt and Troutdale Formation is approximately at elevation 120 ft near the electrical facilities and surge tank at the upper site and about elevation 65 ft in the vicinity of the caisson structure in the lower site. These values should be revisited for other areas of the project site. The ultimate unit skin frictions and end-bearing values can be utilized for design with the specified minimum FS. End bearing should be neglected for all static-load cases as well as uplift-load cases. To account for the effects of downdrag on the CFA piles, we recommend the seismic-load case consider an additional downdrag (negative) load on the pile equal to 65 kips per ft of pile diameter at the upper site and 100 kips per ft of pile diameter at the lower site.

Table 4.4: **ULTIMATE CFA PILE CAPACITIES AND FACTORS OF SAFETY FOR ELECTRICAL BUILDINGS AND SURGE TANKS**

	Static Loading	Seismic Loading
Ultimate Unit Skin Friction		
Within Willamette Silt	0.5 ksf	Neglect
Within Troutdale Formation	1.5 ksf	1.5 ksf
Ultimate End Bearing		
Within Willamette Silt	NA	NA
Within Troutdale Formation	Neglect	25 ksf
Factor of Safety		

	Static Loading	Seismic Loading
For Compression	2.0	2.0
For Uplift	3.0	2.0

For static loading, we estimated maximum static settlements on the order of ½ in. for individual elements. We should review the static-settlement recommendations considering group effects once a pile layout and load schedule have been finalized. For seismic-load combinations with a maximum allowable load of 175 kips, we estimate an additional ½ to 1 in. of settlement depending on selected CFA diameter. This additional settlement should be considered in addition to static settlements. If necessary, seismic settlements can be reduced by lengthening the CFA piles and neglecting the end-bearing resistance. For static loading, vertical pile springs can be estimated assuming the allowable capacities and ½ in. of settlement. For seismically induced loading, the springs should be softened to accommodate an additional ½ to 1 in. of settlement under the design load.

The capacities provided above are based on soil-support considerations and may be limited by structural properties, which should be evaluated by the structural engineer. The estimated resistances provided above assume the CFA piles will have a center-to-center spacing of at least 3D, where D is the diameter of the drilled shaft.

Seismically induced settlements of the pile-supported buildings will be relatively small compared to the estimated free-field settlements, and design detailing will need to consider the differential settlement of utilities. The differential settlement between the structures and utilities can conservatively be assumed similar to the free-field estimated soil settlements.

4.6.1 Lateral Loading for Deep Foundations

We anticipate the lateral loading of deep foundations will be evaluated by B&V using the computer software LPILE developed by Ensoft, Inc., of Austin, Texas.

Recommended input parameters for the various soil units for LPILE analysis are tabulated below for static and seismic loading conditions. For seismic loading conditions, the recommended parameters for soil conditions experiencing cyclic softening were evaluated using the relationship between initial soil density and P-multiplier, as recommended by Brandenberg et al. (2007).

Table 4.5: SOIL PROPERTIES FOR LPILE ANALYSIS FOR LOWER SITE

		LPILE	Soil Properties			P-Multiplier for Seismic Loading
Soil Unit	Elevations, ft	Soil Type	g′, pcf	c, psf	e50	
Willamette Silt (above water table)	Ground Surface to 78 ft	Soft Clay	115	700	0.012	1.0
Willamette Silt (below water table)1	78 to 65	Soft Clay	53	550	0.015	0.3
Troutdale Formation	Below 65	Stiff Clay without Free Water	57	3000	0.006	1.0

Notes:

1) Submerged soils below the groundwater level assumed at a depth of approximately 47 ft.

Table 4.6: SOIL PROPERTIES FOR LPILE ANALYSIS FOR UPPER SITE

Soil Unit	Elevations, ft	LPILE Soil Type	Soil Properties			P-Multiplier for Seismic Loading
			g’, pcf	c, psf	e50	
Willamette Silt (above water table)	Ground Surface to 132 ft	Soft Clay	115	1000	0.012	1.0
Willamette Silt (below water table)1	132 to 120	Soft Clay	53	1000	0.015	0.3
Troutdale Formation	Below 120	Stiff Clay without Free Water	57	3000	0.006	1.0

Notes:

1) Submerged soils below the groundwater level assumed at a depth of approximately 48 ft.

It should be noted that LPILE provides isolated single-pile capacities. Depending on the direction of the loading and layout of the piles, group effects may need to be considered. Group effects can be modeled in LPILE by applying an appropriate P-modifier in non-liquefiable soils. The P-modifier is a function of the center-to-center pile spacing and tabulated below.

Table 4.7: MODIFIERS FOR GROUP EFFECTS

Center-to-Center Pile/Shaft Spacing	P-Modifiers for Rows 1, 2, and 3+
3D	0.8, 0.4, 0.3
5D	1.0, 0.85, 0.7

Notes:

For cyclically softening conditions, the P-modifier is 1.0.

Passive earth pressures against embedded pile caps can be computed on the basis of an equivalent fluid having a unit weight of about 250 pcf. The amount of horizontal deformation required to mobilize passive earth pressures is a function of the thickness of the pile cap and the type and consistency of soil surrounding the pile cap. We estimate horizontal movements on the order of 0.5 to 1 in. will be required to mobilize this passive earth pressure at the site. This passive earth pressure and anticipated displacement would be applicable only if the backfill for the pile caps is placed as granular structural fill and above the groundwater level.

In addition to the lateral loading induced on the piles from the inertial loading of the structures, any piles located in zones of estimated laterally induced soil movement will need to consider the kinematic loading or soil displacements. In accordance with the performance criteria, the maximum lateral soil movement for structures is 2 in., and this displacement should be distributed over the entire section of saturated Willamette Silt. This movement is typically modeled as soil displacements within LPILE.

4.6.2 Installation Criteria

CFA piles are constructed by drilling to the required depth using a continuous-flight, hollow-stem auger and pumping high-strength grout or concrete down the stem of the auger as it is withdrawn. A reinforcing cage is generally placed in the fluid grout in the upper portion of the pile to resist lateral loads, and a full-length center bar is installed to limit shrinkage cracking or transmit loads across sections of minor defect and resist uplift. In addition, the full-length center bar provides a means to evaluate construction of the shaft below the rebar cage. Without the full-length center bar, there is no practical way to evaluate integrity of the pile below the rebar-cage elevation during installation. Therefore, we recommend all CFA piles be installed with full-length center bars to provide proper quality control.

We recommend all non-redundant (i.e., one pile per column) CFA piles be evaluated with either Cross Hole Logging (CSL), Thermal Integrity Profiler (TIP), or Pile Integrity Testing (PIT) equipment to confirm pile integrity. Additionally, we recommend a minimum of 5% or three elements (whichever is more) be evaluated using full-depth TIP installed on the center bar. The estimated CFA pile capacities provided above assume the piles will be constructed in accordance with Section 1810.4.8 of the 2018 IBC and the specifications we developed for the piles. Portions of the site are mantled with fill over Willamette Silt and then Troutdale Formation. The Troutdale Formation contains zones of gravel and cobbles, usually contains scattered boulders and open-work zones capable of accepting large volumes of grout or concrete, and may contain layers or zones of gravel that exhibit slight to moderate cementation. The presence of cobbles, boulders, open-work zones, and cemented zones may impact the efficiency and cost of CFA pile installation and should be addressed in the contract documents. Based on our experience in the area, it is common for CFA piles to require concrete volumes greater than 130% above the theoretical pile volume when installed in gravel and cobbles.

CFA piles at this site will develop a large portion of their compressive capacity in skin friction within the underlying Troutdale Formation, which contains zones of gravel, cobbles, and possible scattered boulders; therefore, the following equipment requirements and construction procedures will be incorporated into the construction specifications:

1) The grout exit hole should be a maximum of 6 in. above the tip of the auger.

2) After the auger has been advanced to the design depth, the auger should be positively rotated for a brief period while grout is being pumped through the auger.

The successful construction of CFA piles requires experienced operators, proper equipment, and close observation of the installation by geotechnical engineering staff. Prior to mobilizing to the site, the specialty contractor should provide a description of the proposed pile-installation equipment, accessories, and procedures to the project team for review.

We recommend a continuous record of actual pile installation for each pile be maintained by qualified personnel at the time of installation in accordance with Section 1705.8 of the 2018 IBC. These records should be maintained for the full depth of penetration of the pile and provided to the geotechnical engineer prior to acceptance of the pile installation.

4.7 Subdrainage and Floor Support

At this site, a shallow, perched groundwater table can develop during periods of intense rainfall. For this reason, it is appropriate to install a granular base course/drainage blanket beneath floors embedded below the ground surface. A subdrainage successfully used on similar projects includes placement of a minimum 10-in.-thick granular base course/drainage layer below the floor slab. The granular layer should consist of open-graded, crushed rock of up to 1½-in. maximum size having less than about 2%

passing the No. 200 sieve (washed analysis), as indicated in the Free-Draining Granular Fill section of this report. The upper 2 in. of the granular layer can consist of ¾-in.-minus crushed rock having less than about 5% passing the No. 200 sieve (washed analysis).

Depending on the contractor's methods, it may be practical to incorporate the drainage blanket as part of the granular working pad, if required.

Each layer of the underslab rock can be installed as a single loose lift and compacted by at least five passes with a moderately heavy vibratory roller. Prior to placement of the granular base course, any areas of soft-silt subgrade should be overexcavated and backfilled with structural fill.

4.8 Embedded Structures

Design lateral earth pressures on the walls of embedded structures depend on the drainage condition behind the wall and the ability of the wall to yield. The two possible conditions regarding drainage include providing drainage to the area behind the embedded wall or designing the structure to withstand the hydrostatic pressure.

The two possible conditions regarding the ability of the wall to yield include the at-rest and active earth pressure cases. The at-rest earth pressure case is applicable to a wall that is relatively rigid and laterally supported at the top and bottom and therefore unable to yield. The active earth pressure case is applicable to a wall capable of yielding slightly away from the backfill by either sliding or rotating about its base. A conventional cantilevered retaining wall is an example of a wall that develops the active earth pressure case by yielding.

Assuming the top of the backfill will be horizontal and the backfill completely drained, yielding and non-yielding walls can be designed on the basis of hydrostatic pressures based on equivalent fluid unit weights of 35 and 50 pcf, respectively. These loads assume backfill consists of either compacted on-site soils or compacted imported crushed rock. Additional lateral pressures due to surcharge loadings in the backfill area can be estimated using the guidelines provided on Figure 4.8.1. Typical drainage details for embedded structures are shown on Figure 4.8.2.

In any areas where it is not practical to completely drain the backfill and the embedded walls will be designed as undrained and watertight structures, yielding and non-yielding walls can be designed on the basis of hydrostatic pressures based on equivalent fluid unit weights of 80 and 90 pcf, respectively. In addition, a watertight structure should be designed to resist buoyancy. A common method used to resist buoyancy is to increase the thickness of the base slab and/or extend the base slab beyond the sidewall of the structure. The forces resisting uplift would include the weight of the structure as well as the buoyant weight of the backfill material placed directly over the portion of the base slab that extends beyond the wall of the structure. The effective weight of submerged backfill should be evaluated using a buoyant unit weight of 55 pcf, which assumes all backfill will consist of granular material.

To account for seismic loading, recommendations provided by Agusti and Sitar (2013) were employed to develop lateral earth pressures on embedded footings or walls. The design PGA for evaluating the dynamic seismic lateral earth pressures is based on the geometric mean maximum considered earthquake (MCE_G) PGA adjusted for Site Class D in accordance with Section 21.5 of ASCE 7-16. Using

Agusti and Sitar's (2013) method, the static lateral earth pressures should be increased by an equivalent fluid unit weight of 30 pcf for non-yielding walls and 16 pcf for yielding walls with a level back slope. This results in a triangular distribution with the resultant acting at $^1/_3$H up from the base of the wall, where H is the height of the wall in feet. The lateral force induced by an earthquake is in addition to the lateral earth pressures acting on the wall during static conditions.

Overcompaction of the backfill behind walls should be avoided. In this regard, we recommend compacting the backfill to about 95% of the maximum dry density (ASTM D698). Heavy compactors and large pieces of construction equipment should not operate within 5 ft of any embedded wall to avoid the buildup of excessive lateral pressures unless the walls have been designed to accommodate these pressures. Otherwise, compaction close to the walls may need to be accomplished using hand-operated vibratory-plate compactors.

4.9 Pipeline Design and Construction Considerations

4.9.1 General

The majority of the pipeline will be installed through the Willamette Silt unit. Portions of the pipeline will also be installed through fills surrounding the caisson.

4.9.2 Soil Parameters

The following table provides soil properties for design of the new raw-water pipeline. We anticipate the majority of the pipeline will be within the Willamette Silt above groundwater; however, we have provided additional parameters for materials below groundwater as well. Additionally, elastic moduli (E′) in the range of 8,000 to 50,000 psi can be assumed for crushed-rock backfill within the trench backfill.

Table 4.8: STATIC SOIL PROPERTIES FOR PIPELINE DESIGN

		Soil Properties		
Soil Unit	**Elevations, ft**	**Total Unit Weight, pcf**	**Su, psf**	**Phi**
Willamette Silt (above water table)	Varies	110	0	30
Willamette Silt (below water table))	Varies	110	2,000	0
Troutdale Formation	Varies	115	3,000	0

4.9.3 Peak Ground Velocity

To help evaluate the seismic performance of the new raw-water pipeline, we understand B&V is evaluating the pipeline stresses. In accordance with the program's Seismic Guidelines and Minimum Design Requirements (WWSP, 2018), preliminary peak ground velocities (PGV) were developed to support this evaluation. These values were developed from our Total Stress Analysis (TSA) site-response modeling for the soil layers associated with the anticipated pipeline depths of 0 to 20 ft. Table 4.9 presents the average, lower-bound, and upper-bound PGV values from our analysis.

Table 4.9: ESTIMATED PEAK GROUND VELOCITY

Level	PGV (ft/sec)
Median	2.03
Lower-bound	1.78

Level	PGV (ft/sec)
Upper-bound	2.90

4.9.4 Buoyancy

The majority of the pipeline will be embedded at depths less than 20 ft, which is significantly above the permanent groundwater table for consideration of buoyancy. The pipeline segment east of the trenchless crossing was recently modified to a deeper, buried, non-trenchless crossing and should be evaluated for buoyancy based on the range of groundwater levels observed and potential flood conditions. The potential for buoyancy will likely be highest near Arrowhead Creek, where less soil cover is present.

4.9.5 Soil Corrosion Characteristics

Corrosion index testing was performed with samples of soil collected in 13 borings across the site. The results of the laboratory testing are included in Appendix F of the Geotechnical Data Report (GRI, 2018b).

4.9.6 Utility Excavation

We anticipate utility trenches will be either shored or shielded. Dewatering of utility trenches will also depend on groundwater levels at the time of construction. Depending on the depth of the trenches and groundwater levels at the time of construction, it may be necessary to overexcavate the trench bottoms to place granular stabilization material and facilitate dewatering. The appropriate thickness of trench-bottom stabilization material depends on conditions exposed at the time of construction and is typically on the order of 6 to 30 in. in addition to the normal 6-in.-thick lift of pipe-bedding material. Clean, coarse-graded, up to about 2-in. maximum size, well-graded, crushed rock with less than about 5% passing the No. 200 sieve is typically used for this purpose. Seepage, if encountered, can likely be controlled by pumping from sumps in the trench excavation.

4.10 Trenchless Crossing Considerations

4.10.1 General

B&V submitted a June 14, 2018, Trenchless Crossing Design Technical Memorandum (Trenchless TM) summarizing the trenchless-crossing alternatives. Stahelli supported B&V in the trenchless-crossing design and will be preparing a geotechnical baseline report for the project. We understand pipe ramming is currently being considered for the trenchless crossing on the north side of the existing Arrowhead Creek bridge. At this time, we understand the preferred alternative is shown in Figure 2-3 of the Trenchless TM. This alternative includes a jacking pit on the west side of the alignment with a vertical riser. The pipeline on the east side of the alignment will transition up to existing grades in a shored excavation.

4.10.2 Shoring Considerations

The deep excavation for the west-side jacking pit will be made in proximity to existing improvements, and the excavations will be shored to support existing improvements and excavation sidewalls. The selected shoring method will likely be selected by the contractor. For preliminary planning, the shoring can be designed using the lateral earth pressure criteria shown on Figure 4.10.1. As noted on the figure, surcharge loads due to construction operations must be added to the earth pressures presented on the figure. Figure 4.8.1 can be used to evaluate surcharge-induced lateral loads. We recommend any proposed shoring system be designed by a licensed engineer registered in Oregon.

4.11 Pavement Design

The following pavement sections are based on our experience with similar facilities and subgrade materials and assume the pavement subgrade consists of on-site silt soils compacted as recommended for structural fill or firm, undisturbed silt in cut sections.

Table 4.10: AC PAVEMENT SECTION RECOMMENDATIONS

AC Pavement Use	Minimum Base Course Thickness, in.	Minimum Asphaltic Concrete Thickness, in.
Parking for automobiles and light trucks	8	3
Access roads and areas subjected to truck traffic	12	4

Table 4.11: PCC PAVEMENT SECTION RECOMMENDATIONS

PCC Pavement Use	Minimum Base Course Thickness, in.	Minimum Portland Cement Concrete Thickness, in.
Loading-dock access	6	7

The recommended pavement sections should be considered minimum thicknesses, and it should be assumed some maintenance will be required over the life of the pavement (15 to 20 years). The sections are based on the assumption pavement construction will be accomplished during the dry season and after construction of the building has been completed. If wet-weather pavement construction is considered, it will be necessary to increase the thickness of crushed-rock base course to support construction equipment and protect the subgrade from disturbance. It should be emphasized the pavement sections may not be adequate for the support of intense, heavy construction traffic.

Pavement-area subgrades should be proof rolled with a loaded dump truck prior to and after the placement of the base course. Soft areas identified by proof rolling should be overexcavated and backfilled with structural fill. All workmanship and materials should conform to the applicable standards of the Oregon Department of Transportation (ODOT) Standard Specifications for Highway Construction.

5.0 SEISMIC MITIGATION

5.1 Caisson Mitigation

5.1.1 Existing Raw Water Caisson Background

The existing caisson consists of a 48-ft-internal-diameter, reinforced-concrete structure with 54-in.-thick walls. During construction, records show the site immediately surrounding the caisson was dewatered, allowing for excavation down to the lower slab. The construction of a mud slab was included down to about elevation 26 ft to plug the bottom of the caisson prior to placing the actual caisson floor. The top of the finished floor at the bottom of the caisson is at elevation 34 ft. Construction methods consisted of placing cast-in-place concrete in half sections of the caisson in 20-ft-high vertical lifts; four total lifts were completed to reach the base of the pump-station floor slab at elevation 114 ft. The pump-station floor slab is a 12-in.-thick slab set at elevation 115 ft.

Technical Memo 2.1.3 (GRI, 2018c) documented free-field lateral soil deformations at the top of the caisson were estimated to be up to about 2 ft. These deformations were considered excessive for the target lateral deformations developed by B&V to meet the WWSP caisson-performance objectives. The following sections discuss the seismic mitigation considered to date.

5.1.2 Seismic Mitigation Overview

The seismic hazards to infrastructure near the crest of the slope are being controlled by the presence of a saturated layer (below the groundwater table) of the Willamette Silt unit near the contact with the underlying Troutdale Formation. The loss of strength within this unit due to seismic loading results in lateral and vertical deformations in the saturated and overlying Willamette Silt soils. However, smaller slope deformations would also occur without liquefaction due to the relatively steep slopes, large PGAs at the 2,475-year hazard level, and long-duration ground motions associated with the contributing subduction-zone ground motions. As stated in Section 1.3, for structures subjected to seismically induced horizontal and vertical permanent movements, B&V recommends designing mitigation that will limit the total movement of structures to less than 2 in. (horizontal) and 1 in. (vertical).

5.1.3 Identification of Seismic Mitigation Alternatives

To address the requirement to limit lateral and vertical deformations to the target values, a range of mitigation alternatives was identified and evaluated, including dewatering, vibroflotation/stone columns, compaction grouting, DSM, jet grouting, structural elements (such as piles and drilled shafts), and structural elements with ground improvements. Below is a brief description of each of these mitigation alternatives.

- Dewatering – Dewatering is the installation of either vertical or horizontal wells that pump (actively) or gravity drain (passively) to remove water from the targeted (screened) zone. In soil types conducive to effecting dewatering (e.g., moderate to high permeability), this approach can effectively lower groundwater levels, mitigating hazards associated with liquefaction of saturates soils.

- Vibro-Flotation/Stone Columns – For these techniques, a mandrel is inserted into the ground using a combination of its weight, vibration, and compressed air and/or water. Once the mandrel reaches the design elevation, either native clean sands (vibro-flotation) or angular crushed rock (stone columns) are inserted into the hole the mandrel created. The mandrel is then used to compact the sand/stone into lifts. This process is repeated until the mandrel reaches the ground surface. These methods generally densify coarse-grained soils or reinforce fine-grained soils with dense, granular materials. The risk of liquefaction is thereby reduced through the increase in density or reduction in stress due to reinforcement.

- Compaction Grouting – Compaction grouting is performed by driving or drilling a hollow grout pipe to the desired depth in the soil profile. After reaching the desired depth, low-slump concrete is pumped under pressure through the hollow grout pipe and into the soil formation creating a localized "grout bulb" and densifying granular soils or reinforcing fine-grained soils. As the grout pipe is incrementally withdrawn, concrete pumping continues at each stage creating a "bulb-shaped" concrete column and improving/reinforcing the surrounding soils.

- Deep Soil Mixing – DSM is performed by drilling a large, rotary cutter head or a large paddle-wheel assembly into the ground. As the assembly drills into the ground, it mixes the soil and injects cement grout. Depending on the soil type, required product strength, and drilling conditions, the operator can adjust the rate of rotation, advancement, or cement injection to ensure a uniform, homogenous soil-mixed column. Due to the injection of the cement binder, DSM can create a significant amount of spoils. The amount of spoils can vary greatly depending on the type of mixing performed (dry versus wet).

- Jet Grouting – Jet grouting consists using high-velocity jets to mix cement with the surrounding soils to create a soil-cement grout. The jets are located at the bottom of a sectional casing commonly advanced to depth with a track-mounted drill rig. Jet grout is commonly installed in circular columns as the drill stem is rotated and raised through the target depth of treatment. Optional air and water jets are commonly used to aid in erosion of the soil, which results in an increase in the column diameter. Due to the injection of the cement, jet grout can create a significant amount of spoils. The amount of spoils can vary greatly depending on the type of jetting performed but may approach 100% of the treated-soil volume.

- Structural Elements – Structural elements commonly consist of variations of either cantilever or tied-back drilled-shaft alternatives. The drilled-shaft alternatives include isolated drilled shafts, tangent pile walls, and secant pile walls, with variations dependent on the spacing and overlap of the drilled-pile elements. Driven piles can also be considered but are less commonly installed in constrained-access locations on steeply sloping sites. The drilled-shaft diameters and wall types are selected based on the loading conditions and performance criteria. If site access and soil conditions are suitable, the use of drilled shafts supplemented with tiebacks is common for an efficient wall design (relative to cantilevered walls). A tieback anchor is typically installed by drilling a cased hole to the desired depth into the bearing layer, placing a reinforcing bar or strands to the bottom of the hole, and pumping grout under pressure to form a bond zone as the casing is withdrawn.

Section 5.1.4 describes the key considerations utilized to pre-screen the initial group of mitigation alternatives to a range of preferred techniques.

5.1.4 Pre-Screening of Prospective Seismic Mitigation Alternatives

A pre-screening exercise was completed to evaluate the larger range of ground-improvement and structural-mitigation options commonly utilized in waterfront slope-instability mitigation. At any site, the following are key considerations for selecting a preferred mitigation technique:

- Required ground-motion parameters (i.e., seismic loading).

- Soil profile.

- Target allowable deformation criteria for the mitigated case.

In addition, the following constraints were also important considerations for the pre-screening phase of this project:

- Existing infrastructure and utility conflicts.
- The proposed location of new infrastructure.
- Permitting constraints, including the existing Joint Permit Application and the City of Wilsonville Significant Resource Overlay Zone (SROZ).
- Site topography and access for large construction equipment.
- Potential long-term impacts to the City of Wilsonville Park.
- Environmental considerations (e.g., construction vibration, noise, spoils).

Table 5.1 provides a brief list of advantages and disadvantages for the larger list of ground-improvement techniques. Based on review of advantages, disadvantages, and known site constraints, dewatering, compaction grouting, stone columns, and DSM were removed from the primary list of alternatives to undergo further evaluation. The key factors summarizing the removal of these techniques from further consideration during this pre-screening exercise are summarized below:

- Dewatering – This technique was removed from further consideration because the elevations for passive systems did not work out relative to the elevation of saturated soils and river elevations. An active or pumped system was not considered practical due to the low permeability of the soils, subsequent relative large number and extent of wells, and long-term pump maintenance in low-flow conditions.
- Compaction Grouting – This technique was removed from consideration due to the primarily fine-grained soil profile at the site and the relative lack of stiffness of the smaller-diameter ground-improvement elements.
- Stone Columns – Like compaction grouting, this technique was removed from further consideration due to it providing less benefit and fewer stiffness improvements in fine-grained soils than other alternatives. The larger required footprint of mitigation combined with larger, crane-mounted construction equipment would also be a significant clearing and temporary-staging consideration on the site.
- Deep Soil Mixing – While DSM can be very effective in the soil types encountered on site, a gridded formation of overlapping elements are required to meet the project performance criteria. The required clearing, benching, and temporary staging to install these elements may be impractical depending on the acceptable level of riverbank disturbance in front of the caisson.

Therefore, based on the pre-screening process, mitigation alternatives that involve a combination of ground improvement (e.g., jet grouting, DSM, etc.) and structural elements were selected for conceptual design development.

Table 5.1: ADVANTAGES AND DISADVANTAGES OF SEISMIC MITIGATION ALTERNATIVES

Mitigation Type	Advantages	Disadvantages
Dewatering	■ Relatively inexpensive.	■ Elevations do not work for passive systems. ■ Large footprint and maintenance considerations for active pumping system.
Vibro-Flotation and Stone Columns	■ Relatively inexpensive.	■ Will not meet performance guidelines in fine-grained soils. ■ Does not work with site constraints.
Compaction Grouting	■ Relatively inexpensive.	■ Not as effective in fine-grained soils. ■ Small diameter is typically less effective for lateral loading and not suitable for caisson deformation criteria.
DSM	■ Limited ground-surface deformations/vibrations. ■ Effective in most soil types.	■ Equipment requires relatively large, flat work surface. ■ Moderately expensive. ■ Spoils disposal.
Jet Grouting	■ Effective in these soils. ■ Limited footprint. ■ Can more easily be installed around existing utilities.	■ Most-expensive ground-improvement method. ■ Control of spoils can be challenging, and they require disposal.
Structural Mitigation	■ Deformations easier to estimate. ■ Effective in all soil types.	■ Equipment required to install large-diameter elements needs a relatively flat work surface. ■ May not meet some lateral/vertical displacement criteria without ground improvement.
Structural Mitigation with Ground Improvement	■ Most-robust alternative.	■ May require multiple contractors. ■ Relatively expensive. ■ Construction of structural elements may require temporary grading of the lower slope.

5.1.5 Description of Selected Seismic Mitigation Alternatives

As discussed above, alternatives with ground improvement, structural elements, or a combination of ground improvement and structural elements were the primary alternatives advanced for further analysis. The following sections provide additional background on ground-improvement and structural alternatives and then focus on modeling results and subsequent design refinements.

5.1.5.1 Ground Improvement

Jet grouting was initially advanced as the preferred ground-improvement technique in front of the caisson for the following reasons: 1) it can typically achieve higher unconfined compressive strengths of improved soil compared to other ground-improvement methods; 2) smaller, track-mounted drill rigs can be used to install the drilled elements; 3) the technique can target-treat zones of interest and be installed at angles; and 4) it would require less site clearing than most other alternatives. With the more-recent inclusion of an extended area of ground improvement to the west (see Section 5.2), we anticipate DSM could also be an alternative for at least a portion of the ground-improvement section. For modeling purposes, the report discussion is intended to treat the performance of either of these techniques in a similar manner.

5.1.5.2 Structural Walls

In addition to a larger, targeted zone of ground improvement installed from the upper portion of the slope, a lower structural wall was also initially evaluated in front of the caisson (i.e., downslope, or riverward) to evaluate the significant lateral-spreading hazards identified in the conceptual design phase. Due to concerns regarding the proximity of the intake pipe and riverbank slope, vibratory or impact driving of large-diameter pipe piles was not considered as a preferred alternative. Therefore, a wall consisting of adjacent drilled shafts (such as tangent piles) was initially evaluated for the lower-wall design. For the soil conditions and limited amount of available working space on the lower slope, the team limited the pile size on the lower slope to a maximum diameter of about 4 ft to allow consideration of CFA drilling equipment. CFA installation does not require temporary casing and can usually be completed in a smaller footprint as the concrete is pumped into the drilled hole as the auger is withdrawn.

The type, capacity, and quantity of large construction-equipment rigs are dependent on the diameter and height of the drilled shafts. For example, larger, 10-ft-diameter, cantilever, drilled shafts installed between the top of the slope and the existing pump station were selected as one of the preferred alternatives during the conceptual design phase. In reviewing alternatives, it was acknowledged the installation of 10-ft-diameter drilled shafts could have a smaller construction disturbance than other alternatives. However, initial analyses to evaluate the performance of the cantilevered, 10-ft-diameter shafts showed they would not meet the project's target lateral-deformation criteria of less than 2 in. for the caisson. In addition, the construction staging for large-diameter structural wall elements would be a significant consideration at the top of the slope. Additional significant challenges to solve with this approach include 1) likely utility conflicts in the plant area east of the caisson, 2) impacts to WRWTP access-road availability due to construction staging, and 3) requirements for significant offsets from the existing buried clearwell to avoid damage.

5.1.6 Modeling of the Selected Seismic-Mitigation Alternative

Prior to modeling the selected mitigation alternative, GRI completed preliminary FLAC evaluations of the conceptual mitigation schemes. The results of this analysis indicate the conceptual mitigations would not meet the relatively tight deformation criteria to meet project LoS goals. As a result, a rather-robust mitigation scheme was modeled within FLAC to meet the program's design requirements and LoS goals. The design advanced to date includes a ground-improvement buttress largely installed between the caisson and the crest of the slope and a tied-back wall installed on the lower slope. The riverside portion of the modeled ground-improvement block was sloped to reduce rotations observed in previous mitigation approaches and measures approximately 80 ft tall, 20 ft wide at the top, and 65 ft wide at the base. The top of the ground-improvement block is at elevation 114 ft and extends approximately 25 ft into the Troutdale Formation to elevation 34 ft. The tieback-supported wall consists of tangent-drilled shafts approximately 4 ft in diameter with tiebacks that anchor into the base of the jet-grout block.

The results of these analyses indicate the selected mitigation alternative can meet the deformation criteria to meet the LoS goals. A detailed description of the geotechnical approach to model the selected mitigation alternative within FLAC is included in Appendix D. The following sections briefly describe the approach to develop the caisson stresses and soil-structure interaction methodology, pipeline-mitigation analyses, and downslope-mitigation analyses.

5.1.6.1 Caisson Stresses

Dynamic and kinematic loads on the caisson with downslope mitigation were developed using FLAC and an analysis approach similar to that described in Section 4.5.4. The caisson was modeled using elastic plane-strain solid elements that incorporate side shear forces at the caisson boundary using interface elements. Structural properties of the caisson were calibrated to the 3D STAAD model as described in Appendix D. Three-dimension soil-structure interaction effects were approximated using a shape factor of 1.5. The remediation was included by modeling a continuous ground-improvement buttress using Mohr-Coulomb elements.

Net loads on the caisson were computed at each time increment, approximately every 0.01 to 0.02 sec, throughout the earthquake. Critical snapshots (concurrent response estimates) corresponding to peak caisson forces for each motion were averaged to develop a recommended lateral earth pressure diagram. In general, maximum moment in the river-side direction of the caisson was the controlling condition. Applied loads during shaking were found to be substantially higher than the residual load at the end of shaking. The averaged lateral earth pressure diagram for loading in this direction is provided on Figure 38D. Since these design loads reflect net loading, the 3D structure analysis does not require lateral soil springs with the use of these loads.

For comparison, B&V requested alternative design loads, including a range of soil spring stiffnesses, be prepared for the 3D analysis. The range of soil springs and loads were developed to be consistent with the FLAC-analysis results described in Appendix D and are shown on Figure 39D. Specific methodologies used to develop caisson stresses and soil springs are summarized in Appendix D.

5.1.6.2 Downslope Mitigation Analyses

The selected mitigation scheme discussed above is a robust mitigation scheme initially modeled within FLAC to meet the program's design requirements and performance goals. As part of this mitigation scheme, the FLAC modeling incorporated a lower tieback-supported tangent pile wall to mitigate large slope movements on the river side of the ground-improvement block. Subsequent FLAC and limit-equilibrium slope-stability analyses indicated the risk of large slope movements in the Willamette Silt between the ground-improvement block and river is significantly lower than estimated during the conceptual-design phase.

Following this design effort, the project team evaluated several smaller mitigation schemes for the pipelines extending west from the caisson, where allowable deformations are increased. Modeling results for the smaller ground-improvement block west of the caisson indicated the soils downslope were not deforming enough to impact the screens in the water, which suggested the possibility of removing the lower tieback-supported drilled-shaft wall from the mitigation scheme.

To further investigate the removal of the lower wall, additional FLAC analyses were completed with a revised caisson model that did not include the lower drilled-shaft wall. For these analyses, the crustal and subduction-zone input motions that produced the most-significant deformations from the previous analyses were rerun. Results of these analyses indicated only minimal increases in the caisson deformation that still satisfied the 2-in. performance criteria. Seismic deformations of material on the river side of the ground-improvement block did increase, but for analyses performed using best-estimate soil properties, the ground displacements were typically less than a few feet. Additionally, the timing and scale of deformations is indicative of a ratcheting-type movement and not a deep-seated flow failure that would lead to extensive run-out of debris tens of feet into the river.

The results of these FLAC analyses are also supported by case histories of liquefaction-induced flow slides. As documented by Olson and Stark (2002), flow failures have only been observed in soils with $(N1)_{60}$ blow counts less than about 12 blows/ft, which is lower than the material characterization at this site. To further evaluate the risk of a flow failure, a post-seismic deformation analysis was performed using FLAC to assess the effect of residual strength on simulated deformations. Reviewing the results of the dynamic FLAC model indicated the saturated Willamette Silt did not achieve full liquefaction. However, as a conservative evaluation of large deformations, we assumed the entire saturated Willamette Silt layer liquefied by the end of shaking, and the strength in this layer was set equal to the liquefied residual strengths outlined in Table D.1. These analyses indicated estimated slope displacements are still relatively modest after the post-seismic analysis, with deformations generally less than 5 ft for soils downslope of the jet-grout mitigation. A subsequent parametric evaluation was completed assuming an additional 15% reduction applied to the estimated residual soil strengths, again assuming the saturated Willamette Silt was fully liquefied. These analyses with residual strengths indicated slope deformations could increase for the average deformation response but are unlikely to extend to the intake screens.

In addition, a series of in-water explorations were completed in December 2018 to evaluate the thickness of soft, deformable alluvium over the stiffer underlying Troutdale Formation. Results of this work are presented in an addendum to the Geotechnical Data Report. While our preliminary analyses assumed 7 ft of soft alluvial soils, the additional explorations indicate this layer is generally thinner, with depths ranging between about 1 and 4.5 ft.

The results of the additional analyses indicate a low risk of flow failure or significant additional caisson deformations if the lower tieback-supported wall is removed from the mitigation scheme. Based on these parametric analyses and results, we recommend advancing the mitigation design with the ground-improvement block and eliminating the tieback-supported wall considered in earlier phases of design. Also, although the sediment thickness in the river was somewhat less than previously assumed, we still recommend including the pile-supported "catchment" system in the river. The "catchment" system would be a physical barrier to the screens to help address the uncertainty present in the evaluation of seismically induced slope deformations involving the potential movement of soil through the water column adjacent to the intake screens. Based on our analyses and in-water explorations, we recommend the "catchment" system be designed to accommodate seismically induced lateral soil loading based on an equivalent hydrostatic pressure with a fluid unit weight of 30 pcf. We recommend the design consider this loading begins approximately 2 ft below mudline and extend approximately 2 ft above mudline for a total height of applied load of approximately 4 ft. We understand hydraulic loading on the piles is being evaluated by others.

5.2 Pipeline Mitigation Alternatives

The conceptual design for the project indicated the pipeline would likely be supported on piles to mitigate the vertical differential settlement. As part of this scope of work, the differential settlement criteria outlined in Section 7.8 of the June 2018 WWSP Seismic Guidelines and Minimum Design Requirements (WWSP, 2018) were reviewed to assess mitigation of vertical settlements. Based on the review of the allowable differential settlements, the estimated vertical differential settlements were not anticipated to exceed the thresholds for butt-welded joints. Therefore, mitigation of the vertical differential settlements for areas away from additional lateral slope movements is not anticipated.

The primary pipeline-mitigation alternatives were then focused on areas of the site where free-field vertical settlements were combined with estimated lateral movements for either the free-field or mitigated conditions. For the west ravine site, several mitigation alternatives, including varying pipe offsets from the slope, were considered for mitigating the combined horizontal and vertical displacements. These alternatives and analyses are summarized in Section 4.5. The team has also met and discussed alternatives for structural walls, ground improvement, or additional pile support of the pipeline through the park if the recommended offsets are not acceptable.

As indicated in Section 4.5, the team evaluated larger deformation criteria along the Willamette River slope to the west of the caisson. Pipeline-mitigation modeling efforts focused on utilizing a smaller block of ground improvement without a lower wall. In this area west of the caisson, the current pipeline angles to the northwest, resulting in varying offsets from the crest of the slope. A FLAC model was evaluated with the following ground-improvement dimensions: 20 ft wide by 50 ft tall. Similar to the larger block of ground improvement considered for the caisson mitigation, the base of this block is keyed into the underlying Troutdale Formation. To evaluate the seismic behavior of the western pipeline-mitigation conditions, a single ground motion that produced the most-significant deformation of the crustal motions and average displacements out of all seven motions was input into the model and run. Based on this analysis, the total estimated peak maximum composite displacements for the pipeline would be about 7 in., which would meet the program's displacement criteria. These displacement estimates assumed the centerline of the pipeline is located at least 15 ft back from the riverside face of the zone of ground improvement. The modeling approach and analyses are summarized in Appendix D.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 Earthwork

6.1.1 General

Our experience indicates the fine-grained soils at the site are moisture sensitive and above their optimum moisture content for compaction during the majority of the year. When these soils are in excess of their optimum moisture content, they soften and become unstable when subjected to construction traffic. As a result, the contractor must employ construction equipment and procedures that prevent disturbance and softening of the subgrade soils. Placement of granular structural fill concurrent with excavation will be necessary to support construction traffic and protect the underlying subgrade. Additionally, it should be understood a significant depth of uncontrolled fill is present at the upper site. We understand this material came from construction of the WRWTP.

The following section discusses site preparation in additional detail.

6.1.2 Site Preparation

As previously discussed, the project site is covered with a variety of vegetation, including grasses, mature trees, and shrubs. Therefore, the ground surface within areas of mass grading or the limits of proposed structures and hardscape improvements should be stripped of vegetation, surface organics, and loose surface soils. Strippings will not be suitable for use as structural fill and should be disposed of off site or used in landscaped areas. We anticipate the average stripping depth will be on the order of 6 in. to remove the surface organics. Deeper grubbing will be necessary to remove stumps and heavy tree roots. Upon completion of site stripping or excavation to subgrade level, the exposed subgrade should be evaluated by a qualified member of GRI's engineering/geological staff. Any areas of soft or unsuitable material should be overexcavated to firm, undisturbed soil and backfilled with structural fill.

As discussed in the subsurface conditions, the upper site has significant thicknesses of uncontrolled fill. This fill will need to be removed to undisturbed subgrade where improvements will be located.

During and following stripping and/or the removal of uncontrolled fill, the contractor must use care to protect the subgrade from disturbance by construction traffic. The use of wide-track bulldozers or trackhoes equipped with smooth cutting edges rather than scrapers would be most appropriate to minimize the potential for subgrade disturbance during excavation. We further recommend the contractor plan the earthwork operations such that heavy construction traffic is not permitted on exposed, untreated, fine-grained subgrades. Following stripping, the exposed surface should be evaluated by the contractor and the geotechnical engineering staff to detect any loose, soft, or disturbed areas that may require additional stripping or overexcavation and replacement with structural fill. Proof rolling with a fully loaded dump truck or other heavy, rubber-tired vehicle may be part of the evaluation.

We recommend all construction traffic be limited to movement on granular work pads or haul roads to avoid remolding and softening the exposed fine-grained subgrade soils, especially during wet weather. Generally, a minimum of 12 to 24 in. of relatively clean, fragmental rock placed over a geotextile fabric is required to protect the subgrade depending on the intensity of the construction traffic and the previous treatment of the subgrade. In areas where piles are to be installed, we recommend the geotextile fabric be omitted; however, the granular work pads should consist of a minimum of 24 in. of relatively clean, fragmental rock having a maximum particle size between ¾ and 1½ in. In heavy traffic areas, such as those areas that may be subjected to a large number of dump trucks or heavier off-road, wheeled, earth-moving equipment, 24 in. or more of rock may be necessary to adequately support this traffic, particularly during wet weather. The use of a geotextile fabric, such as AMOCO 2006 or similar product, between the granular work-pad materials and underlying, untreated, subgrade soils serves as a separation layer to limit the movement of fines into the crushed rock. The use of a geotextile fabric tends to reduce maintenance of the section during construction.

Lime and/or cement treatment of subgrades would serve to moisture condition the subgrade, improve its load-carrying capacity beneath heavy equipment traffic during subsequent fill or base-course placement, and provide a reasonably hard surface against which to begin compacting the first lift of structural fill or base course. Equipment is available to provide treatment depths of up to 12 to 16 in. The actual depths of treatment and the percentage of admixture used should be evaluated in the field by the contractor and geotechnical engineering staff on the basis of the relative consistency of the subgrade soils, the percentage of clay or organic content in the soils, and natural moisture content of the soils at the time of subgrade preparation. Additional recommendations regarding the use of soil admixtures, such as lime and cement, are provided in the following sections of this report.

6.1.3 Structural Fill

6.1.3.1 General

All structural fill materials should be compacted to at least 95% of the maximum dry density and at a moisture content within about 3% of optimum, as determined by ASTM D698, or until well keyed. The contractor's compactive effort should be evaluated on the basis of field observations and density testing. Moisture contents should be adjusted accordingly by either wetting or drying the soil, and lift thicknesses should be proportionate to the type of compaction equipment used to meet compaction specifications.

Organic-rich strippings will not be suitable for reuse as structural fill and should either be disposed of off site or used in landscaped areas. Fill in landscaped areas should be placed at about 90% of the maximum dry density as determined by ASTM D698. The moisture content of soils placed in landscaped areas is not as critical as soils placed in developed or paved areas, provided the contractor's equipment can effectively handle the material. Additional information regarding specific types of fill and soil treatment using admixtures is provided below.

6.1.3.2 Select Granular Fill

We recommend all fill placed within the footprints of and around major structures consist of imported select granular fill. Granular material, such as sand, sandy gravel, or fragmental rock with a maximum size of about 4 in. and not more than about 5% passing the No. 200 sieve (washed analysis), would be suitable structural-fill material. Lift thicknesses should be based on the type of compaction equipment used. For example, the first lift of granular fill placed over a fine-grained subgrade should be about 18 in. thick and subsequent lifts about 12 in. thick when using medium- to heavy-weight vibratory rollers.

6.1.3.3 Fine-Grained Fill

Use of the on-site, fine-grained soils for structural fill material is limited to the dry season, when the moisture content of these materials can be controlled and drying can be accomplished, if necessary, prior to fill placement. This is typically accomplished by plowing, disking, or tilling to aerate thin lifts over large borrow and fill areas. Drying rates depend on weather factors, such as wind, temperature, and relative humidity. Fine-grained fill should be spread in about 8- to 12-in.-thick lifts and compacted using medium- to heavy-weight, segmented-pad rollers. If fine-grained fill soils are compacted at a moisture content higher than recommended, the specified densities cannot be achieved, and the fill material will be relatively weak and compressible.

6.1.3.4 Treated Soils

To treat subgrades or facilitate the construction of structural fills, admixtures such as lime or cement may be mixed with fine-grained soils as an alternative to extensive aeration of on-site soils. The amount of admixture required will depend on the moisture, clay content, and organic content of the existing soil and must be determined at the time of construction. In the past, typical admixtures of 5 to 8% lime or cement based on the dry weight of the treated soil have been successfully implemented. Lime treatment principally serves to hydrate excessive soil moisture; cement treatment hydrates excessive moisture and significantly improves the strength properties of a fine-grained subgrade or structural fill.

Treatment is accomplished by spreading a measured quantity of lime or cement onto the surface and tilling 12 to 16 in. into the subgrade or structural-fill lift using specialized equipment. The treated soils are subsequently compacted with segmented-pad rollers and finished with graders and smooth, steel-drum vibratory rollers. Cement-treated soils are typically cured for a period of 3 to 5 days to maximize their strength gain prior to being trafficked by equipment or placing granular base course.

6.1.3.5 Free-Draining Granular Fill

Free-draining material used for wall drains or for the subdrainage system beneath and around the embedded portions of structures should not have more than 2% passing the No. 200 sieve (washed analysis). Examples of materials that would satisfy this requirement include 1½- to ¾-in., open-graded, crushed rock. Materials such as 1½- and ¾-in.-minus crushed rock typically contain an excessive percentage of fines to meet this requirement. The crushed rock should be hard, durable, and free of excessive fines or other deleterious material. Use of a geotextile fabric is recommended to provide separation between free-draining granular fill and the on-site fine-grained soils or general structural fill.

6.1.3.6 Utility Trench Backfill

Utility trench backfill should consist of granular fill limited to a maximum size of about 3 in. When used in close proximity to new conduits, the maximum size of the material should be about 1 in. unless other requirements call for the use of sand, pea-gravel, or lean-mix concrete for backfill. The granular trench backfill should be compacted to at least 95% of the maximum dry density as determined by ASTM D698 in the upper 4 ft of the trench and to at least 90% of the maximum dry density below this depth. The use of hoe-mounted vibratory-plate compactors is usually most efficient for this purpose. Lift thicknesses should be evaluated on the basis of field density tests; however, particular care should be taken when operating hoe-mounted compactors to prevent damage to the newly placed conduits. Flooding or jetting as a means of compacting the trench backfill should not be permitted.

6.2 Dewatering Considerations

As currently planned, the Arrowhead Creek trenchless crossing is planned at a similar elevation to the existing treated-water pipeline that was also installed utilizing trenchless methodologies. The proposed invert on the west side of the site will be approximately 100 ft, which is at least 20 ft below the measured groundwater table in the area. The dewatering system utilized during construction of the existing pipeline is unknown; however, the contractor indicated seepage and flooding of the jacking-pit excavation during the summer months. Explorations completed near the existing pipeline alignment indicate the near-surface soils generally consist of Willamette Silt and/or silt fill underlain by a gravel and cobble unit of the Troutdale formation. In general, the gravel and cobbles unit of the Troutdale formation contains varying portions of silt, sand, and boulders. The trenchless crossing is proposed in a portion of the upper site where the thickness of the predominantly granular portion of the Troutdale formation generally increases to the east, and the trenchless crossing is anticipated to encounter this unit.

Supplemental explorations and slug tests were performed in August 2018 to support design of the dewatering system. Results of these explorations and slug tests can be found in our revised April 1, 2019, data report.

The gravel, cobble, boulder, and sand contents of the Troutdale formation may require the contractor to install a system of well points installed outside and within the jacking pits to supplement the sump system. The system should be designed to maintain static groundwater levels a minimum of 2 ft below the bottom of the excavation. Due to the significant variability in subsurface conditions and particularly the percentage of fine-grained soil in the Troutdale formation, the depth, number of wells, and quantity of water that will need to be pumped to accomplish the required dewatering is difficult to estimate. Therefore, it will likely be necessary to adjust the number and depth of the wells and the size of the pumps based on the actual conditions encountered. In this regard, it should be anticipated the actual quantity of water pumped from each dewatering well will likely vary widely depending on the subsurface conditions encountered throughout the excavation.

Due to the variability in subgrade conditions, some overexcavation and replacement of the subgrade with stabilization material consisting of clean, open-graded crushed rock will be needed to provide a firm subgrade and accomplish the dewatering. Typically, the maximum gradation for this material ranges from 4 to 6 in. Based on our experience, this drainage blanket material will likely need to be at least 2 ft thick, with the actual required thickness determined at the time of construction. Additional groundwater in the excavations is commonly controlled with a series of sumps installed within the excavation in the open-graded rock.

Zones of relatively clean sand, if encountered, will be subject to “running sand” conditions and can also develop sand boils if significant differential heads are observed within the excavation. Therefore, regardless of the method used by the contractor, any proposed dewatering system should be capable of maintaining groundwater levels below the base of the excavation to maintain a stable excavation subgrade. GRI should review the contractor’s proposed dewatering system prior to mobilization to the site.

6.3 Seismic Mitigation Construction Considerations

This section briefly summarizes additional considerations for constructing the proposed seismic mitigation techniques.

6.3.1 Slope Access

Construction of seismic mitigation features will require clearing and grading of a new access road from the concrete plant located to the east. The road will likely need to be established at grades significantly flatter than the existing temporary access road, where drill rigs have accessed the site.

6.3.2 Ground Improvement Alternatives and Construction Considerations

The generation, containment, and disposal of ground-improvement spoils will also be a significant construction consideration. Jet grouting and DSM can generate soil/cement-grout spoils on the order of 50 to 100% of the treated volumes. The most cost-effective way to dispose of the materials will be to find a location on site where the materials can be stockpiled and allowed to set up. The jet-grout and DSM spoils can be considered for structural fill. Alternatively, the jet-grout and DSM spoils could be hauled off site. Based on experience, the disposal of the spoils on or off site will be a significant cost consideration for the project.

The layout of the ground improvement considered the proximity of jet-grout columns relative to the slope to maintain enough cover for the high-pressure jetting methods of jet grouting. Based on discussions with regional ground-improvement contractors, the minimum cover should be on the order of 10 to 15 ft. The ground-improvement specifications will also include allowances for minimum vertical and horizontal offsets from the existing raw-water intake pipe.

The jet-grouting and/or DSM processes will also require the implementation of a test program to evaluate the selected equipment and processes to create the desired block of ground improvement. We anticipate jet-grout column diameters could be reduced in clayey portions of the Troutdale Formation, and this potential change in diameter will be a key assumption in the specialty subcontractor design. Therefore, we recommend the contracting mechanism include a test program for the specialty subcontractor to establish variations in both column diameters and strengths with depth. In this regard, DSM would have less construction uncertainty, as it will create uniform column diameters with depth. Although jet grouting was originally considered to be the preferred alternative in front of the caisson, the access constraints and typical geometries of the new west mitigation block do not preclude the use of DSM. Additionally, DSM could potentially be used in front of the caisson with significant regrading. It should be understood if the contractor proposes DSM as an alternative to jet grouting, plans should be provided that demonstrate the required temporary grading and regrading within the limits of the project permitting.

For either jet grouting or DSM, the specialty subcontractor will likely perform a pre-installation laboratory bench scale testing program. This effort will require the contractor to mobilize to the site to obtain additional soil samples to support lab testing.

The elevation of the pipeline will need to be considered when constructing ground improvement and the new pipe installation in front of the caisson. We recommend the ground-improvement and pipeline contractor coordinate efforts where the elevations of the pipeline and ground improvement overlap to optimize the final layout and minimize challenging excavation conditions.

7.0 LIMITATIONS

This report has been prepared to aid the engineer in the design of this project. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of the earthwork, foundation support, and seismic mitigation. In the event any changes in the design and location of the proposed improvements as outlined in this report are planned, we should be given the opportunity to review the changes and modify or reaffirm the conclusions and recommendations of this report in writing.

The conclusions and recommendations submitted in this report are based on the data obtained from the subsurface explorations made at the locations indicated on Figures 2.2.1 and 2.3.1 and other sources of information discussed in this report. In the performance of subsurface investigations, specific information is obtained at specific locations at specific times. However, it is acknowledged variations in soil conditions may exist between exploration locations. This report does not reflect any variations that may occur between these explorations. The nature and extent of variation may not become evident until construction. If, during construction, subsurface conditions different from those encountered in the explorations are observed or encountered, we should be advised at once so we can observe and review these conditions and reconsider our recommendations where necessary.

Please contact the undersigned if you have any questions regarding this report.

Submitted for GRI,

74883PE
May 11, 2004
SCOTT M. SCHLECHTER

Renews 06/2020

Scott Schlechter, PE
Principal

Jason Bock, PE
Associate

This document has been submitted electronically.

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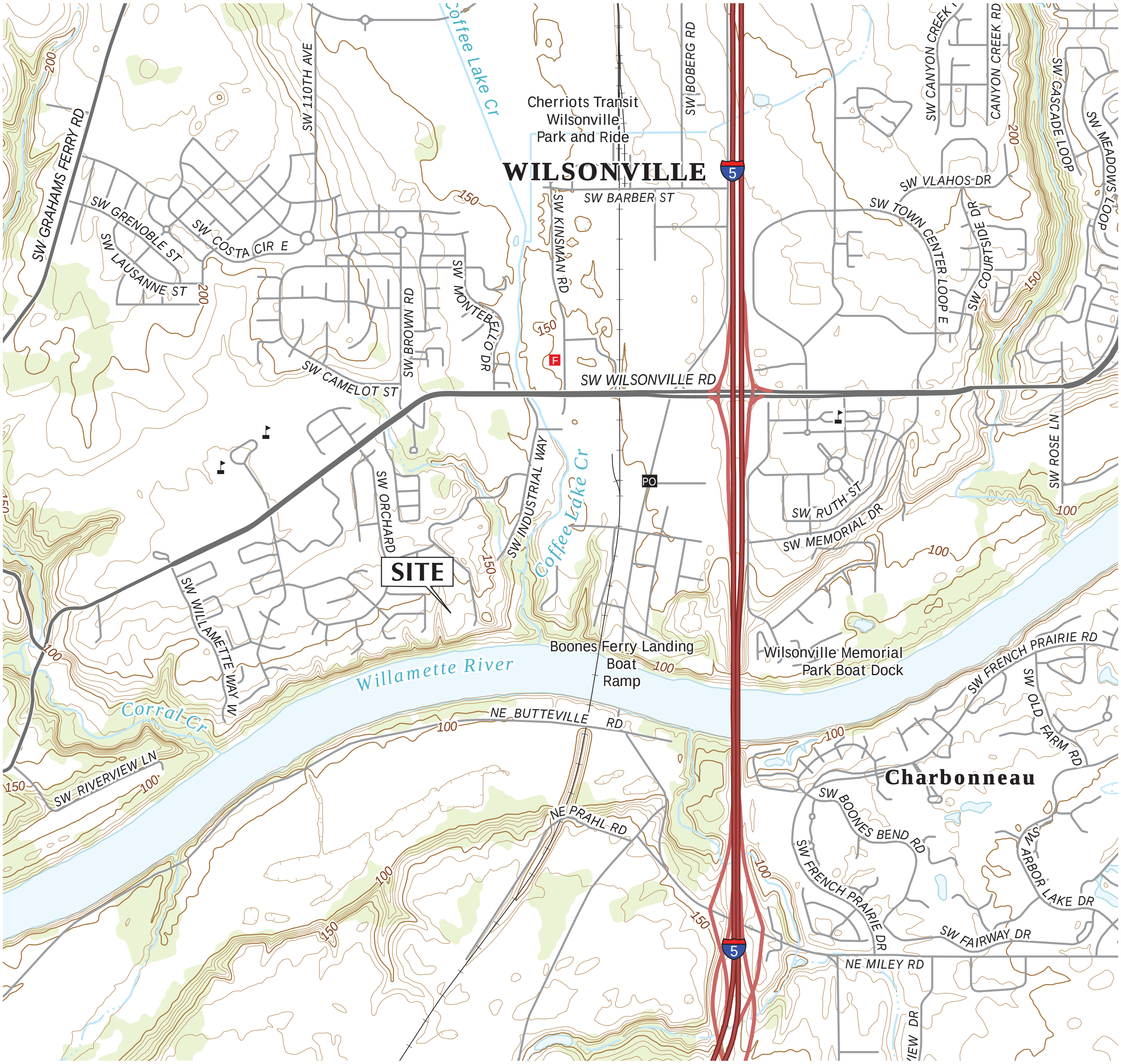

USGS TOPOGRAPHIC MAP
SHERWOOD, OREG. (2017)

North

0 1/2 1 MILE

GRI

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WILLAMETTE RIVER WATER SUPPLY PROGRAM

VICINITY MAP

APR. 2019 JOB NO. 6042 FIG. 1.1

⊕ BORING COMPLETED BY SHANNON & WILSON (2015)

⊙ BORING COMPLETED BY SQUIER (2000)

● BORING AND PIEZOMETER COMPLETED BY GRI (NOVEMBER 6 - 22, 2017)

◒ BORING COMPLETED BY GRI (NOVEMBER 6 - 22, 2017)

■ CONE PENETRATION TEST COMPLETED BY GRI (NOVEMBER 6 - 22, 2017)

⬓ DILATOMETER COMPLETED BY GRI (NOVEMBER 6 - 22, 2017)

A A' CROSS SECTION LOCATION

SITE MAP FROM GOOGLE EARTH PRO, DATED MAY 22, 2017

North

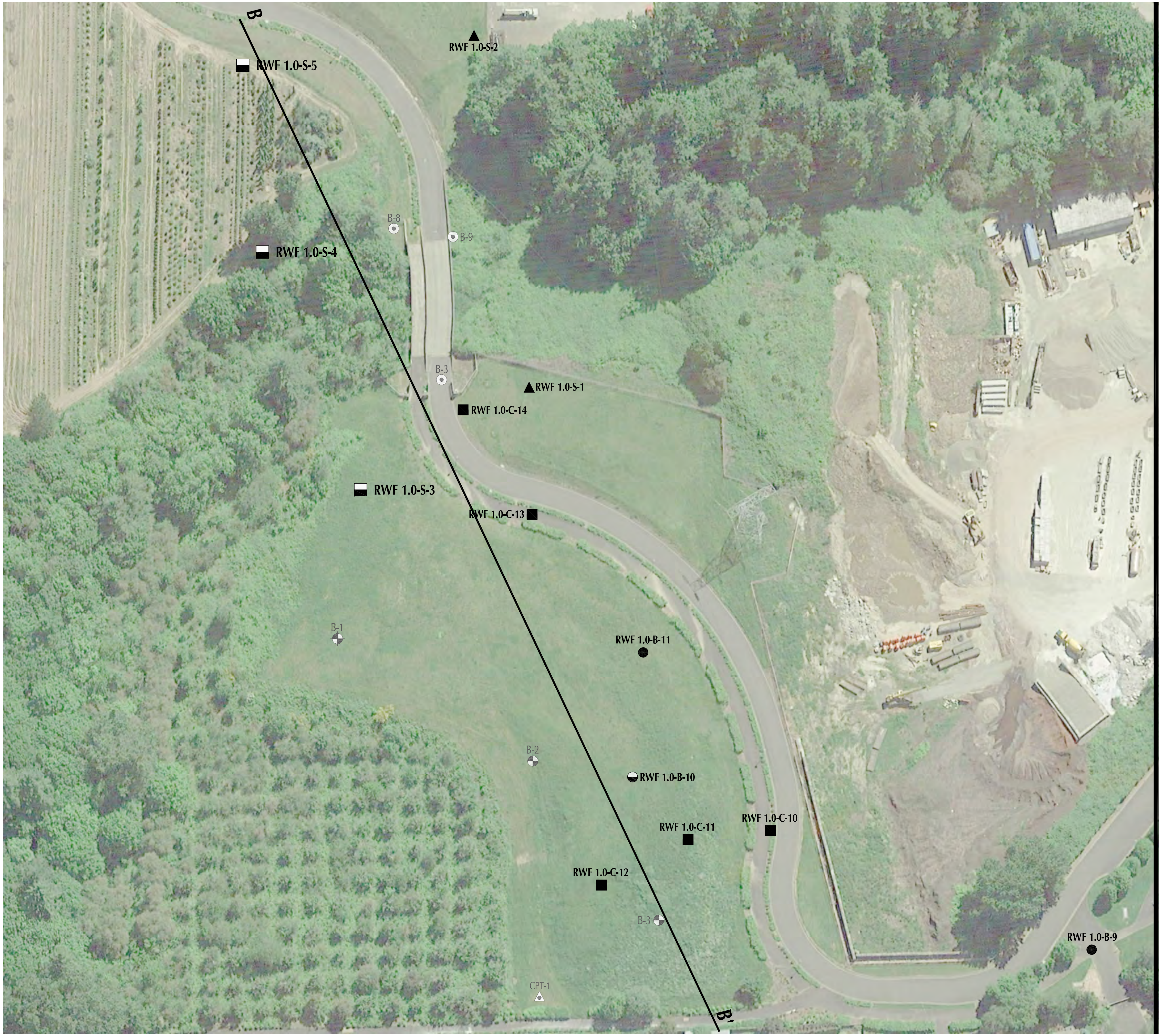
0 100 200 FT

GRI

BLACK & VEATCH
WILLAMETTE RIVER WATER SUPPLY PROGRAM

SITE MAP
(LOWER SITE)

APR. 2019 JOB NO. 6042 FIG. 2.2.1



MATCHLINE SEE FIGURE 2.2.1

● BORING AND PIEZOMETER COMPLETED BY GRI (NOVEMBER 6 - 22, 2017)

◒ BORING COMPLETED BY GRI (NOVEMBER 6 - 22, 2017)

■ CONE PENETRATION TEST COMPLETED BY GRI (NOVEMBER 6 - 22, 2017)

▲ SONIC BORING COMPLETED BY GRI (NOVEMBER 6 - 22, 2017)

⬓ SONIC BORING COMPLETED BY GRI (AUGUST 20-22, 2018)

⊕ BORING COMPLETED BY SHANNON & WILSON (2015)

△ CONE PENETROMETER TEST COMPLETED BY SHANNON & WILSON (2015)

⊙ BORING COMPLETED BY SQUIER (2000)

B B' CROSS SECTION LOCATION

SITE MAP FROM GOOGLE EARTH PRO, DATED MAY 22, 2017

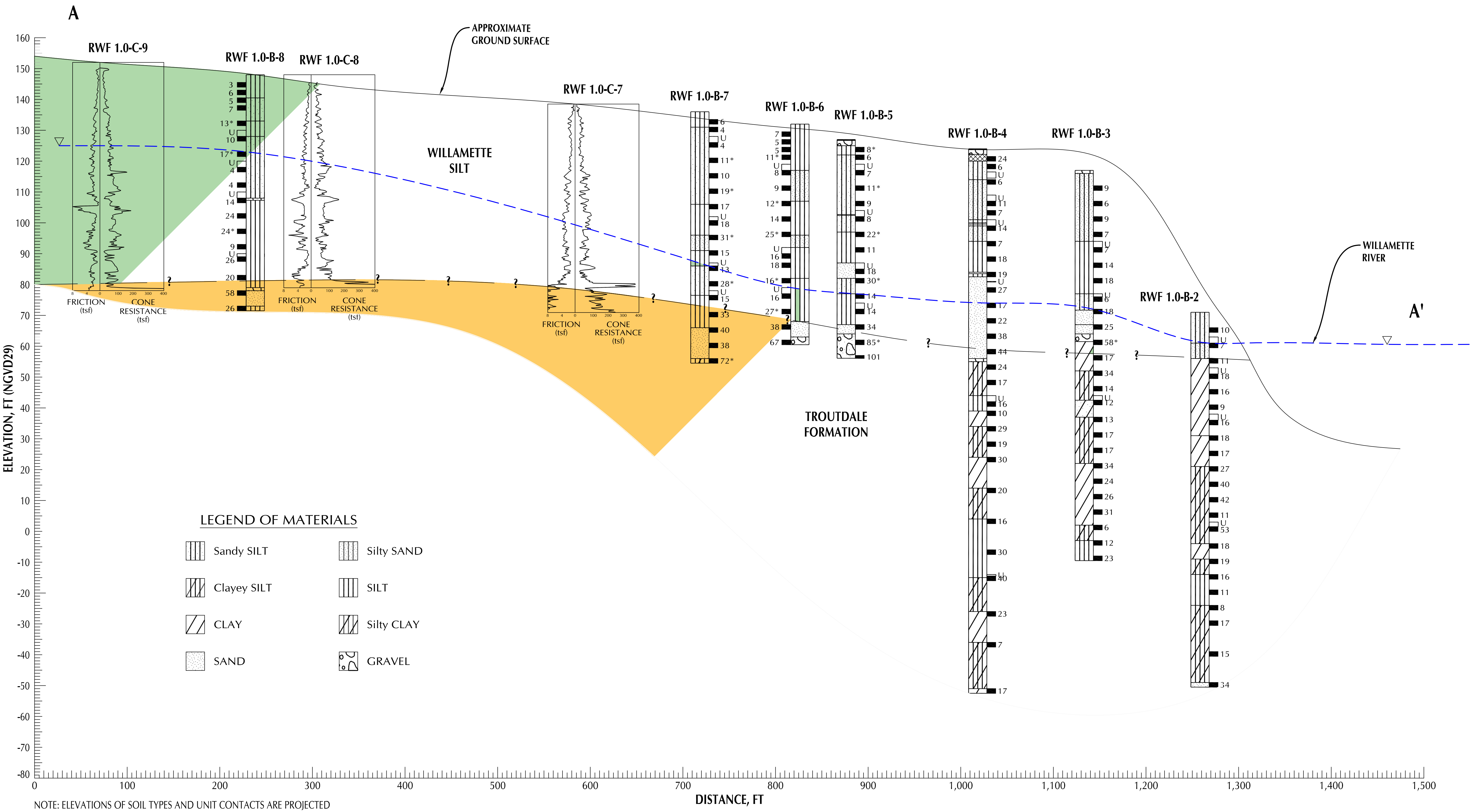
North

0 100 200 FT

GRI BLACK & VEATCH
WILLAMETTE RIVER WATER SUPPLY PROGRAM

SITE MAP
(UPPER SITE)

APR. 2019 JOB NO. 6042 FIG. 2.3.1



NOTE: ELEVATIONS OF SOIL TYPES AND UNIT CONTACTS ARE PROJECTED ONTO CROSS SECTION LINE A-A'

LEGEND

16 ■ SPT SAMPLE AND N VALUE

32* ■ 3-IN. SAMPLE AND N* VALUE

U ☐ UNDISTURBED SAMPLE

☐ ROCK CORE

☐ GRAB SAMPLE

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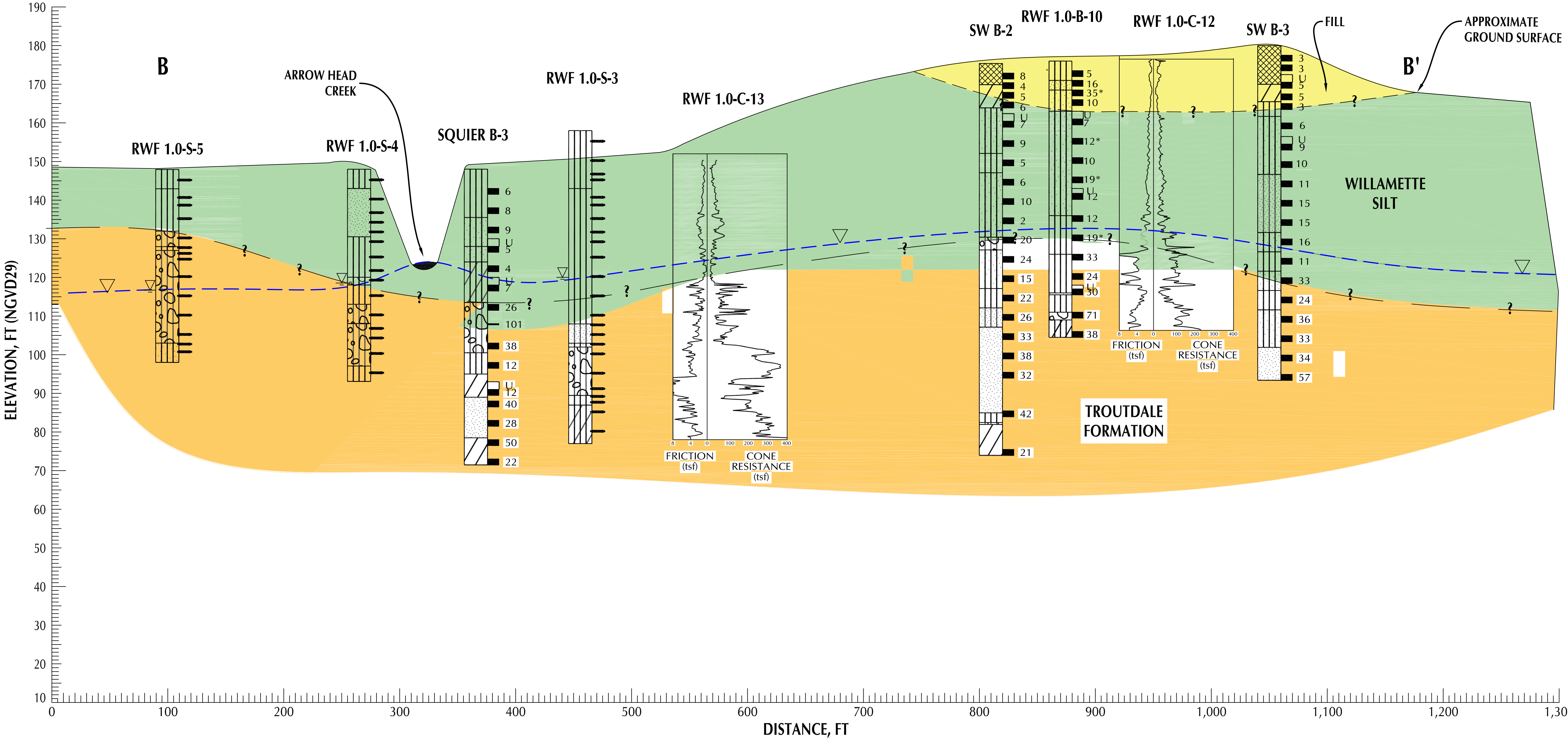
WILLAMETTE RIVER WATER SUPPLY PROGRAM

CROSS SECTION A-A'

APR. 2019 JOB NO. 6042 FIG. 3.1



NOTE: ELEVATIONS OF SOIL TYPES AND UNIT CONTACTS ARE PROJECTED
ONTO CROSS SECTION LINE B-B'

LEGEND

16 ■ SPT SAMPLE AND N VALUE

32* ■ 3-IN. SAMPLE AND N* VALUE

U ☐ UNDISTURBED SAMPLE

☐ ROCK CORE

☐ GRAB SAMPLE

LEGEND OF MATERIALS

▥ Sandy SILT

▨ Clayey SILT

▨ CLAY

▒ SAND

▥ Silty SAND

▥ SILT

▨ Silty CLAY

▒ GRAVEL

GRI

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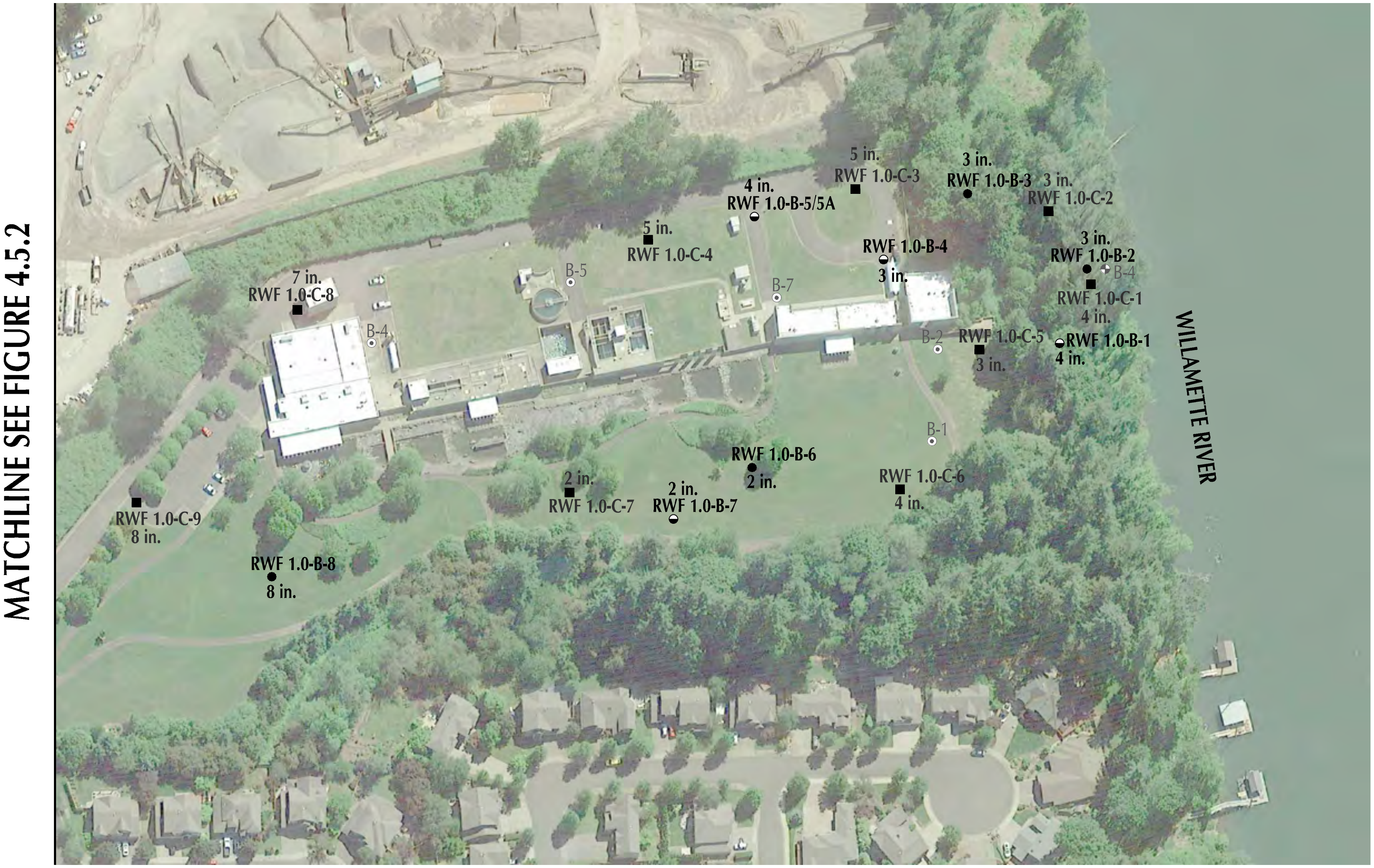
CROSS SECTION B-B'

APR. 2019 JOB NO. 6042 FIG. 3.2



NOTE:

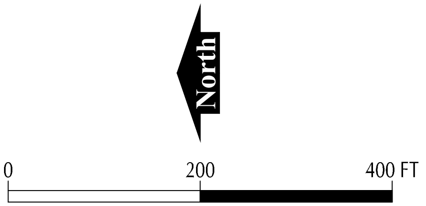
SETTLEMENT PROVIDED ARE BEST ESTIMATES BASED ON SIMPLIFIED PROCEDURE AND DO NOT INCLUDE THE VERTICAL SETTLEMENT DUE TO LATERAL DEFORMATION.

SITE MAP FROM GOOGLE EARTH PRO, DATED MAY 22, 2017

● BORING AND PIEZOMETER COMPLETED BY GRI
(NOVEMBER 6 - 22, 2017)

◒ BORING COMPLETED BY GRI
(NOVEMBER 6 - 22, 2017)

■ CONE PENETRATION TEST COMPLETED BY GRI
(NOVEMBER 6 - 22, 2017)



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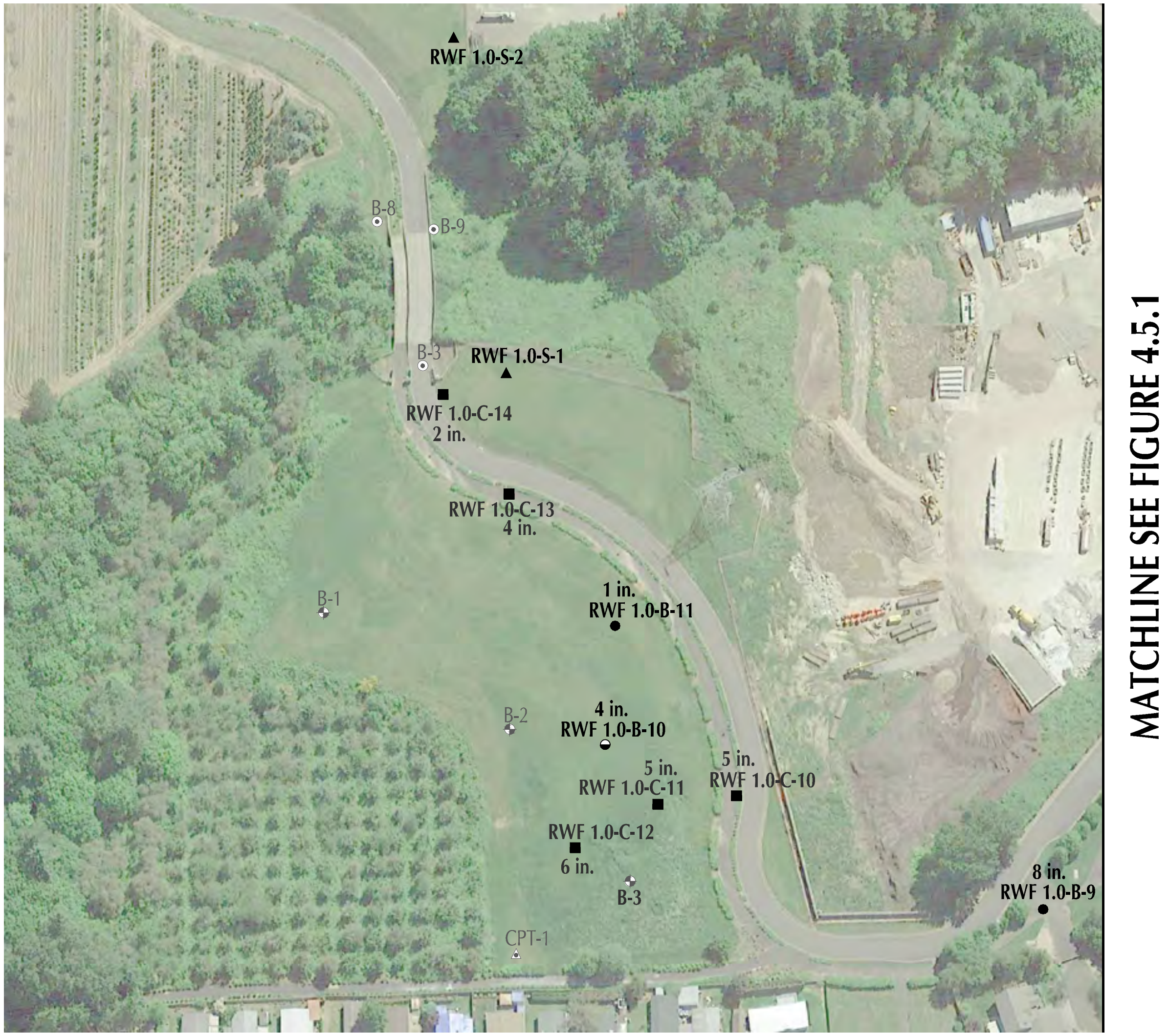
POST SEISMIC RECONSOLIDATION SETTLEMENT

(LOWER SITE)

APR. 2019 | JOB NO. 6042 | FIG. 4.5.1



SITE MAP FROM GOOGLE EARTH PRO, DATED MAY 22, 2017

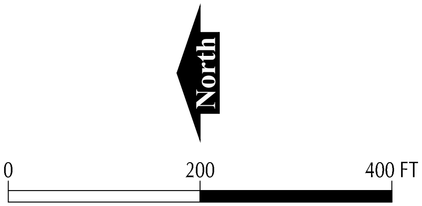
NOTE:

SETTLEMENT PROVIDED ARE BEST ESTIMATES BASED ON SIMPLIFIED PROCEDURE AND DO NOT INCLUDE THE VERTICAL SETTLEMENT DUE TO LATERAL DEFORMATION.

● BORING AND PIEZOMETER COMPLETED BY GRI
(NOVEMBER 6 - 22, 2017)

◒ BORING COMPLETED BY GRI
(NOVEMBER 6 - 22, 2017)

■ CONE PENETRATION TEST COMPLETED BY GRI
(NOVEMBER 6 - 22, 2017)



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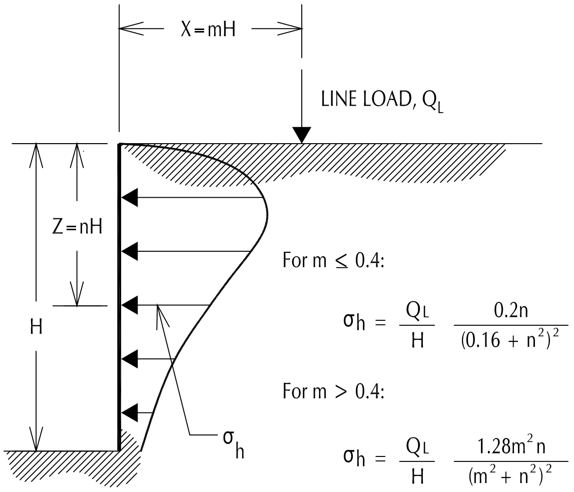
POST SEISMIC RECONSOLIDATION SETTLEMENT

(UPPER SITE)

APR. 2019 | JOB NO. 6042 | FIG. 4.5.2



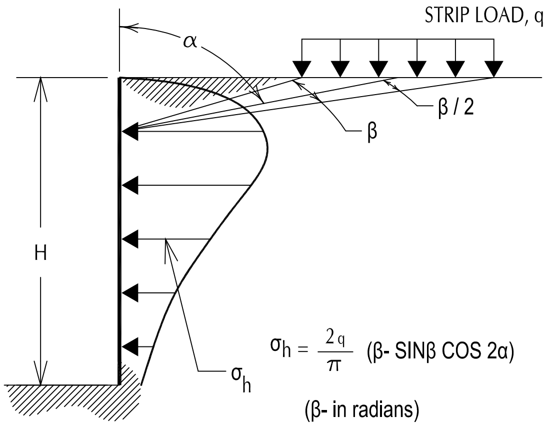
For m ≤ 0.4:

$$\sigma_h = \frac{Q_L}{H}\ \frac{0.2n}{(0.16 + n^2)^2}$$

For m > 0.4:

$$\sigma_h = \frac{Q_L}{H}\ \frac{1.28m^2 n}{(m^2 + n^2)^2}$$

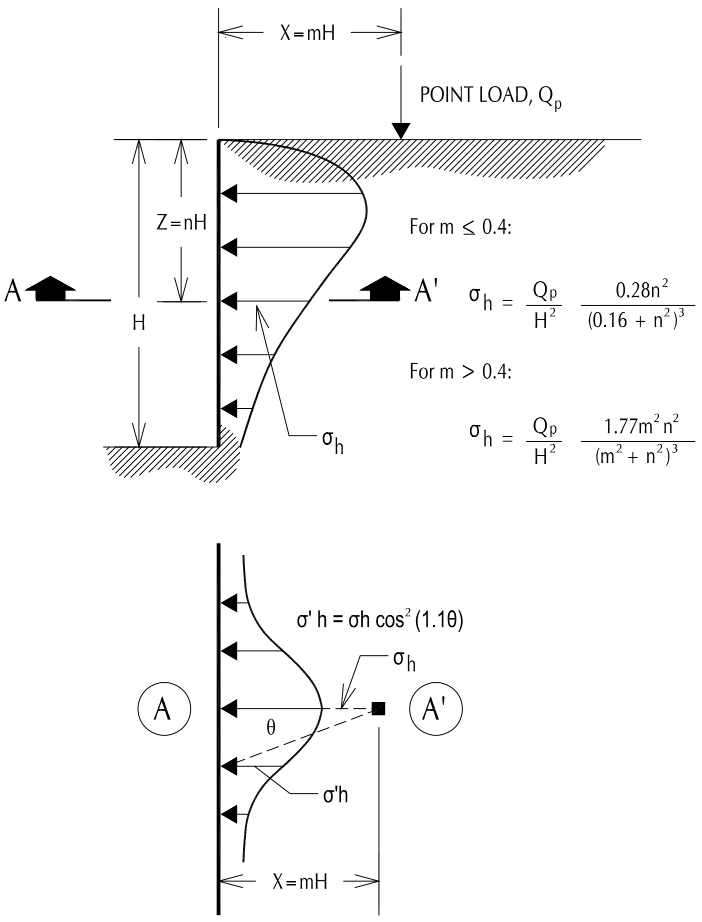
LINE LOAD PARALLEL TO WALL



$$\sigma_h = \frac{2q}{\pi}\ (\beta\text{- SIN}\beta\ \text{COS}\ 2\alpha)$$

(β- in radians)

STRIP LOAD PARALLEL TO WALL



For m ≤ 0.4:

$$\sigma_h = \frac{Q_p}{H^2}\ \frac{0.28n^2}{(0.16 + n^2)^3}$$

For m > 0.4:

$$\sigma_h = \frac{Q_p}{H^2}\ \frac{1.77m^2 n^2}{(m^2 + n^2)^3}$$

DISTRIBUTION OF HORIZONTAL PRESSURES

VERTICAL POINT LOAD

NOTES:

1) THESE GUIDELINES APPLY TO RIGID WALLS WITH POISSON'S RATIO ASSUMED TO BE 0.5 FOR BACKFILL MATERIALS.

2) LATERAL PRESSURES FROM ANY COMBINATION OF ABOVE LOADS MAY BE DETERMINED BY THE PRINCIPLE OF SUPERPOSITION.

GRI

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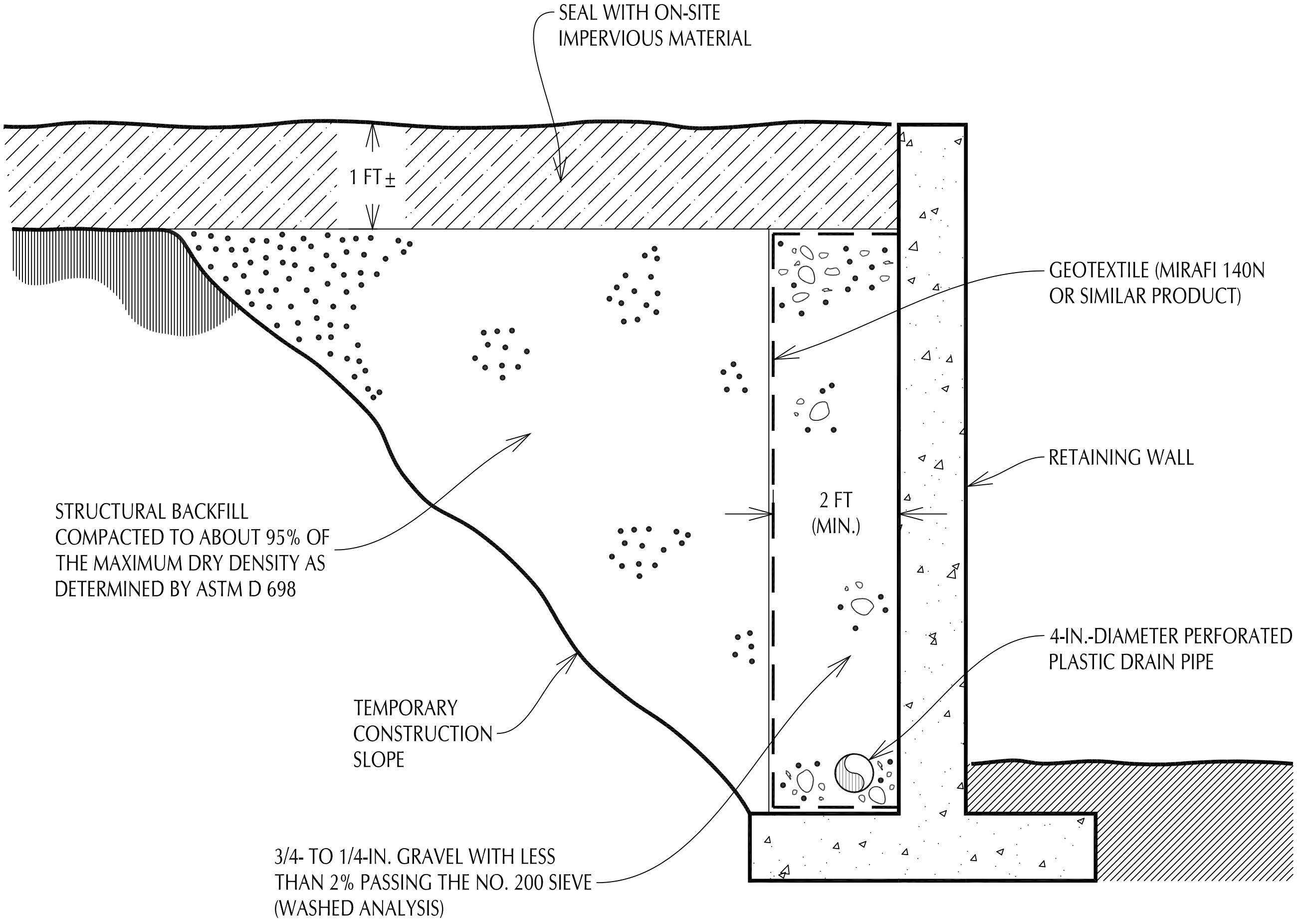
WILLAMETTE RIVER WATER SUPPLY PROGRAM

SURCHARGE-INDUCED LATERAL PRESSURE

APR. 2019 JOB NO. 6042 FIG. 4.8.1



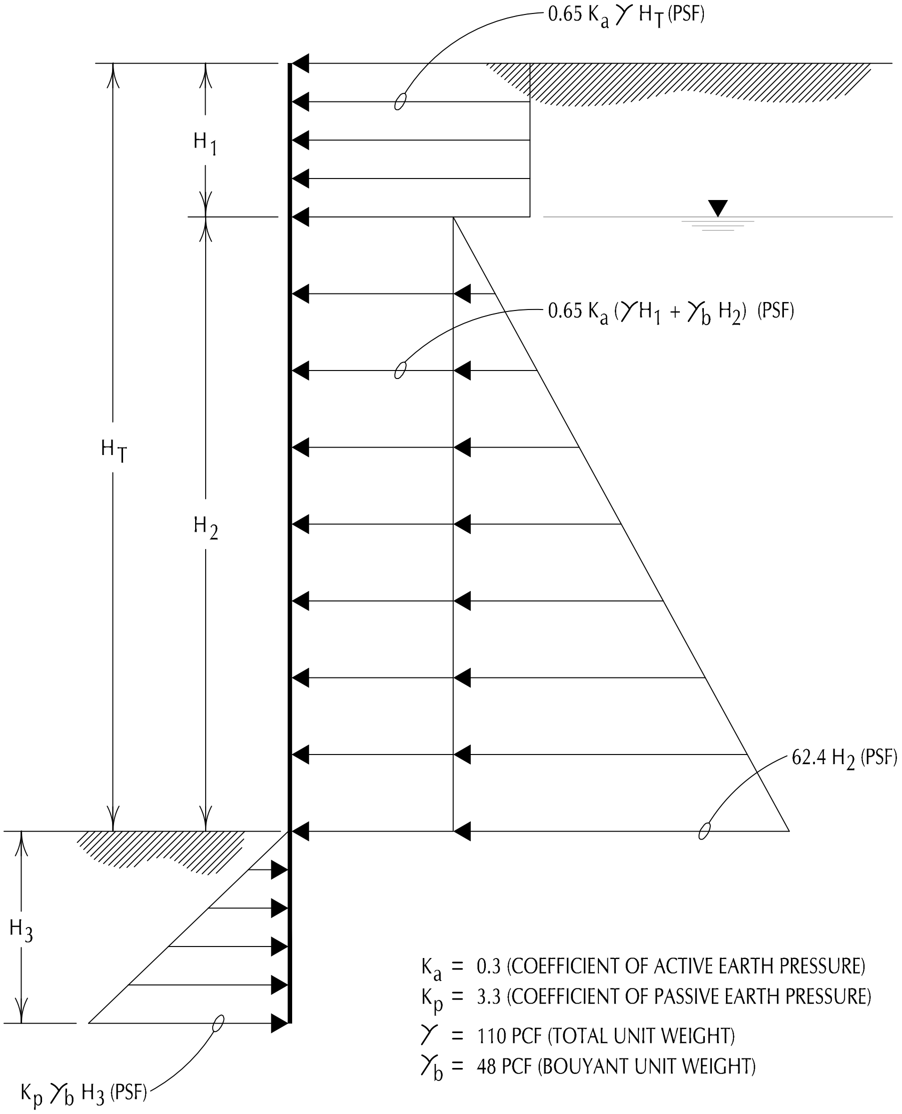
NOT TO SCALE

GRI

BLACK & VEATCH
WILLAMETTE RIVER WATER SUPPLY PROGRAM

TYPICAL SUBDRAINAGE DETAIL

APR. 2019 JOB NO. 6042 FIG. 4.8.2



K_a = 0.3 (COEFFICIENT OF ACTIVE EARTH PRESSURE)
K_p = 3.3 (COEFFICIENT OF PASSIVE EARTH PRESSURE)
γ = 110 PCF (TOTAL UNIT WEIGHT)
γ_b = 48 PCF (BOUYANT UNIT WEIGHT)

NOTE: SURCHARGE EFFECTS FROM TRAFFIC, CONSTRUCTION EQUIPMENT, ETC., SHOULD BE ADDED TO THE ABOVE DESIGN PRESSURES. THE ACTUAL AMOUNT OF THIS SURCHARGE WILL DEPEND ON THE CONTRACTOR'S APPROACH TO THE WORK; HOWEVER, WE RECOMMEND A MINIMUM UNIFORM VERTICAL PRESSURE OF 300 PSF BE ADDED BEHIND THE WALL.

GRI

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WILLAMETTE RIVER WATER SUPPLY PROGRAM

DESIGN OF TEMPORARY BRACED EXCAVATION SUPPORT

APR. 2019 JOB NO. 6042 FIG. 4.10.1

(Geotechnical Design Report appendices available upon request)

Exhibit N: Arborist Report/Tree Survey

HARRITY
TREE SPECIALISTS, INC.
PO BOX 12395
PORTLAND, OR 97212
503-331-0452
harritytree@comcast.net

MATTHEW SANCHEZ
CERTIFIED ARBORIST
PNW/ ISA #7830A
ISA TREE RISK ASSESSMENT
QUALIFIED
CCB #84426

PROVIDING
KNOWLEDGEABLE
CARE FOR TREES
IN THE URBAN
ENVIRONMENT

Attn:
David Evans and Associates, Inc.
2100 SW River Parkway
Portland, OR 97201

RE:
Tree Maintenance and Protection Plan

Site:
Willamette River Water Treatment Plant
10350 Arrowhead Creek Ln
Wilsonville, OR 97070

Date and Time of Visit:
January 22, 2019 @ 1 p.m.
February 2, 2019 @ 9 a.m.
February 7, 2019 @ 8 a.m.
October 23, 2019 @ 12 p.m.

Hello,

Harrity Tree Specialists, Inc. have been tasked with the design of the Tree Maintenance and Protection Plan for the proposed Willamette Water Supply System (WWSS) Raw Water Facilities (RWF_1.0) located at the Willamette River Water Treatment Plant in Wilsonville. The purpose of this plan is meant to identify the trees that will be protected and the methods used to protect those trees. In addition to the methods of protection, the report will discuss the general health of the protected trees.

The original tree and land survey was completed by OTAK in 2018. Harrity Tree Specialists have since field verified the trees for species, size, and health. In addition to the survey, Harrity Tree Specialists have tagged all the trees that are planned for preservation during the proposed site activity.

The site has a mature flat landscape that consists of ornamental and native trees around the main campus of the water treatment plant that gradually turns into a predominately native forest. The native forest turns into a semi steep terrain that steadily slopes into the Willamette river. A majority of the site will remain preserved outside of the proposed RWF _1.0 facilities and temporary access road.

This report is written as a question and answer response to the Section 4.610.40.02 Type C Permit requirements. All answers will be written in *italics*.

Section 4.610.40. Type C Permit

(.02) The applicant must provide ten copies of a Tree Maintenance and Protection Plan completed by an arborist that contains the following information:

All 10 copies will be provided upon final submission of this plan to the City of Wilsonville.

A. A plan, including a topographical survey bearing the stamp and signature of a qualified, registered professional containing all the following information:

1. Property Dimensions. The shape and dimensions of the property, and the location of any existing and proposed structure or improvement.

The property dimensions can be found on attached survey maps of the site.

2. Tree survey. The survey must include:

a. An accurate drawing of the site based on accurate survey techniques at a minimum scale of one inch (1”) equals one hundred feet (100’) and which provides a) the location of all trees having six inches (6”) or greater d.b.h. likely to be impacted, b) the spread of canopy of those trees, (c) the common and botanical name of those trees, and d) the approximate location and name of any other trees on the property.

a) The accurate drawing of the site can be found on attached survey maps of the site.

b) The canopy spread of the trees on site is shown on the provided map.

c) The common and botanical name of trees found on the site can be found at the end of this report.

d) The approximate location and name of any other trees on the property can be found on both survey maps and the spreadsheet.

b. A description of the health and condition of all trees likely to be impacted on the site property. In addition, for trees in a present or proposed public street or road right-of-way that are described as unhealthy, the description shall include recommended actions to restore such trees to full health. Trees proposed to remain, to be transplanted or to be removed shall be so designated. All trees to remain on the site are to be designated with metal tags that are to remain in place throughout the development. Those tags shall be numbered, with the numbers keyed to the tree survey map that is provided with the application.

b) A description of the health and condition of all trees likely to be impacted on the site property can be found on the attached spreadsheet. There are no trees on this site that are considered public street or right of way trees. All trees proposed to remain or be *removed are currently designated on the survey map as red for removal or green for preservation. All trees that are to remain have been tagged with associated survey numbers.*

c. Where a stand of twenty (20) or more contiguous trees exist on a site and the applicant does not propose to remove any of those trees, the required tree survey may be simplified to accurately show only the perimeter area of that stand of trees, including its drip line. Only those trees on the perimeter of the stand shall be tagged, as provided in "b," above.

c) The East section of the property will largely be protected. Perimeter trees have been tagged as required.

d. All Oregon white oaks, native yews, and any species listed by either the state or federal government as rare or endangered shall be shown in the tree survey.

d) Harrity Tree Specialists will show all trees that are rare or endangered. The survey did not identify any Oregon white oaks, yew, madrone, or any other species that would otherwise be considered at risk or endangered.

3. Tree Protection. A statement describing how trees intended to remain will be protected during development, and where protective barriers are necessary, that they will be erected before work starts. Barriers shall be sufficiently substantial to withstand nearby construction activities. Plastic tape or similar forms of markers do not constitute "barriers."

3) All tree protection shall be erected prior to the start of any site work including installation of the temporary service road. To best protect the trees, Harrity Tree Specialists recommend that an erosion fence be installed on the upslope of all trees below major grade changes to not bury trunks and root zones. Harrity Tree recommends that the use of 6' chain link fencing on 8' posts be installed along the route of all major construction activity including temporary roads. The fencing shall be highlighted with tree protection signage that prohibits entry to vehicles, equipment, or persons not associated with the trees directly. The tree protection fencing shall be routinely inspected during the site work for sturdiness and protection efficiency. In areas where chain link fencing is not practical, will encroach into the construction work zone,, or will encroach on the dripline of protected trees, orange construction fencing will be used to denote tree protection, In these instances, a certified arborist will be on-site to monitor active construction work. In the scenario that damage occurs or if there is a concern by equipment operators that damage could occur to a tree(s) the consulting arborist shall be notified immediately to resolve the issue. All tree protection materials shall remain in place throughout the project and removed after final inspection by the City of Wilsonville.

4. Easements and Setbacks. Location and dimension of existing and proposed easements, as well as all setbacks required by existing zoning requirements.

4) All easements and setbacks, if applicable, are designated on the site plans.

5. Grade Changes. Designation of grade changes proposed for the property that may impact trees.

5) The designation of grade changes proposed for the property that may impact trees have been highlighted on the attached site maps.

6. Cost of Replacement. A cost estimate for the proposed tree replacement program with a detailed explanation including the number, size and species.

6) A cost estimate for the removal of all trees on this site shall be in the form for one to one replacement of similar native species. Only native species that are removed shall be replaced. Any nuisance species do not require replacement. The restoration of the site forest shall be replenished during applicable planting seasons. Replacement tree size shall be determined by the City of Wilsonville. For purposes of a conservative cost estimate, 6' conifers and 2" deciduous trees have been used to estimate an average tree replacement cost of $250 (labor and the cost of an individual tree). Based on a total of 91 trees being replaced, this equals $22,750. There are 73 trees in the significant resource overlay zone (SROZ) and 18 trees outside the SROZ. Ideally, smaller plant stock will be used when replanting in natural areas since smaller native stock tends to be more adaptive to such settings. All trees outside of the SROZ will be replaced on a 1:1 basis.

7. Tree Identification. A statement that all trees being retained will be identified by numbered metal tags, as specified in subsection "A," above in addition to clear identification on construction documents.

7) All trees that are to be retained are identified by numbered metal tags that are directly associated with the inventory spreadsheet and the trees shown on project design plans. Ideally, all metal tags should be removed after the project is complete to reduce any disruption on tree growth or health.

Matt

Matt Sanchez
11/6/19
Reviewed 4/4/2019, 4/18/19, 4/25/19, 11/6/19

Attachments:
-Tree Species Botanic and Common name list
-Tree Removal and Protection Plan figure
-Tree Survey Spreadsheet

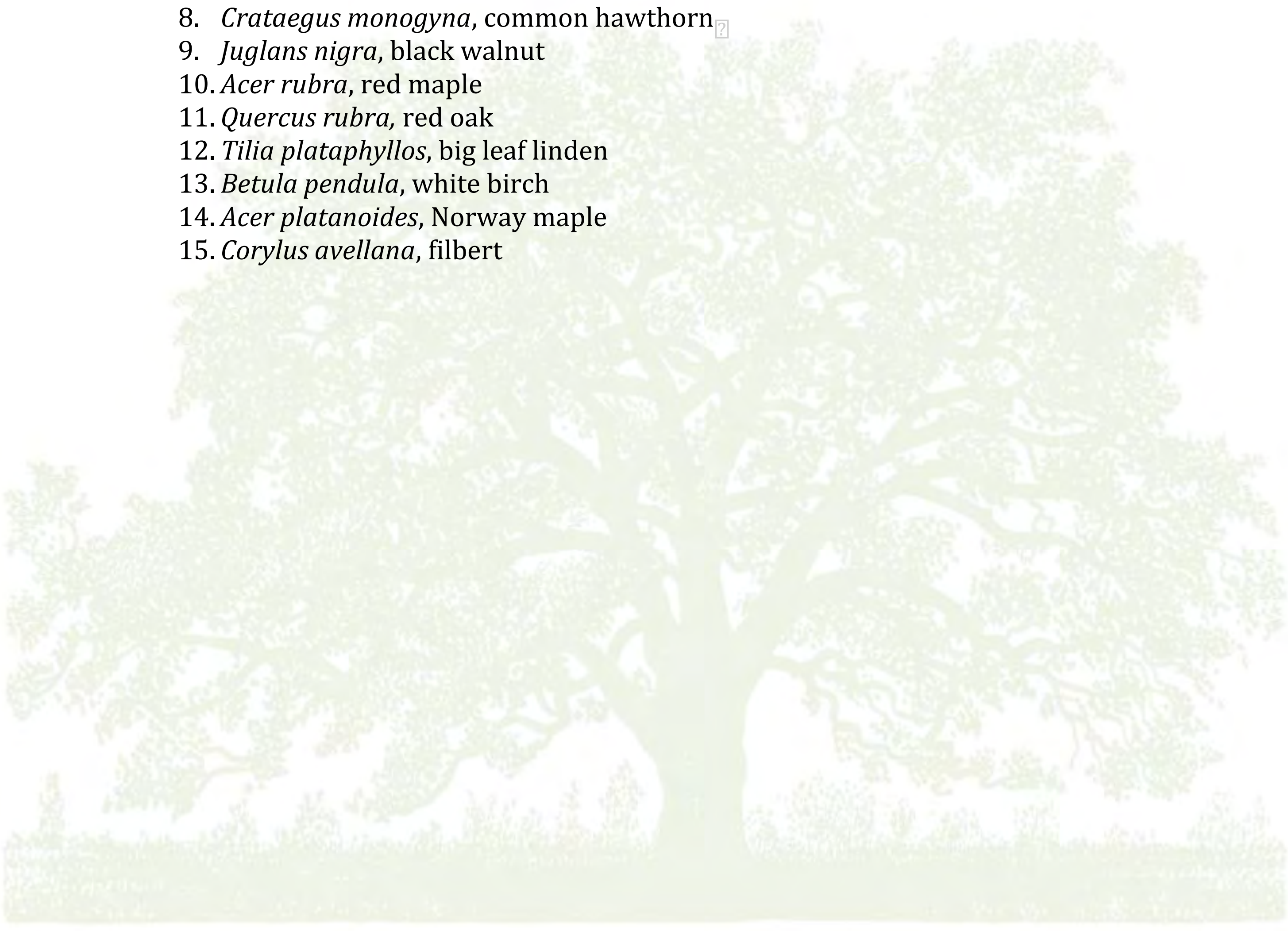
Tree Species: Botanic and Common Name

Conifers

1. *Abies grandis*, grand fir
2. *Pseudotsuga menziesii*, Douglas fir
3. *Thuja plicata*, western red cedar
4. *Tsuga heterophylla*, western hemlock

Deciduous

1. *Alnus rubra*, red alder
2. *Acer macrophyllum*, bigleaf maple
3. *Salix discolor*, pussy willow
4. *Salix sp.,* willow species
5. *Fraxinus latifolia*, Oregon white ash
6. *Populus trichocarpa,* cottonwood
7. *Prunus avium*, common cherry
8. *Crataegus monogyna*, common hawthorn
9. *Juglans nigra*, black walnut
10. *Acer rubra*, red maple
11. *Quercus rubra,* red oak
12. *Tilia plataphyllos*, big leaf linden
13. *Betula pendula*, white birch
14. *Acer platanoides*, Norway maple
15. *Corylus avellana*, filbert



18439 WWSP RAW WATER
WILLAMETTE RIVER WATER TREATMENT PLANT
WILSONVILLE, OREGON
COORDINATE SYSTEM: HORIZONTAL: OCRS PORTLAND ZONE
VERTICAL :NGVD29
OTAK SURVEYED TREES

NOTE: ELEVATIONS MAY NOT BE AT GROUND
SPECIES DETERMINED BY OTAK SURVEYOR AT TIME OF SURVEY (Updated by Harrity Tree Specialists as needed)

						Total Trees	413	91	287	35		
POINT	**NORTHING**	**EASTING**	**ELEVATION**	**NOTE**	**APPROX. SIZE**	**SPECIES**	**Health**	**Remove**	**Preserve**	**Pres. w/ Fencing**	**Conifer**	**Deciduous**
20010	89156.7221	#########	122.436		Unknown	Unknown		X				
25013	90105.991	319317.072	156.17		12"	Oak			X			X
25014	90113.554	319330.585	154.918		5"	Unknown Deciduous			X			X
25015	90100.556	319346.323	155.103		10"	Unknown Deciduous			X			X
25016	90128.139	319312.969	155.074		6"	Unknown Deciduous			X			X
25017	90166.914	319156.724	155.604	2X6"-	10"	Unknown Deciduous			X			X
25018	90171.268	319138.752	154.919		18"	Cedar			X		X	
25019	90159.139	319130.097	154.564		14"	Cedar			X		X	
25020	90138.417	319129.254	153.755	5X7"-	16"	Maple			X			X
25021	90133.04	319132.538	153.694	5X4"-	8"	Maple			X			X
25022	90132.14	319139.216	153.772		18"	Fir			X		X	
25028	89196.174	319347.103	129.876		10"	Unknown Deciduous		X				X
25040	89038.838	319515.629	121.587	2X36"-	54"	Fir	Fair			X	X	
25041	89030.33	319493.514	120.885		52"	Fir				X	X	
25042	89004.502	319446.993	114.773		57"	Fir				X	X	
25043	88966.63	319316.598	102.784		36"	Fir			X		X	
25044	88951.918	319323.42	97.613		7"	Maple			X			X
25045	88946.632	319307.985	92.106		12"	Maple			X			X
25046	88947.457	319284.919	86.41		54"	Fir			X		X	
25047	88936.68	319304.578	86.112		22"	Maple			X			X
25048	88929.866	319325.74	84.881		34"	Maple			X			X
25049	88911.528	319305.368	77.962		18"	Cottonwood			X			X
25050	88919.835	319355.309	74.861		22"	Alder			X			X
25051	88924.029	319369.307	74.843		14"	Unknown Deciduous			X			X
25052	88919.321	319365.925	74.817		15"	Cottonwood			X			X
25053	88946.161	319451.675	81.02		27"	Fir			X		X	
25054	88948.127	319480.102	75.068	2X-	20"	Alder			X			X
25055	88969.667	319512.989	74.676		16"	Alder			X			X
25058	89226.514	319319.236	131.719		12"	Maple			X			X
25059	89240.997	319318.183	131.754		8"	Maple			X			X
25060	89242.869	319316.898	131.732		18"	Alder			X			X
25061	89241.202	319303.99	129.518		32"	Maple			X			X
25062	89267.014	319312.286	131.595		12"	Alder			X			X
25063	89270.486	319311.47	131.523		14"	Maple			X			X
25064	89290.173	319311.188	131.846		12"	Maple			X			X
25065	89292.708	319312.601	132.263		12"	Maple			X			X
25066	89298.71	319311.615	132.233		12"	Maple			X			X
25067	89308.669	319313.064	132.577		16"	Unknown Deciduous			X			X
25068	89322.965	319308.167	132.615		16"	Alder			X			X
25069	89340.556	319304.402	133.48		26"	Unknown Deciduous			X			X
25070	89376.885	319299.827	132.369		12"	Maple			X			X
25071	89392.466	319296.576	134.325	3X4"-	8"	Hawthorne			X			X
25072	89411.983	319299.615	133.651		20"	Alder			X			X
25073	89412.088	319291.487	132.615		28"	Maple			X			X
25074	89428.41	319292.819	131.417		15"	Hawthorne			X			X
25075	89474.564	319313.766	135.916		18"	Hawthorne			X			X
25076	89489.643	319310.913	136.34		32"	Fir			X		X	
25079	89941.794	319463.621	149.02		21"	Oak			X			X
25080	89939.166	319426.189	150.306		14"	Maple			X			X
25081	89962.59	319390.11	151.071		10"	Maple			X			X
25082	89905.135	319394.609	149.267		14"	Maple			X			X
25083	89888.611	319418.889	147.737		18"	Alder			X			X
25084	89875.374	319413.516	147.664		13"	Alder			X			X
25085	89862.536	319400.134	147.603		9"	Maple			X			X
25086	89849.376	319409.001	147.477		12"	Maple			X			X
25087	89826.088	319426.073	146.422		17"	Alder			X			X
25088	89812.844	319427.083	146.187		16"	Alder			X			X
25089	89758.787	319430.174	144.249		22"	Cottonwood			X			X
25090	89909.25	319203.968	145.914		24"	Cedar			X		X	
25091	89913.862	319195.608	145.519	7X4"-	10"	Unknown Deciduous			X			X
25092	89910.641	319184.099	144.867		10"	Cedar			X		X	
25093	89918.291	319177.483	145.416		14"	Cedar			X		X	
25094	89930.817	319163.401	145.587		20"	Cedar			X		X	
25095	89952.979	319142.063	147.044	5X4"-	10"	Alder			X			X
25096	89968.942	319138.942	146.804		12"	Fir			X		X	
25097	89978.675	319134.829	147.805	7X3"-	6"	Unknown Deciduous			X			X
25098	89992.231	319132.625	147.369		12"	Fir			X		X	
25099	90007.735	319143.518	149.245		18"	Fir			X		X	
25100	90021.817	319140.56	149.192	12X2"-	8"	Alder			X			X
25101	90048.122	319139.995	150.959	6X3"-	10"	Alder			X			X
25102	90075.181	319152.439	152.019		14"	Fir			X		X	
25103	90101.964	319128.757	152.19		18"	Fir			X		X	
25104	90110.264	319139.178	152.242		10"	Alder			X			X
25105	90036.594	319416.734	153.067		10"	Unknown Deciduous			X			X
25106	90049.14	319428.043	152.581		10"	Unknown Deciduous			X			X
25107	90036.97	319443.105	151.769		10"	Unknown Deciduous			X			X
25108	90023.045	319459.118	150.575		10"	Unknown Deciduous			X			X
25109	90008.476	319476.257	149.346		10"	Unknown Deciduous			X			X
25110	89994.504	319492.856	148.314		10"	Unknown Deciduous			X			X
25111	89980.881	319509.841	147.429		10"	Unknown Deciduous			X			X
25112	89969.564	319521.367	147.269		10"	Unknown Deciduous			X			X
25113	89958.016	319510.743	147.238		10"	Unknown Deciduous			X			X
25114	89927.799	319541.502	148.029		8"	Unknown Deciduous			X			X
25115	89938.418	319551.236	148.038		8"	Unknown Deciduous			X			X
25150	90944.905	319889.545	148.088		34"	Fir		X			X	
25151	90986.024	319890.491	148.973		14"	Cottonwood		X				X
25152	90996.984	319881.909	149.126		14"	Cottonwood		X				X
71053	89047.023	319772.975	86.38		14"	BL Maple	Fair		X			X
71054	89069.127	319780.914	89.559	2X-	9"	BL Maple	Fair		X			X

POINT	NORTHING	EASTING	ELEVATION	NOTE	APPROX. SIZE	SPECIES	Health	Remove	Preserve	Pres. w/ Fencing	Conifer	Deciduous
71055	89079.448	319782.264	92.916		16"	Cottonwood	Fair		X			X
71056	89084.332	319764.579	98.636		9"	Cherry	Fair			X		X
71057	89071.48	319742.037	92.782		19"	BL Maple	Fair			X		X
71058	89070.666	319753.285	93.903		9"	Alder	Fair		X			X
71059	89058.803	319756.185	89.376		24"	Bl Maple	Fair		X			X
71060	89054.98	319748.271	87.622		6"	Alder	Fair			X		X
71064	89024.937	319728.784	81.257		10"	Cherry	Fair		X			X
71065	89026.096	319717.182	81.846		17"	BL Maple	Fair		X			X
71066	89032.923	319715.303	81.891		12"	BL Maple	Poor		X			X
71067	89023.044	319706.746	80.727		11"	Oregon ash	Poor		X			X
71077	89089.381	319728.125	98.471		7"	Cherry	Fair	X				X
71080	89103.633	319735.457	109.68		18"	BL Maple	Fair	X				X
71081	89102.573	319727.997	108.111		12"	BL Maple	Fair	X				X
71082	89099.464	319717.941	109.786		18"	BL Maple	Fair	X				X
71084	89104.638	319715.926	114.142		22"	BL Maple	Fair	X				X
71085	89098.86	319706.609	107.649		45"	Cottonwood	Fair	X				X
71086	89100.757	319703.72	113.274	2X10-	15"	BL Maple	Fair	X				X
71087	89099.718	319703.492	112.63		14"	BL Maple	Fair	X				X
71089	89090.47	319681.978	106.552		6"	Bl Maple	Fair	X				X
71090	89090.51	319678.793	106.525		46"	Douglas fir	Fair	X			X	
71091	89090.309	319676.316	106.547		24"	BL Maple	Fair	X				X
71092	89092.518	319679.563	108.21		17"	BL Maple	Fair	X				X
71102	89062.357	319705.613	86.803		25"	BL Maple	Fair	X				X
71103	89040.114	319682.073	82.065		11"	Cherry	Fair		X			X
71104	89049.399	319667.74	83.988		14"	Cherry	Fair		X			X
71105	89061.415	319657.938	91.351		12"	Cherry	Fair		X			X
71108	89049.34	319610.579	97.722		14"	BL Maple	Fair		X			X
71110	89042.842	319624.835	88.271		15"	Cherry	Fair		X			X
71111	89038.267	319642.063	84.566		14"	Alder	Fair		X			X
71112	89031.545	319641.224	84.683		8"	Alder	Fair		X			X
71113	89022.981	319657.005	79.733		9"	BL Maple	Fair		X			X
71114	89026.983	319672.698	80.309		7"	BL Maple	Fair		X			X
71115	89017.944	319654.507	79.172		7"	BL Maple	Fair		X			X
71116	89028.26	319615.947	86.414		10"	Cherry	Fair		X			X
71117	89010.559	319618.033	85.622		37"	BL Maple	Fair		X			X
71118	89006.357	319613.89	85.377		32"	Cedar	Fair		X			X
71134	88998.647	319592.9	83.869		27"	BL Maple	Poor		X			X
71135	89002.368	319593.769	85.049		27"	BL Maple	Poor		X			X
71149	89050.078	319560.76	120.475		8"	Western Cedar	Fair			X	X	
71150	89056.686	319565.51	121.632		17"	Western Cedar	Fair			X	X	
71151	89061.42	319558.877	121.623	2X18"-	30"	Western Cedar	Fair			X	X	
71152	89059.17	319554.343	121.624		36"	BL Maple	Fair			X		X
71160	89060.247	319497.665	124.253		7"	Linden	Fair	X				X
71161	89057.404	319490.697	124.553		6"	Linden	Fair	X				X
71164	89050.771	319469.755	124.976		22"	Linden	Fair			X		X
71165	89048.173	319471.971	125.493		8"	Hawthorn	Fair			X		X
71166	89078.28	319457.216	125.884		6"	Linden	Fair	X				X
71171	89025.475	319444.496	125.065		10"	Linden	Fair		X			X
71172	89032.1	319453.419	125.568	2X6"-	10"	Linden	Fair		X			X
71173	89047.057	319453.038	125.861		9"	Linden	Fair			X		X
71176	89048.356	319432.906	125.942		7"	Linden	Fair			X		X
71180	89038.996	319414.641	125.462		12"	Linden	Fair			X		X
71181	89046.879	319409.113	126.018	3X7"-	18"	Linden	Fair		X			X
71182	89055.52	319392.495	126.3	3X9"-	11"	Linden	Fair		X			X
71184	89088.994	319389.654	127.251		36"	Douglas fir	Fair	X			X	
71395	89006.789	319693.858	76.825		12"	Cottonwood	Poor		X			X
71396	88980.657	319688.39	72.169		90"	Cottonwood	Fair		X			X
71397	88964.525	319677.325	69.266		48"	Cottonwood	Fair		X			X
71398	88964.83	319667.028	69.191		12"	Oregon ash	Fair		X			X
71399	88960.874	319656.543	69.574		9"	Oregon ash	Fair		X			X
71400	88958.478	319655.403	68.832		9"	Oregon ash	Fair		X			X
71401	88943.01	319656.927	65.396		18"	Oregon ash	Fair		X			X
71402	88950.159	319646.763	67.366		10"	Oregon ash	Poor		X			X
71403	88942.108	319631.879	67.403		12"	Oregon ash	Fair		X			X
71404	88953.696	319627.76	68.919	2X32	42"	Cottonwood	Fair		X			X
71405	88978.18	319627.556	74.146		10"	BL Maple	Fair			X		X
71406	88977.886	319629.15	73.876		8"	BL Maple	Fair			X		X
71407	88979.051	319630.667	73.869		6"	BL Maple	Fair			X		X
71408	88979.497	319638.002	74.424		12"	BL Maple	Fair			X		X
71409	88990.788	319661.248	73.327		18"	Oregon ash	Fair			X		X
71412	90986.717	319925.966	147.43		24"	Cottonwood	Fair	X				X
71413	91018.114	319891.013	149.985		16"	Cottonwood	Fair	X				X
71512	89022.629	319411.427	124.859							X		
71513	89010.372	319410.479	122.743		23"	Douglas fir	Fair		X		X	
71514	89022.268	319430.636	125.175		9"	Linden	Fair		X			X
71515	89005.044	319401.854	118.682		7"	Linden	Fair		X			X
71516	89005.198	319380.423	124.509		10"	Linden	Fair			X		X
71517	89000.386	319368.243	124.502		9"	Linden	Fair			X		X
71518	88994.452	319339.866	123.391		29"	Douglas fir	Fair			X	X	
71519	88995.446	319330.277	120.769		26"	Douglas fir	Fair		X		X	
71520	88997.906	319326.894	121.001		40"	Douglas fir	Fair		X		X	
71521	89015.181	319343.289	123.862		7"	Linden	Fair			X		X
71532	89024.378	319340.804	123.867		9"	Linden	Fair			X		X
71533	89029.747	319363.133	124.799		9"	Douglas fir	Fair			X	X	
71534	89035.174	319370.948	125.288		28"	Douglas fir	Fair			X	X	
71535	89041.438	319375.945	125.518		24"	Douglas fir	Fair		X		X	
71536	89036.458	319379.152	125.109		11"	Douglas fir	Fair		X		X	
71537	89034.728	319382.01	125.581		28"	Douglas fir	Fair		X		X	
71538	89059.154	319387.169	126.04		9"	Linden	Fair		X			X
71541	89087.441	319376.898	127.03	2X7-	9"	Western Cedar	Poor			X	X	
71542	89086.432	319374.25	127.354		22"	Linden	Fair			X		X
71543	89082.128	319371.707	126.746		7"	Western Cedar	Fair			X	X	
71544	89081.405	319381.024	126.307		12"	Linden	Fair			X		X
71545	89072.175	319372.898	126.433		12"	Linden	Fair			X		X
71546	89066.432	319350.669	126.232	2X16-	36"	Western Cedar	Fair		X		X	
71547	89056.918	319346.055	125.445		19"	Western Cedar	Fair		X		X	
71548	89036.759	319333.713	123.278		8"	BL Maple	Fair		X			X
71554	89052.87	319338.108	124.295		26"	Western Cedar	Fair		X		X	

POINT	NORTHING	EASTING	ELEVATION	NOTE	APPROX. SIZE	SPECIES	Health	Remove	Preserve	Pres. w/ Fencing	Conifer	Deciduous
71555	89062.474	319334.306	123.248		46"	Douglas fir	Fair		X		X	
71567	89103.007	319330.966	123.039		30"	Western Cedar	Fair		X		X	
71568	89104.894	319341.604	125.156		24"	Western Cedar	Fair		X		X	
71569	89115.405	319339.434	125.78		32"	Western Cedar	Fair		X		X	
71570	89119.37	319336.271	125.151		17"	Western Cedar	Dead		X		X	
71571	89123.939	319342.083	126.566		28"	Western Cedar	Fair		X		X	
71572	89129.893	319339.319	126.813		32"	Western Cedar	Fair		X		X	
71573	89134.764	319338.088	127.412		21"	Western Cedar	Fair		X		X	
71581	89125.552	319324.642	124.424		30"	Western Cedar	Fair		X		X	
71582	89135.678	319324.526	127.372		48"	Douglas fir	Fair		X		X	
71583	89141.365	319320.208	126.069		36"	Douglas fir	Fair		X		X	
71585	89152.172	319322.61	127.527		16"	Western Cedar	Fair		X		X	
71597	89157.423	319336.436	129.024		13"	Douglas fir	Fair		X		X	
71599	89171.935	319327.263	129.141		14"	Douglas fir	Fair		X		X	
71600	89188.984	319321.433	130.153		18"	BL Maple	Fair		X			X
71601	89194.282	319325.364	129.304		8"	Douglas fir	Fair		X		X	
71602	89197.818	319313.419	128.319		17"	Unknown Deciduous	?		X			X
71603	89198.214	319306.462	124.445		17"	Unknown Deciduous	?		X			X
71604	89187.844	319306.944	124.922		17"	Unknown Deciduous	?		X			X
71605	89176.339	319304.23	122.353		17"	Unknown Deciduous	?		X			X
71667	88993.213	319720.589	73.647	2X40"-	48"	Cottonwood	Fair		X			X
71668	88984.98	319717.412	72.04		9"	Oregon ash	Fair		X			X
71669	88989.168	319730.376	72.588		13"	BL Maple	Fair		X			X
71670	88993.501	319755.165	72.987		25"	Oregon ash	Fair		X			X
71671	88996.518	319755.841	73.089		7"	Oregon ash	Fair		X			X
71672	88993.198	319770.457	72.718		8"	Oregon ash	Fair		X			X
71673	88994.188	319783.192	74.426		35"	Cottonwood	Fair		X			X
71674	89000.92	319781.95	74.727		17"	Oregon ash	Fair		X			X
71675	88985.842	319776.982	72.43		10"	Oregon ash	Fair		X			X
71676	88982.458	319780.621	72.154		6"	Oregon ash	Fair		X			X
71677	88980.084	319767.99	70.155		11"	Oregon ash	Fair		X			X
71678	88972.192	319781.661	70.594		11"	Oregon ash	Fair		X			X
71679	88971.159	319787.142	70.898		7"	Oregon ash	Fair		X			X
71680	88959.431	319769.36	69.417		12"	Oregon ash	Fair		X			X
71681	88972.895	319760.358	68.998		10"	Oregon ash	Fair		X			X
71682	88971.416	319755.98	69.348		26"	Cottonwood	Poor		X			X
71683	88972.453	319750.355	69.124		7"	Oregon ash	Fair		X			X
71684	88979.156	319750.809	69.272		7"	Oregon ash	Fair		X			X
71685	88959.702	319740.34	68		10"	Oregon ash	Fair		X			X
71686	88951.291	319782.34	68.434	3X-	8"	Oregon ash	Fair		X			X
71687	88949.053	319753.259	67.208		12"	Oregon ash	Fair		X			X
71688	88944.966	319736.088	66.341		8"	Oregon ash	Fair		X			X
71689	88944.816	319724.564	63.984		8"	Oregon ash	Fair		X			X
71690	88940.47	319727.751	63.858	5X-	8"	Oregon ash	Fair		X			X
71691	88947.039	319710.76	65.771		10"	Oregon ash	Fair		X			X
71692	88954.549	319713.52	66.512		14"	Oregon ash	Fair		X			X
71693	88962.974	319726.858	66.393		9"	Oregon ash	Fair		X			X
71694	88963.101	319702.251	67.206		36"	Cottonwood	Poor		X			X
71695	88943.706	319692.191	62.749		18"	Oregon ash	Fair		X			X
71698	88952.902	319598.621	72.886	2X48"-	50"	Cottonwood	Fair		X			X
71699	88945.064	319609.7	68.572		30"	Cottonwood	Poor		X			X
71700	88936.421	319605.835	67.831		15"	Oregon ash	Fair		X			X
71701	88935.191	319616.321	65.736		10"	Oregon ash	Fair		X			X
71702	88937.754	319583.702	67.604		10"	Oregon ash	Fair		X			X
71703	88930.296	319580.668	62.887	2X6"-	9"	Oregon ash	Fair		X			X
71704	88953.26	319572.347	74.567	10X2"-	24"	Filbert	Fair		X			X
71705	88964.811	319555.079	76.305		43"	Western Cedar	Fair		X		X	
71706	88952.369	319552.886	74.477	2X6"	7"	BL Maple	Fair		X			X
71764	88919.795	319461.373	67.174		14"	Unknown Deciduous	?		X			X
71765	88919.044	319468.615	67.58		10"	Unknown Deciduous	?		X			X
71766	88917.799	319483.745	63.61		12"	Unknown Deciduous	?		X			X
71767	88924.887	319491.183	68.256	3X7"-	18"	Oregon ash	Poor		X			X
71768	88922.327	319514.646	65.228		13"	Unknown Deciduous	?		X			X
71769	88922.75	319517.383	64.995		13"	Unknown Deciduous	?		X			X
71770	88942.332	319530.106	72.836		32"	Cottonwood	Fair		X			X
71771	88936.453	319545.422	69.212		10"	Oregon ash	Fair		X			X
71772	88940.258	319542.892	69.211		10"	Oregon ash	Fair		X			X
71773	88951.883	319552.568	73.631	2X6"-	8"	BL Maple	Fair		X			X
71801	89000.591	319536.461	93.43		8"	Western Cedar	Fir		X		X	
71802	88991.212	319546.316	89.306		24"	Western Cedar	Fair		X		X	
71803	88968.341	319527.66	75.899		8"	Alder	Fair		X			X
71805	88983.774	319524.488	84.513		6"	Western Cedar	Fair		X		X	
71808	89004.767	319499.076	113.658	3X12"-	14"	BL Maple	Fair		X			X
71809	89003.004	319490.958	111.534		14"	BL Maple	Fair		X			X
71810	89001.447	319493.146	109.046		10"	BL Maple	Fair		X			X
71833	88949.117	319481.733	73.978	2X12"-	37"	Cottonwood	Fair		X			X
71834	88950.824	319469.421	78.633		8"	BL Maple	Fair		X			X
71835	88959.627	319466.418	81.367		8"	BL Maple	Fair		X			X
71836	88947.283	319452.992	80.504		26"	BL Maple	Poor		X			X
71837	88944.245	319449.843	80.33		26"	BL Maple	Poor		X			X
71838	88958.666	319447.845	83.79		6"	BL Maple	Fair		X			X
71839	88946.445	319434.027	81.799		26"	Douglas fir	Fair		X		X	
71905	88924.24	319393.313	72.495		24"	BL Maple	Fair		X			X
71907	88951.892	319388.878	87.436		24"	Cottonwood	Fair		X			X
71909	88946.537	319369.894	87.89		8"	BL Maple	Fair		X			X
71910	88905.344	319378.986	65.695	2X	8"	Unknown Deciduous	inset		X			X
71911	88923.273	319368.94	69.966		28"	Oregon ash	Fair		X			X
71912	88919.062	319365.961	68.976		12"	Unknown Deciduous	inset		X			X
71913	88919.211	319355.115	69.829		18"	Unknown Deciduous	inset		X			X
71914	88912.65	319355.624	72.993		18"	Unknown Deciduous	inset		X			X
71915	88898.562	319332.71	69.535	2X	8"	Unknown Deciduous	inset		X			X
71916	88914.642	319299.621	78.864		14"	Unknown Deciduous	inset		X			X
71917	88936.104	319304.917	87.15		18"	Unknown Deciduous	inset		X			X
71919	88947.09	319308.481	92.538		12"	Unknown Deciduous	inset		X			X
71920	88946.358	319285.202	86.66		54"	Unknown Deciduous	inset		X			X
71925	88964.07	319297.615	95.323		14"	Unknown Deciduous	inset		X			X
71926	88961.807	319295.467	93.089		6"	Unknown Deciduous	inset		X			X
71927	88968.407	319316.639	101.521		28"	bl Maple	Fair		X			X

POINT	NORTHING	EASTING	ELEVATION	NOTE	APPROX. SIZE	SPECIES	Health	Remove	Preserve	Pres. w/ Fencing	Conifer	Deciduous
71931	88973.232	319337.333	110.199		40"	Douglas fir	Fair		X		X	
71932	88969.486	319339.707	107.072		16"	Bl Maple	Fair		X			X
71933	88979.06	319361.659	110.324		36"	Cottonwood	Fair		X			X
71934	88976.789	319351.336	109.117		6"	BL Maple	Fair		X			X
71935	88982.282	319348.901	116.889		10"	Bl Maple	Fair		X			X
71937	88974.406	319385.672	102.8		10"	BL Maple	Fair			X		X
71938	88988.152	319382.988	106.713		40"	Douglas fir	Fair			X	X	
71942	88976.349	319424.577	97.308		46"	Douglas fir	Fair		X		X	
71943	88970.962	319432.785	93.417		46"	Douglas fir	Fair		X		X	
71946	88992.542	319480.129	108.73	6X10"-	18"	BL Maple	Fair		X			X
71947	88997.172	319474.57	111.018		12"	BL Maple	dead		X			X
72048	88998.135	319290.575	93.521		36"	Douglas fir	inset		X		X	
72069	89061.323	319316.797	111.149		18"	Douglas fir	Fair		X		X	
72071	89027.03	319307.166	102.027		9"	Unknown Deciduous	inset		X			X
72072	89025.362	319302.278	99.892		9"	Unknown Deciduous	inset		X			X
72073	89013.629	319298.378	98.499		10"	Western Cedar	inset		X		X	
72074	89014.91	319310.66	102.791		22"	Western Cedar	inset		X		X	
72082	89075.854	319266.316	97.568		16"	Unknown Deciduous	inset		X			X
73002	89201.286	319292.805	118.23		15"	Alder	inset2		X			X
73003	89198.758	319286.472	113.34		10"	Alder	inset2		X			X
73006	89195.333	319286.045	113.205		10"	Bl Maple	inset2		X			X
73007	89182.511	319291.516	115.457		12"	Alder	inset2		X			X
73022	89146.142	319291.748	115.253		18"	Maple	inset2		X			X
73023	89144.156	319298.624	118.044		9"	Western Cedar	inset2		X		X	
101041	90662.612	319130.721	167.751	15X2"-	8"	Willow	Fair	X				X
101042	90690.742	319127.194	168.42	3X7"-	9"	Alder	Fair	X				X
101108	90553.375	319143.157	164.361		14"	Douglas fir	Fair	X			X	
101518	90248.733	319169.058	157.089		10"	Norway maple	Poor	X				X
101519	90262.692	319157.498	157.389		4"	Linden	Fair	X				X
101520	90276.379	319148.713	157.615		8"	Linden	Poor	X				X
101522	90289.656	319141.044	158.112		9"	Linden	Poor	X				X
101523	90304.099	319132.823	158.135		9"	Linden	Fair	X				X
101524	90319.62	319125.746	158.681		10"	Linden	Fair	X				X
101635	90292.311	319117.735	159.254	6X6"-	12"	Pussy Willow	Fair		X			X
101809	90205.017	319221.439	156.51		10"	Linden	Fair		X			X
101810	90192.419	319236.048	156.405		12"	Linden	Fair		X			X
101811	90179.683	319251.345	156.196		6"	Linden	Fair		X			X
101812	90167.062	319266.529	156.347		8"	Linden	Fair		X			X
101813	90153.346	319282.75	155.662		8"	Linden	Fair		X			X
101814	90140.74	319298.267	155.511		8"	Linden	Fair		X			X
101816	90123.637	319294.378	157.105		12"	Red oak	Fair		X			X
101817	90102.077	319256.224	156.202		5"	Ornamental	N/A		X			X
102015	90267.752	319113.241	158.064		14"	Douglas fir	Fair		X		X	
102016	90252.82	319112.459	157.777		10"	Birch	Fair		X			X
102017	90240.421	319118.54	157.593		14"	Western Cedar	Fair		X		X	
102018	90229.934	319116.008	157.424		21"	Western Cedar	Fair		X		X	
102240	89717.258	319335.519	142.306	6X3"-	8"	Pussy Willow	Fair	X				X
102241	89750.603	319310.093	141.086	6X4"-	8"	Pussy Willow	Fair		X			X
102242	89772.842	319302.735	142.044		6"	Douglas fir	Fair	X			X	
102243	89779.195	319298.848	142.063		7"	Douglas fir	Fair	X			X	
102244	89783.727	319292.638	141.928		10"	Douglas fir	Fair		X		X	
102245	89789.538	319292.75	142.059		7"	Douglas fir	Fair	X			X	
102246	89796.951	319286.998	141.848		8"	Hemlock	Fair	X			X	
102247	89805.736	319280.541	141.877		10"	Douglas fir	Fair	X			X	
102248	89811.579	319276.331	141.932		13"	Douglas fir	Fair	X			X	
102249	89819.611	319273.235	142.236		9"	Douglas fir	Fair	X			X	
102250	89828.227	319264.989	142.262		10"	Douglas fir	Fair		X		X	
102251	89832.595	319271.706	142.662		9"	Douglas fir	Fair	X			X	
102252	89838.659	319264.002	142.716		6"	Western Hemlock	Fair	X			X	
102253	89855.944	319258.484	143.476		10"	Douglas fir	Fair	X			X	
102254	89865.619	319256.279	143.745		12"	Douglas fir	Fair	X			X	
102255	89865.418	319249.472	143.354		8"	Douglas fir	Fair		X		X	
102256	89869.5	319241.122	143.714		13"	Douglas fir	Fair		X		X	
102257	89880.481	319235.943	144.286		11"	Douglas fir	Fair		X		X	
102258	89890.127	319230.567	144.787		14"	Douglas fir	Fair		X			X
102342	89529.434	319415.573	137.714		12"	Alder	Fair	X				X
102343	89549.627	319434.929	137.648		10"	Red Maple	Fair	X				X
102344	89561.838	319426.71	138.278		10"	Red Maple	Fair	X				X
102345	89617.924	319414.418	140.087		16"	Alder	Fair	X				X
102346	89629.081	319402.538	140.511		12"	Alder	Fair	X				X
102347	89642.133	319409.454	140.964		14"	Alder	Poor	X				X
102348	89752.948	319404.083	144.589		18"	Alder	Fair	X				X
102349	89767.467	319397.495	145.012		11"	Red Maple	Fair	X				X
102350	89804.377	319339.94	144.506		13"	Red oak	Fair	X				X
102351	89838.922	319336.664	146.19		13"	Red oak	Fair	X				X
102352	89893.872	319378.35	148.558		14"	Red Maple	Fair		X			X
102353	89902.689	319364.806	148.913		13"	Red Maple	Fair		X			X
102545	89677.598	319345.547	141.933	9X6"-	10"	Alder	Fair	X				X
102546	89646.721	319344.173	140.342	4X6"-	9"	Pussy Willow	Fair		X			X
102547	89635.204	319339.627	139.344	3X7"-	10"	Pussy Willow	Fair		X			X
102548	89621.325	319338.833	138.428	2X6"-	10"	Pussy Willow	Fair		X			X
102549	89605.59	319342.614	138.369	4X5"-	8"	Pussy Willow	Fair		X			X
102550	89601.216	319344.379	138.469	4X2"-	6"	Pussy Willow	Fair		X			X
102551	89590.688	319349.707	138.789	5X3"-	8"	Pussy Willow	Fair	X				X
102552	89579.929	319349.714	138.87	4X5"-	8"	Pussy Willow	Fair	X				X
102553	89536.121	319338.403	137.201	7X4"-	9"	Pussy Willow	Fair		X			X
102554	89449.733	319328.983	135.529		12"	Pussy Willow	Fair		X			X
102555	89338.914	319437.628	130.026		12"	Red Maple	Fair		X			X
102556	89350.363	319427.933	130.924		12"	Red Maple	Fair		X			X
102557	89369.952	319458.877	131.791		9"	Alder	Fair		X			X
102558	89386.688	319460.68	132.508		16"	Alder	Fair		X			X
102560	89405.509	319464.814	132.979	6X3"-	6"	Pussy Willow	Fair		X			X
102925	89150.72	319341.116	128.827		12"	Cherry	Fair		X			X
102926	89154.246	319342.145	129.539		20"	Bl Maple	Fair		X			X
102928	89159.267	319335.011	128.984		14"	Cedar	Fair		X		X	
102929	89137.928	319387.775	128.571		9"	Poplar	Fair	X				X
102930	89127.714	319396.523	128.227		7"	Poplar	Fair	X				X
102931	89130.813	319403.719	128.423		10"	Poplar	Fair	X				X
102937	89097.677	319403.722	127.251	3X14"-	29"	Linden	Fair	X				X

POINT	NORTHING	EASTING	ELEVATION	NOTE	APPROX. SIZE	SPECIES	Health	Remove	Preserve	Pres. w/ Fencing	Conifer	Deciduous
102938	89097.604	319433.08	126.718		7"	Western Hemlock	Fair	X			X	
102945	89081.435	319438.876	126.223		8"	Western Hemlock	Fair	X			X	
103044	89096.293	319625.182	120.678		13"	Cottonwood	Fair	X				X
103045	89102.093	319628.257	120.532		7"	Douglas fir	Fair	X			X	
103046	89114.39	319641.983	121.166		10"	Alder	Fair	X				X
103047	89123.298	319642.902	122.703		7"	Alder	Fair	X				X
103048	89122.779	319625.96	123.51		6"	Alder	Fair	X				X
103049	89115.852	319618.791	122.436		4"	Alder	Fair	X				X
103050	89107.004	319596.072	122.696		6"	Alder	Fair	X				X
103051	89116.836	319591.59	124.254	4X5"-	6"	Alder	Fair	X				X
103052	89096.218	319602.946	121.306		8"	Douglas fir	Fair	X			X	
103087	89137.449	319685.546	120.664	2X19"-	21"	Alder	Fair	X				X
103088	89146.52	319698.581	121.411	2X	7"	Alder	Fair	X				X
103191	89162.784	319668.996	124.1		8"	Alder	Fair	X				X
103192	89160.024	319678.553	123.359		5"	Western Hemlock	Fair	X			X	
103193	89142.854	319664.722	123.593		7"	Western Hemlock	Fair	X			X	
103194	89137.136	319708.511	119.755		13"	Bl Maple	Fair	X				X
103195	89134.357	319713.731	120.231		15"	Alder	Fair	X				X
103196	89135.54	319714.674	119.991	2X7"-	9"	Alder	Fair	X				X
103197	89135.492	319727.399	118.83		15"	Bl Maple	Fair	X				X
103198	89134.979	319734.183	117.356	2X	6"	BL Maple	Fair	X				X
103199	89135.095	319748.04	115.393		7"	BL Maple	Fair	X				X
103200	89137.804	319747.759	116.859		11"	Western Cedar	Fair	X			X	
103201	89135.876	319752.462	116.191		13"	Alder	Fair	X				X
103202	89137.069	319757.176	116.261	2X8"-	20"	Western Cedar	Fair	X			X	
103203	89140.255	319750.487	119.75	2X17"-	18"	Bl Maple	Poor	X				X
103204	89138.765	319761.805	117.811		15"	Western Cedar	Fair	X			X	
103205	89136.007	319767.166	116.063		22"	Bl Maple	Fair	X				X
103206	89137.736	319780.496	115.344	2X13"-	32"	Bl Maple	Fair	X				X

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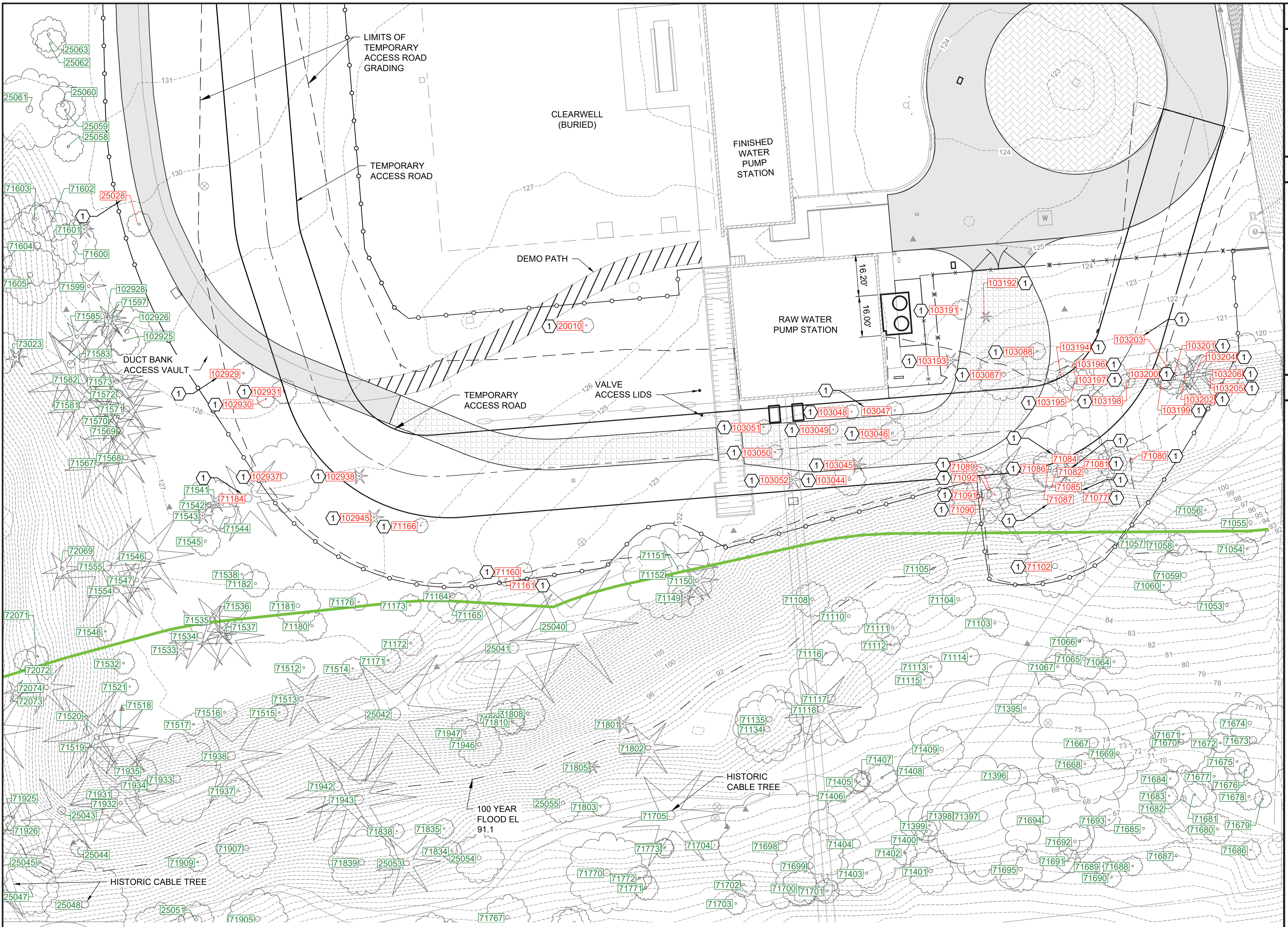

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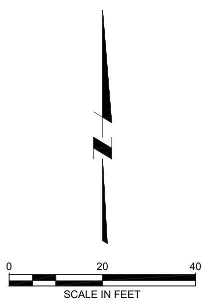

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CHK	R. BROWN					
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WILLAMETTE WATER SUPPLY PROGRAM
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LAND USE PERMIT
TREE REMOVAL AND PROTECTION PLAN
RIVER BANK

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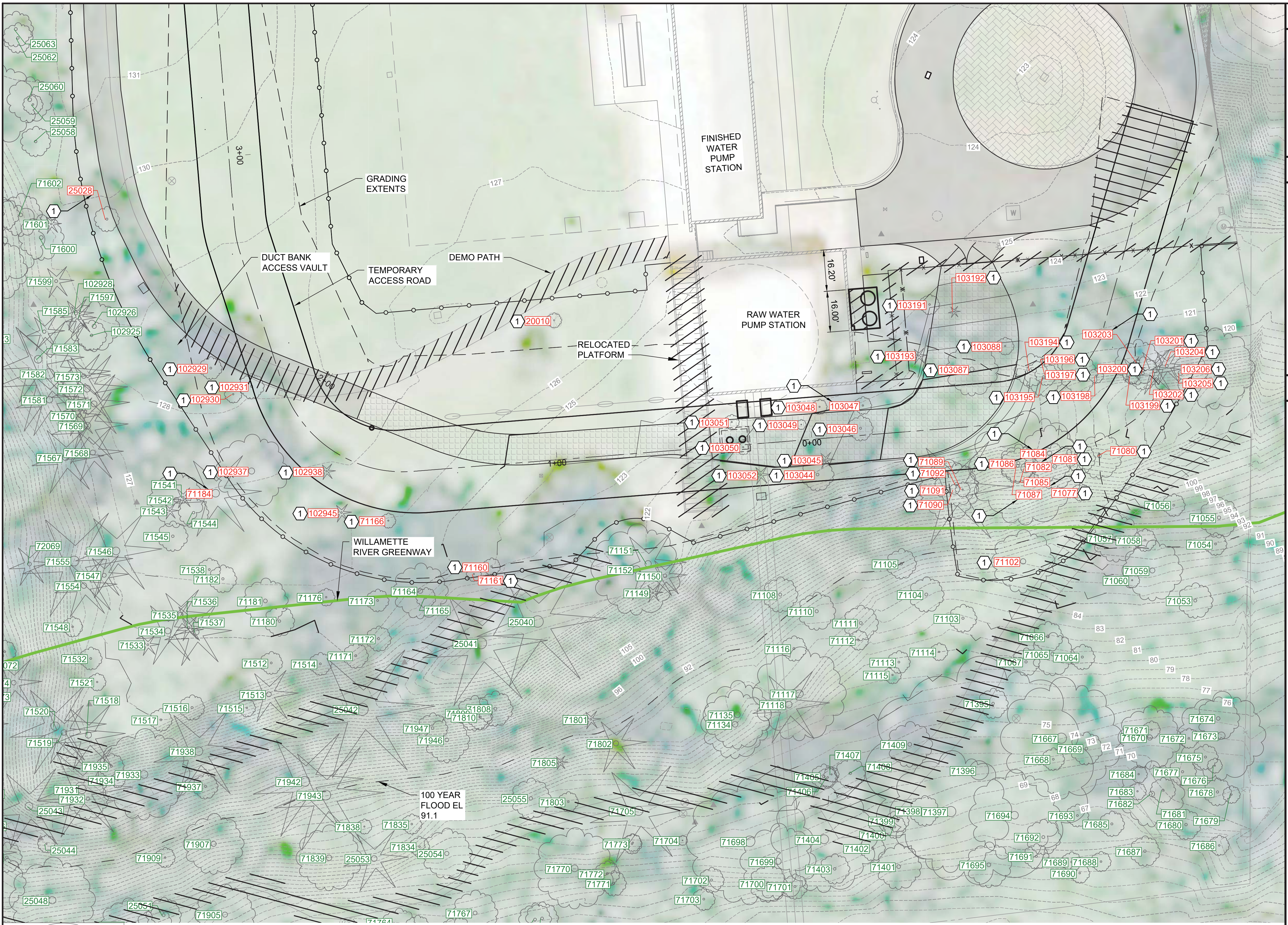

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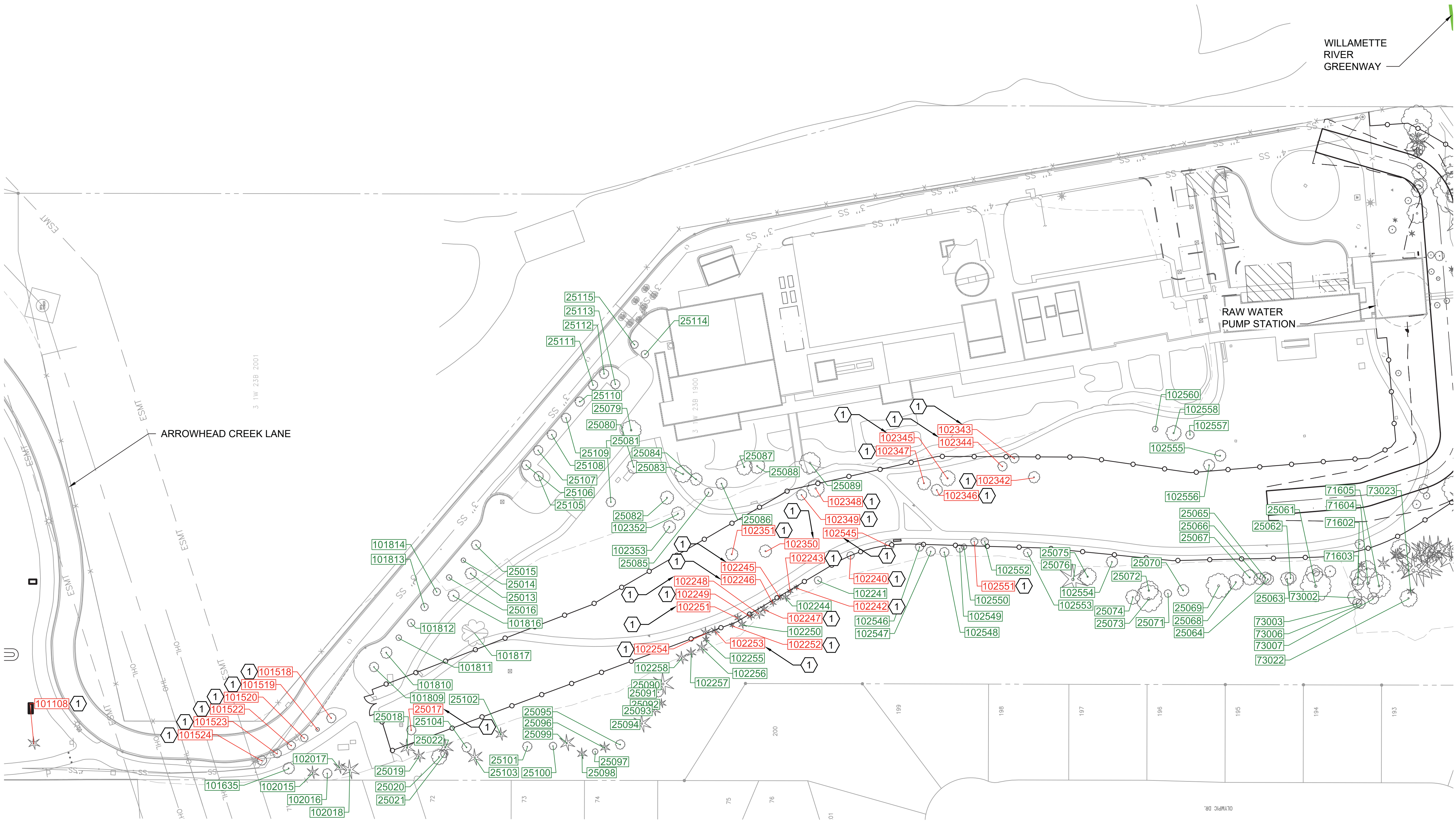

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LAND USE PERMIT
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PARK

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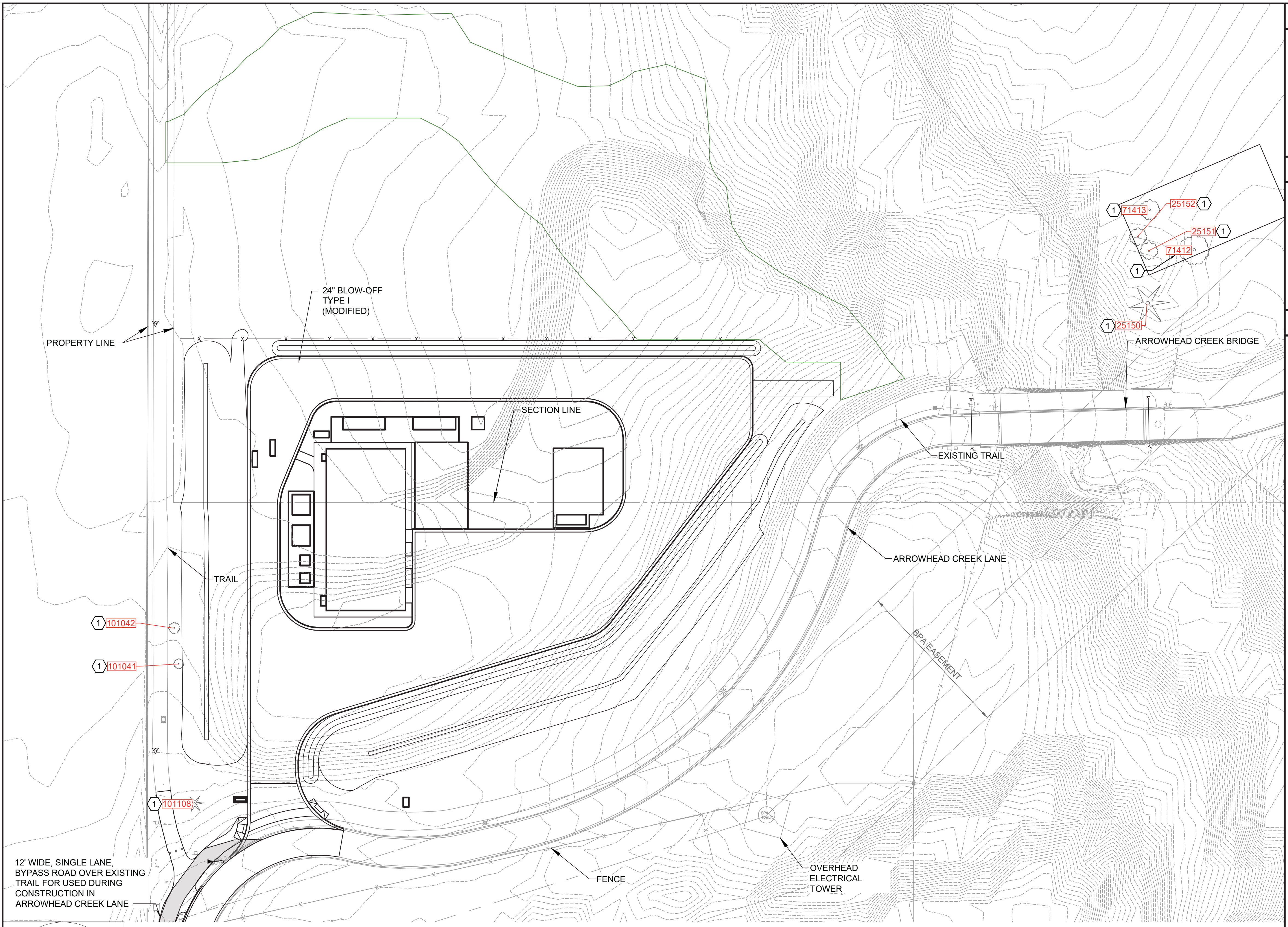

1 SITE YARD PIPING PLAN

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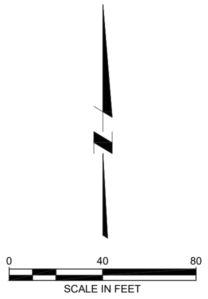

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DR C.J. COGLIANESE						
CHK R. BROWN						
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PRELIMINARY, SUBJECT TO CHANGE

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LAND USE PERMIT
TREE REMOVAL AND PROTECTION PLAN
UPPER SITE

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Exhibit O: No Rise Documentation

DAVID EVANS
AND ASSOCIATES INC.

MEMORANDUM

DATE: July 22, 2019

TO: Dan Pauly, Senior Planner
City of Wilsonville

FROM: Julie McCaskill, P.E.
David Evans and Associates, Inc. (DEA)

SUBJECT: No Rise Analysis for the Willamette Water Supply Program's Raw Water Facilities_1.0 (RWF_1.) Intake Fish Screen and Protection Piles on the Willamette River

CC: Jennifer Minton, WWSP; Jill Chomycia, WWSP; Jeff McMillen, Black & Veatch; Sarah Betz, DEA; Shayna Rehberg, APG, Christina Walter, WWSP

Dear Mr. Pauly,

I am writing to document the "no rise" condition resulting from the installation of proposed pile protection around the existing intake at the Willamette River Water Treatment Plant, in support of the Willamette Water Supply System's Raw Water Facilities (RWF_1.0) project. The protection piles will be installed in the Willamette River in Clackamas County.

Hydraulic modeling using the US Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) model of the Willamette River was performed by Stantec in 2016 in support of the WWSP's application for a permit from the USACE (see attachment). DEA used this model, in conjunction with the Federal Emergency Management Administration's (FEMA) Flood Insurance Study (FIS) model, to determine whether there will be a rise on the Willamette River as a result of the increase in fish screen size on the intake and the installation additional intake protection piles.

Datums of the study model were adjusted 10 feet to be more similar to that of the FEMA model. DEA reduced the model to include the FEMA upstream and downstream cross sections for the Duplicate Effective Model (DEM). The DEM cross sections were updated with the addition of three additional cross sections in the vicinity of the intake to represent the Corrected Effective Model (CEM), which includes the riser, fish screen, and protection piles. Finally, a Proposed Model was created updating the cross section with the intake fish screen and protection piles to determine if the improvement results in a rise. The model identified no rise between the Corrective Effective and Proposed models. The results also show no change in velocity.

As noted in the 70% design plans, the protection piles will be concrete or steel pipe, 24 inches in diameter or smaller, steel H-pile designated HP24 or smaller, or wood that has not been treated with preservatives or pesticides. New protection piles will be less than 10 feet tall. Assuming all 10 piles are 10 feet tall and 24 inches in diameter, their combined volume is 31.4 cubic feet.

Based on the 2016 HEC-RAS modeling completed by Stantec and the assessment presented above, it is the understanding of DEA that the final design creates no changes to the floodway and floodplain that can be hydraulically modeling with HEC-RAS, thereby, achieving a "no rise" condition.

Please contact me if there is any other information that you believe the WWSP and DEA need to be aware of regarding this matter or if there is other information that WWSP and DEA can provide to you.

Sincerely,

Julie McCaskill, P.E.

Exhibit P: Traffic Study Waiver Request

DKS

720 SW Washington St., Suite 500
Portland, OR 97205
503.243.3500
www.dksassociates.com

March 22, 2019

Steve Adams
City of Wilsonville
29799 SW Town Center Loop East
Wilsonville, OR 97070

Subject: Willamette Water Supply Program (WWSP) Traffic Study Waiver Request

Dear Steve:

The applicant, Willamette Water Supply Program (WWSP), is proposing to develop Raw Water Facilities at 10350 Arrowhead Creek Lane in Wilsonville. Consistent with discussion at the pre-application conference on January 10, 2019, the applicant is requesting a waiver from the traffic study request as part of the planning approval process for the following reasons:

- There will be no permanent staff for the Raw Water Facilities.
- Maintenance visits to the site will be scheduled to avoid p.m. peak travel hours (i.e., from 4:00-6:00 p.m.).
- Maintenance visits to the site will involve less than 25 trips per day.

We feel that the proposed project will have negligible impacts to the surrounding transportation facilities and, therefore, the applicant respectfully requests a waiver from the traffic study requirement. The official City waiver form has been completed and is included in this request.

Thank you for your time and consideration.

Sincerely,

Brian K. Copeland, P.E., PTOE
Principal

City of Wilsonville
Community Development Department
Engineering and Planning Divisions

29799 SW Town Center Loop E
Wilsonville, OR 97070
Phone: 503 682-4960; Fax 503 682-7025
adams@ci.wilsonville.or.us

This form must be completed and returned to Steve Adams, Deputy City Engineer, to initiate a traffic Scope of Services, a request for a traffic study waiver, a determination of de minimus traffic impact, or other traffic-related issues.

REQUEST FOR TRAFFIC STUDY – PLEASE READ COMPLETELY

______ **Traffic Study Scope of Services** __X__ **Waiver from Traffic Study requirement**

Other Traffic Related Request ______________________

Requested by: Willamette Water Supply Program (WWSP) **Date:** April 30, 2019

Property address: 10350 SW Arrowhead Creek Lane, Wilsonville, OR 97070

Legal description: **Tax lot(s)** 1800 & 1900 **Section** 31W 23B

Project name: Willamette Water Supply System Raw Water Facilities

Property owner:
Name: City of Wilsonville and Tualatin Valley Water District (TVWD)
Address: (TVWD) 1850 SW 170th Avenue, Beaverton, OR 97003

Applicant:
Name: WWSP; Dave Kraska, Program Director
Address: 1850 SW 170th Avenue, Beaverton, OR 97003

Authorized representative:
(Contact person)*
Name: Shayna Rehberg, Senior Planner
Company: Angelo Planning Group
Address: 921 SW Washington Street, Suite 468
Phone: 503-227-3678 **Email:** srehberg@angeloplanning.com

Note: This person will receive all correspondence regarding traffic analysis.

Process: A Request, along with a site plan and project description must be submitted to the Engineering Division. The request is forwarded to the City's traffic consultant who will prepare a Scope of Services, which will include the necessary fee. The prepared Scope will be reviewed by the Engineering Division, and once approved, will be forwarded to the authorized representative listed above. When the applicant reviews and submits the fee indicated in the Scope of Services, the scope will be authorized by Staff and forwarded to the traffic consultant. When the traffic study has been received and approved by the City's Engineering Division, it will be forwarded to the applicant and the Planning Division.

A request for a Waiver from a traffic study will be reviewed by the Community Development Director and the Engineering Division and the requestor will be notified by mail.

Note: If the project description and/or site plan change from what was originally submitted, additional traffic analysis and fees may be required.

Exhibit Q: Hauler Coordination Documentation

REPUBLIC SERVICES
10295 Southwest Ridder Road Wilsonville, OR 97070
o 503.570.0626 f 503.582.9307 republicservices.com

March 8, 2019

Shayna Rehberg
Angelo Planning Group

Re: Willamette Water Supply Program
10350 SW Arrowhead Creek Ln.
Wilsonville, OR 97070

Dear Shayna,

Thank you, for sending us the site plans for this proposed development in Wilsonville.

My Company: Republic Services of Clackamas and Washington Counties has the trash and recycle collection franchise with the City of Wilsonville to service this area.

It is our understanding that the proposed Upper Site developments including an Electrical Building which will house a janitor room, locker room, and restroom that will not be regularly staffed and will not be generating trash and recycling material for disposal, with the exception of a natural disaster or other emergency event. Therefore there will not be a need for construction of a trash and recycle equipment enclosure at this time. If there are future plans to staff the proposed development, Republic Services will require review and approval of any trash and recycle equipment enclosure plans prior to construction of the enclosure. Should the need arise for temporary trash and recycle disposal during an emergency event, Republic Services will provide trash and recycle receptacles as needed, and will require accessible space for temporary placement at the site. After review of the Upper Site development plans access roadway, driveway entrance and exit, we are confident that there is adequate room for our trucks to safely access and navigate the site.

Thanks Shayna for your help and concerns for our services prior to this project being developed.

Sincerely,

Kelly Herrod
Operations Supervisor
Republic Services Inc.

Exhibit R: Materials Board

(Under Separate Cover)

Exhibit S: Tualatin Valley Water District Water Master Plan (December 2018)

Water Master Plan Update

December
2018

Tualatin Valley Water District

Delivering the Best Water Service Value

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Tualatin Valley Water District

Delivering the Best Water · Service · Value

WATER MASTER PLAN UPDATE

DECEMBER 2018

REGISTERED PROFESSIONAL ENGINEER
93639PE
OREGON
5/8/2018
JOSHUA R. MINER
EXPIRES: 12/31/2020

REGISTERED PROFESSIONAL ENGINEER
85767PE
OREGON
NOVEMBER 8, 2011
NICHOLAS WALTER AUGUSTUS
RENEWS: 12/31/2019

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TUALATIN VALLEY WATER DISTRICT

2018 WATER MASTER PLAN UPDATE

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APPENDIX E TVWD Water System Survey – September 2017

ABBREVIATIONS:

ADD -	Average Day Demand
ASR -	Aquifer Storage and Recovery Well
BPS -	Booster Pump Station
CCR -	Consumer Confidence Report
CFR -	Code of Federal Regulations
CFS -	Cubic Feet per Second
CIP -	Capital Improvement Plan
CSZ -	Cascadia Subduction Zone
DBPs -	Disinfection By-products
DRC -	Direct Responsible Charge
DSL -	Department of State Lands
ENR CCI -	Engineering News Record Construction Cost Index
EPA -	Environmental Protection Agency
EPS -	Extended Period Simulation
FPS -	Feet per Second
FT -	Feet
GIS -	Geographic Information System
GPM -	Gallons per Minute
HAA -	Haloacetic Acids
HGL -	Hydraulic Grade Line
HP -	Horsepower
IN -	Inches
JWC -	Joint Water Commission
LCR -	Lead and Copper Rule
LOS -	Level of Service
MCL -	Maximum Contaminant Level
MDD -	Maximum Day Demand
MG -	Million Gallons
MGD -	Million Gallons per Day
OAR -	Oregon Administrative Rule
OHA -	Oregon Health Authority
ORP -	Oregon Resilience Plan
OSSPAC -	Oregon Seismic Safety Policy Advisory Commission
PFS -	Program Formulation Study
PHD -	Peak Hour Demand
PRV -	Pressure Regulating Valve
PSI -	Pounds per Square Inch
PWB -	Portland Water Bureau
PZ -	Pressure Zone
RAA -	Running Annual Average
SCADA -	Supervisory Control and Data Acquisition
SDC -	System Development Charge
SDWA -	Safe Drinking Water Act
SPL -	Service Provider Letter
THMs -	Trihalomethanes
TVF&R -	Tualatin Valley Fire and Rescue District
TVWD -	Tualatin Valley Water District
UCMR -	Unregulated Candidate Monitoring Rule
UGB -	Urban Growth Boundary
UR -	Urban Reserve
USACE -	U.S. Army Corps of Engineers
VFD -	Variable Frequency Drive
WIF -	Willamette Intake Facilities
WMCP -	Water Management and Conservation Plan
WMP -	Water Master Plan
WMPU -	Water Master Plan Update
WRWC -	Willamette River Water Coalition
WRWTP -	Willamette River Water Treatment Plant
WTP -	Water Treatment Plant
WWSP -	Willamette Water Supply Program
WWSS -	Willamette Water Supply System

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TUALATIN VALLEY WATER DISTRICT

2018 WATER MASTER PLAN UPDATE

ES – Executive Summary

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

The Tualatin Valley Water District (District) is the second largest water provider in Oregon, providing an average of nearly 21 million gallons of water per day to approximately 211,000 customers. As part of its ongoing water system management, the District has prepared a Water Master Plan Update (WMPU) to summarize the existing water system, update demand projections, evaluate water resources, review water quality, perform system analyses, and revise its Capital Improvement Plan (CIP). This WMPU is required to meet state, county, and local requirements. The District's previous plan was updated in 2015 (2015 WMP).

This 2018 Water Master Plan Update (WMPU) was developed with the following major goals:

- Satisfy the Oregon Health Authority (OHA) water master plan requirements as outlined in Oregon Administrative Rule (OAR) 333-61-060.
- Provide updates regarding recent information and decisions related to the District’s sources of supply, which includes the addition of the Willamette River Supply by 2026.
- Provide updates to the CIP due to the following:
  - Several areas within the Beaverton City (City) limits will be hydraulically separated from the District and served by the City.
  - Miller Hill ASR is not yet functional, thus other improvements are necessary to meet peak demands in the Cooper Mountain area.

To accomplish the major goals listed above, the WMPU also includes updates for the following:

- Population projections and water demand forecasts through the planning period to 2068.
- An updated and calibrated water distribution system hydraulic model.
- Water system operations - updates for optimizing operations
- Distribution system reliability and resiliency updates
- An updated CIP for water supply, pipelines, pump stations, and reservoirs through a 50-year planning horizon with future expansion and associated infrastructure improvements.

The following is a brief description of the water system along with a summary of each of the chapters of the 2018 WMPU, including major assumptions, conclusions and recommendations.

ES.2 CHAPTER 1 - DESCRIPTION OF WATER SYSTEM

The District is located in Washington County, west of Portland. Under Oregon Revised Statutes, Chapter 264 – Domestic Water Supply Districts, the District serves a portion of Washington

County, including Aloha, Cedar Hills, Bethany, Rock Creek, Progress, Metzger, and Cooper Mountain. The District also serves portions of the cities of Hillsboro, Beaverton, and Tigard as shown in Figure ES.1. Major changes in this WMPU include the hydraulic separation or withdrawal of certain areas within Beaverton City limits. The ownership of the water system assets within the withdrawal areas were transferred to Beaverton on July 1, 2018, though they continue to be operated by the District. Figure ES.2 presents the District's service area, city boundaries, and indicates the areas which were transferred to City of Beaverton ownership.

The District was created in 1991 following the merger of the Wolf Creek Highway Water District (Wolf Creek), established in 1938, and the Metzger Water District (Metzger), established in 1924. The District is currently governed by a five-member Board of Commissioners elected to four-year terms by District voters. District staff reports to the Board which sets policies and procedures for the District.

The District's primary sources of water supply include wholesale water purchased from the Portland Water Bureau (PWB) and water received from the Joint Water Commission (JWC), of which the District is a part owner. The District also has an Aquifer Storage and Recovery Well (ASR) which it uses to reduce the need for additional peak water supply during the warm summer months. The District also has the ability to obtain groundwater if necessary during other times of the year under its own water rights. The District, in partnership with the City of Hillsboro is developing the Willamette Water Supply System (WWSS) as a future source of supply anticipated to be complete by 2026. This supply source is being delivered by the Willamette Water Supply Program. This additional source is anticipated to be one of the primary water supply sources for the District and will be fully resilient when complete. Additional information related to the WWSS is found in Chapter 7.

The District's existing water distribution system includes over 752 miles of pipelines, 12 booster pump stations, 39 pressure zones, and 21 active reservoirs with one (1) 5 million gallon (MG) reservoir replacement under construction, as shown geographically on Figure ES.3. The active reservoirs include pre-stressed concrete and welded steel tanks with a combined capacity of 57 MG. The system also includes one active ASR well, in-line hydroelectric energy generation, miscellaneous vaults, pressure regulators, and appurtenances. The District operates the water system to meet all applicable service regulations including water quality, pressure, and emergency planning.

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Figure ES.1 District Water Service Area

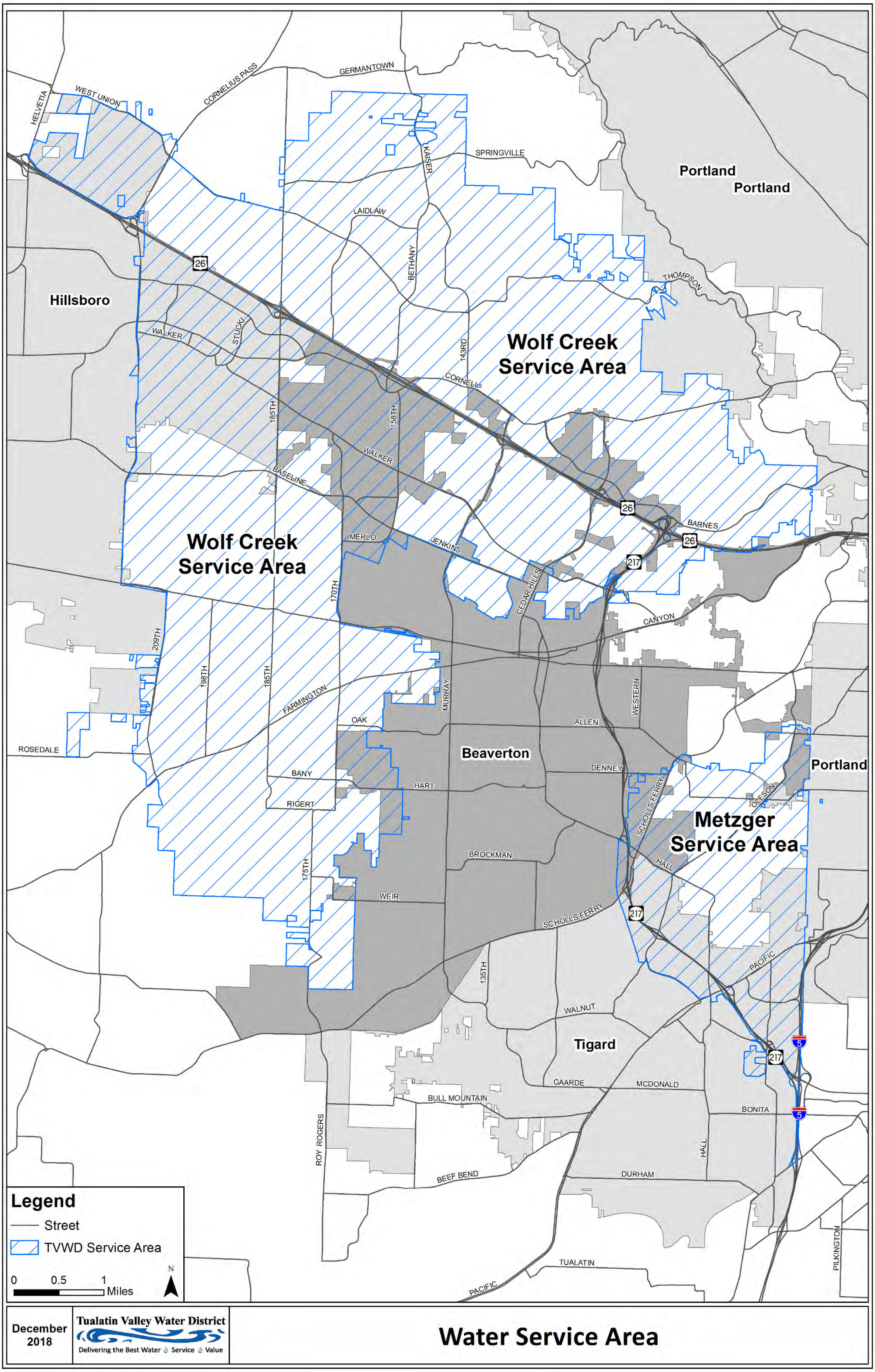

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Figure ES.2 Beaverton Withdrawal Areas

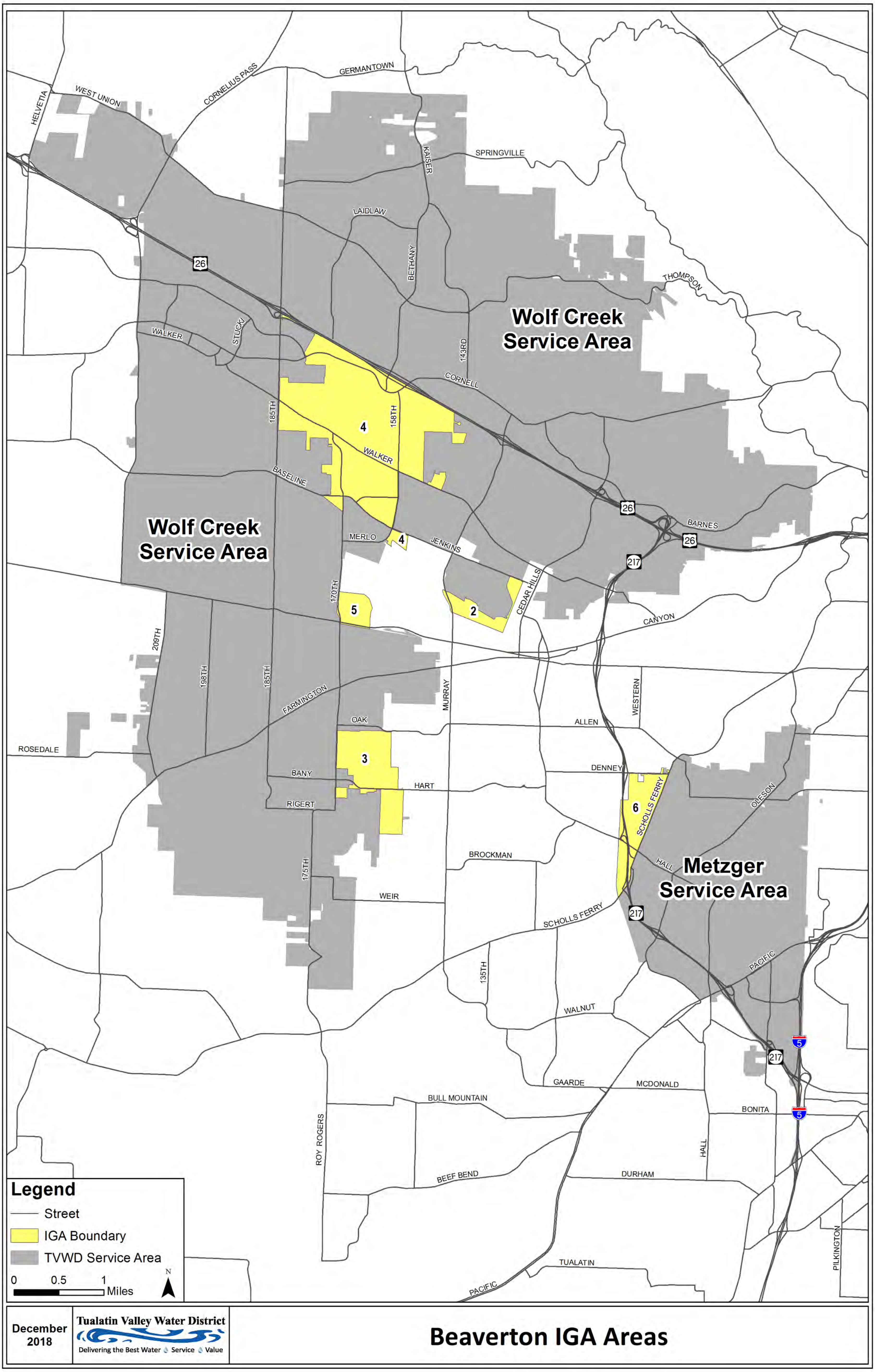

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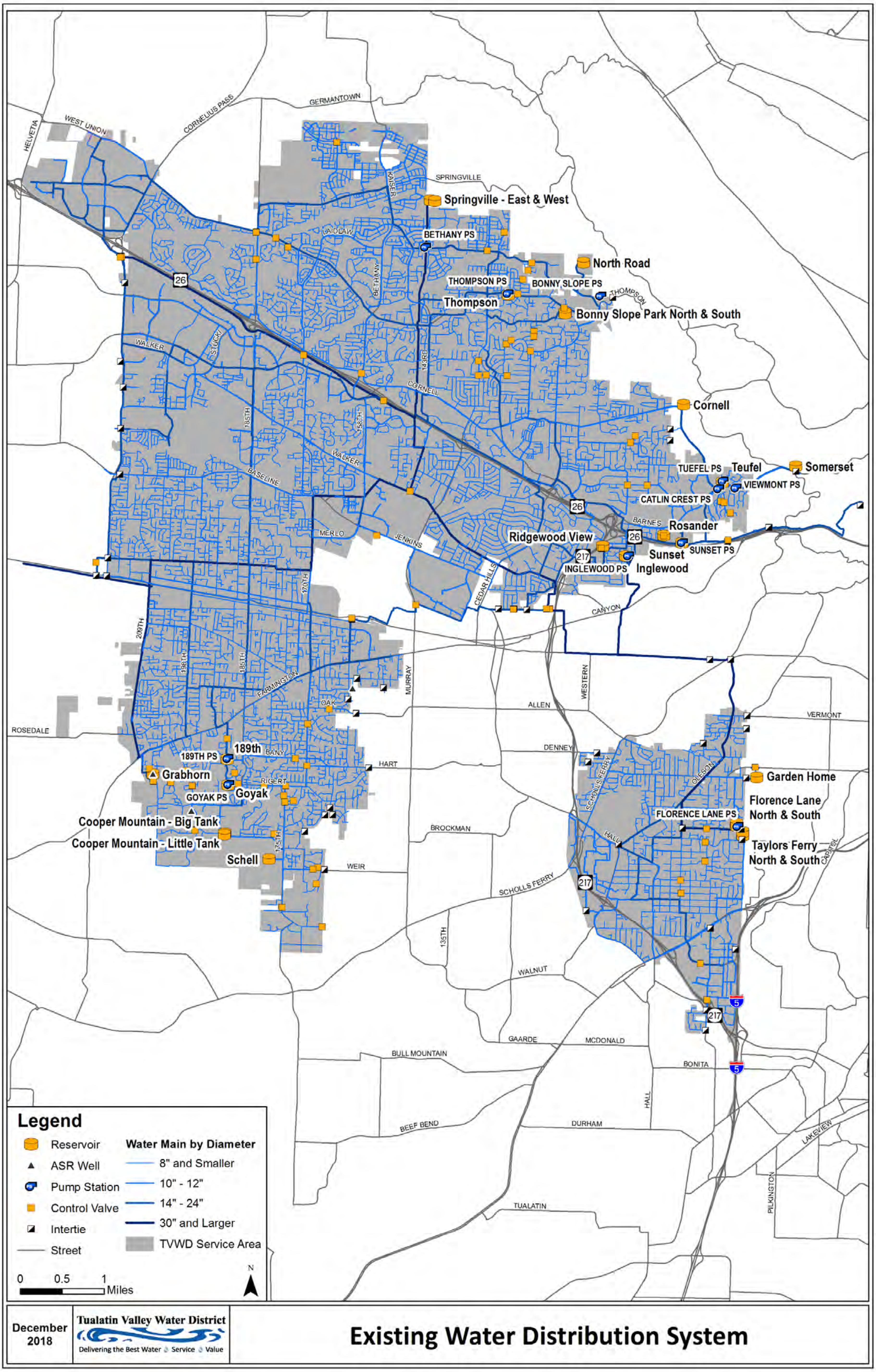
Figure ES.3 Existing Water Distribution System



ES.3 CHAPTER 2 - LEVEL OF SERVICE GOALS AND SYSTEM PLANNING CRITERIA

One of the primary purposes of the 2018 WMPU is to prepare a Capital Improvement Plan (CIP) with an updated comprehensive list of projects to achieve the District's desired level of functionality and reliability. Due to the withdrawal of certain areas of the District's system by the City, updates to the CIP are necessary to guide the District in constructing the most appropriate improvements on an acceptable timeline. The District's goals and criteria for system operation and performance are identified in Chapter 2. Level of Service (LOS) Goals provide a high-level vision for the system to ensure that it meets the District's mission, vision, and values:

Our Vision: Delivering the best water, service, value.

Our Mission: To provide our community quality water and customer service.

Our Values: Reliability, Integrity, Stewardship, Excellence, Safety, and Sustainability.

LOS goals consistent with the District's vision, mission, and values were developed as part of the 2015 WMP. The LOS goals support identification of capital improvement projects and are grouped into three categories: Reliability and Resiliency, Water Quality, and Sustainability and Stewardship.

System planning criteria provided the standards for the detailed analysis of all major system components for identifying deficiencies and the required improvements, including pressure zone supply redundancy criteria, pressure zone supply reliability criteria, fire flow criteria, storage capacity criteria, and transmission and distribution velocity and pressure criteria. These criteria inform the decision-making to determine the necessity and timing of the CIP.

One item noted in this chapter is the reference to high pressures in some areas of the District. Pipe leakage is associated with the pressures in the pipelines, thus the District continues to manage system pressures and evaluate options to reduce pressure when it exceeds 80 pounds per square inch (psi).

ES.4 CHAPTER 3 - WATER REQUIREMENTS

Existing and projected water demands for the District's Wolf Creek and Metzger Service Areas were updated from the previous 2015 WMP given recent demand history and assumptions related to the withdrawal of areas to the City of Beaverton. The previous work estimated demands using an approach that focused on land use and customer type. These projections enable the District to make informed decisions for planning infrastructure projects and for securing adequate water supply to meet demands exerted by future growth. Future water demands were used in the hydraulic analysis of the District's distribution system which was used to develop the CIP. The demands are also being used to determine the District's initial and future capacity from the WWSS.

The average day demand (ADD) from 2003 to 2017 was approximately 19.36 mgd for Wolf Creek and 2.23 mgd for Metzger. A portion of the ADD represents water loss from the system. Recent 2017 estimates for water loss in Wolf Creek indicate a 4.75% water loss and the estimates for Metzger indicate a 4.46% water loss. Meter inaccuracies have been corrected in recent years resulting in more consistent water loss estimates.

The maximum day demand (MDD) identifies the single highest flow day of the year and is typically used to determine supply capacity, pump station discharge rates, and reservoir capacity. Maximum demands typically occur during the summer months when irrigation is more prevalent. The average MDD from 2003 through 2017 was 38.1 mgd for Wolf Creek and 4.27 mgd for Metzger.

Growth rates were assumed to be equivalent to those identified in the 2015 WMP, with the water demand trend beginning in 2018 rather than 2015. The per capita water demand has been declining in recent years, though water demand is projected to rise with additional development. As identified in the previous study, the slight sudden increase in demand in 2034 represents the time at which West Union, West Bethany Urban Reserve (UR), and Shute Road UR are assumed to be brought into the District's service area. The large decrease in demand shown in 2025 and again towards the end of the planning horizon indicates demand reduction due to customers being hydraulically separated by the City of Beaverton. Ignoring the decrease at the end of the planning horizon, in 2068, it is projected that approximately 66.6 mgd of supply capacity will be required to meet peak day demands. The future demands do not account for demand reductions associated with additional water use efficiency or conservation measures by the District. These measures were presented separately in the 2015 Water Management and Conservation Plan.

Table ES.1	**Demand Projection Summary – Medium 2018 Water Master Plan Update Tualatin Valley Water District**			
	2018	**2026**	**2036**	**2068**
ADD Projections (mgd)				
Wolf Creek	22.5	23.2	25.0	29.6
Metzger	2.5	2.6	2.7	3.0
System Total	**25.0**	**25.8**	**27.7**	**32.6**
MDD Projections (mgd)				
Wolf Creek	45.7	48.0	51.6	60.6[1]
Metzger	5.0	5.1	5.4	6.0
System Total	**50.6**	**53.1**	**57.0**	**66.6**

[1]Transfer of services to City of Beaverton in 2066 is ignored.

ES.5 CHAPTER 4 - WATER RESOURCES

The District updated its Water Management and Conservation Plan (WMCP) at the same time as the 2015 WMP to ensure consistent supply planning. The District currently obtains its water supply from the Joint Water Commission (JWC) and the Portland Water Bureau (PWB). Under the current JWC agreement, the District can access up to 12.5 mgd of supply from the JWC water treatment plant. The JWC is currently working on an expansion of the water treatment plant which will make 14.5 mgd of supply available to the District. Under its current water sales agreement with the PWB, the District is required to purchase a minimum of 13.2 mgd annually and is limited to a maximum of 42.3 mgd. In addition, the District currently uses 2.5 mgd of its ASR system during peak summer demands or at other times as necessary.

The year 2026 is anticipated to be a turning point in water supply management for the District. The District expects to have access to the WWSS and anticipates utilizing up to 40 mgd of initial capacity from this source as its primary source of supply. Beginning in 2026, the District intends to meet demands in the Wolf Creek Service Area through a combination of water supply from the JWC, the District’s ASR program, and the WWSS supplied under extended permit S-49240. The District plans to serve its Metzger Service Area with supply from the WWSS beginning in 2026. The District may also elect to purchase wholesale water from the PWB to provide an emergency backup connection as an additional source of supply.

In planning for future demands beyond the 50-year horizon, the District is planning for full build-out capacity of 70.5 mgd. To supply this full demand capacity, the design capacity of the District’s main pipeline and supply from the WWSS is projected to be 59.1 mgd.

ES.6 CHAPTER 5 - WATER QUALITY

Water quality from the PWB and JWC sources, as well as within the distribution system, has consistently surpassed the current U.S. Environmental Protection Agency (EPA) requirements. The constituents tested in the raw and finished water are well below EPA maximum contaminant levels. As wholesale providers, PWB and JWC conduct all source water quality monitoring and are responsible for source water quality compliance. In addition, the District conducts its own water quality tests in the distribution system for disinfectant levels, coliform bacteria, disinfection by-products, lead, and copper. Refer to Chapter 5 for further analysis of source water quality in the District's water distribution system. As the District moves forward with design and incorporation of the WWSS into its supply portfolio, it will plan for and maintain the high water quality that is expected and will meet all standards for quality.

ES.7 CHAPTER 6 - SYSTEM ANALYSIS

Typical water master plans include evaluations of infrastructure capacity to meet standard level of service criteria under new demand assumptions. The District's 2018 WMPU includes these standard evaluations (such as the storage, pumping, pressure, and fire flow evaluations outlined in Chapter 6), which include details regarding new supply sources, removal of known City of Beaverton withdrawal areas, improved operations, and extreme emergency conditions. The details provided in this WMPU include:

- Water Age Analysis including Willamette Water Supply Source (Chapter 6);
- Operational Efficiency Analysis Update (Chapter 6);
- Metzger Supply Evaluation Update (Chapter 6);
- 385 Zone Operational Improvements Evaluation Update (Chapter 6);
- Willamette Supply Integration Study Update (Chapter 7);
- Seismic Resiliency Study – Not part of the current update. The 2015 study recommendations still apply.

Each study results in recommended improvements or ongoing strategies to resolve deficiencies and address the issues of concern. The timing of projects is critical in meeting the District's goals for each study for specific demand conditions (2026, 2038, and 2068). The timing of external projects such as integrating the WWSP by 2026 was also evaluated. In general, the following sections describe the major changes between the 2015 WMP and the current WMPU. Refer to the individual chapters for additional details.

ES.7.1 Storage, Zone Supply, and Distribution System Analyses

Several analyses of the District's water system were conducted to identify deficiencies in system infrastructure and provide updated recommendations given the new supply and operations scenarios. The purpose of these analyses is to evaluate the major aspects of the day-to-day operations of the District: storage, supplies, and the distribution system. Recommended improvement projects are categorized by planning horizon (short-term from 2018 to 2026, mid-term from 2027 to 2038, and long-term from 2038 to 2068).

ES.7.1.1 Storage Analysis

Required storage volumes were compared to the available storage to identify storage surplus or deficits through 2068. Several areas of the system exhibited storage deficits. However, the overall system shows a storage surplus for all planning years.

Given the ability to move excess 435 Zone storage throughout the system, no new storage volume is needed to meet the 2068 demand conditions under the District's storage criteria. However, for the purpose of reliability and resiliency under a "Catastrophic Event" as defined in Chapter 2, additional storage is recommended for operating areas where real estate is available or is currently owned by the District. In addition, structural upgrades for seismic resiliency are recommended for several existing reservoirs. Storage improvement recommendations are summarized in Table ES.2.

ES.7.1.2 Water Age Analysis

The District recognized that the increase in storage, utilizing different supply sources, and different demand scenarios may impact water age, or the amount of time water remains in the system before use. Increased water age is generally associated with decreased chlorine residual and related potential water quality issues. An evaluation of water age was conducted to guide the District's ongoing water quality monitoring program to avoid potential water quality issues related to higher water age. Different pipeline sizes from the WWSS were evaluated as well as water age in 2026 versus 2018. In general, the water age in the Metzger service area and the Cooper Mountain service area is greatly improved with the addition of the WWSS.

ES.7.1.3 Zone Supply Analysis

The District's ability to meet system-wide demands with purchased water and ASR Well production was reviewed and updated in Chapter 4 – Water Resources. The zone supply analysis reviewed the capacity to supply customers at each pressure zone with adequate redundancy and reliability for all demand conditions. Several improvement projects were identified to address zone supply deficiencies, which are summarized in Table ES.2.

ES.7.1.4 Metzger Supply Analysis Update

Recent work has been done to determine the timing and location of the connection from the WWSS to the Metzger service area. This WMPU assumes the eastern extension will connect directly to the Metzger service area and will be the main source of supply by 2026. This connection will provide system resiliency and can provide source redundancy to the Metzger service area if the PWB connection is maintained as an emergency connection.

ES.7.1.5 Distribution System Analysis

The District's hydraulic model was used to evaluate the distribution system capacity. The existing InfoWater™ model which was updated and calibrated as part of the 2015 WMP was updated to incorporate additional infrastructure and changes that have occurred since the 2015 WMP was completed. The updated model was used to analyze:

- System Pressures,
- Pipe Velocities, and
- Fire Flows.

Identified deficiencies were first addressed through storage improvements, pumping improvements, and transmission improvements as recommended elsewhere in this WMPU. The remaining deficiencies were addressed through pipeline improvement projects, which include both local improvements and larger transmission projects. All recommendations are sized to meet 2068 demand conditions and are described in Chapter 6.

ES.7.1.6 385 Zone Operational Improvements Update

Recent analyses have been conducted for the 385 Zone, which encompasses approximately 39 percent of the District’s entire service area. Large pressure zones present many operational challenges in balancing pressures, which can lead to customer complaints of low pressures. The 385 Zone has highly variable customer elevations and somewhat limited transmission capacity for supplies that enter the zone from several locations. The District recently resolved isolated low-pressure issues by increasing the pressure settings of nearby PRVs that supply water from the 435 Zone. The District has also done work to make sure total demand entering the 385 Zone does not exceed total allowable demand from the District’s supply sources.

It was previously recommended that the District increase transmission capacity within the zone and maintain the new pressure settings on supplying PRVs. With the introduction of the WWSS in 2026, the transmission capacity improvement projects within the 385 Zone can be delayed. Assumed connection points which make this possible include the connection at Farmington & 209th, and the connection at Cornelius Pass Rd & Hwy 26. Delivering water directly to the 385 Zone at these locations allows the District to postpone transmission capacity upgrades. In addition, the City of Beaverton IGA withdrawal areas within the 385 Zone contribute to additional postponement of the transmission upgrades.

ES.7.1.7 ASR Analysis

The District currently owns and operates one ASR well. The Grabhorn ASR Well serves the 385 Zone and is located adjacent to the Grabhorn Reservoir. A second ASR Well owned by the District is not currently in operation and was excluded from the analysis.

ES.8 CHAPTER 7 - WILLAMETTE SUPPLY INTEGRATION

The District is in the process of implementing the WWSS to supply both the Wolf Creek and Metzger service areas with a new resilient source of supply by 2026. The previous 2015 WMP had determined that the Metzger service area would be connected to the WWSS in the future, but until then it would be served by PWB. After further analysis, it was determined that an eastern alignment which will connect both the Metzger and Wolf Creek areas to the WWSS by 2026 will provide the greatest advantage in terms of cost, reliability, and operational flexibility. This alignment and the connection locations identified are beneficial, as they are the most similar to the current system operation and will not require much additional improvement to the District's current system. Additional information related to the WWSS can be found in Chapter 7, and attached in Appendix C.

ES.9 CHAPTER 8 - SEISMIC RELIABILITY AND RESILIENCY

Agencies providing public services in western Oregon and Washington are under increasing pressure to plan for meeting critical customer needs and ongoing recovery after a regional catastrophic earthquake. Historical evidence suggests that the anticipated Cascadia Subduction Zone (CSZ) Earthquake could reach a magnitude 9.0 and last as long as three minutes. An earthquake of this size would prove catastrophic to cities in western Oregon and Washington. In February 2013, the Oregon Seismic Safety Policy Advisory Commission (OSSPAC) released the Oregon Resilience Plan (ORP). The District is taking the recommendations of the ORP seriously, beginning with the evaluation presented in Chapter 8 of the 2015 WMP on seismic reliability and resiliency of its water system.

In evaluating the seismic reliability and resiliency of the District's water system, several analyses were performed as part of the 2015 WMP. The recommended seismic resiliency program project list, which was developed as part of the 2015 WMP, has been updated given the changes and assumptions contained in this WMPU. The resulting transmission improvement program is estimated to cost approximately $216.7 M over the 50-year planning period. Additional detail on the development of this program and cost estimating assumptions is provided in Chapter 8 of this Plan.

ES.10 CHAPTER 9 - CAPITAL IMPROVEMENT PLAN

The purpose of the CIP is to provide the District with a guideline for the planning and budgeting of improvements to its water system. A meeting was held with District staff to review and update the recommendations from all evaluations in this WMPU. Resulting projects were identified and prioritized for inclusion in this comprehensive CIP.

Project phasing was developed for the 10-year planning period to show projects divided into biennial increments through FY 2026, then 5-year increments for the mid-term (2027 – 2048), and finally long-term planning horizons for the 50-year planning period (2048 - 2068).

All costs were estimated in 2018 dollars and are based on an Engineering News Record Construction Cost Index (ENR CCI) 20-City Average of 11013 (May 2018). Cost estimates were developed using a Class 4 budget estimate, as established by the American Association of Cost Estimators. This level of estimate is used for budgeting and feasibility studies and assumes a 1 percent to 15 percent level of project definition. The expected accuracy range is -30 percent to +50 percent, meaning the actual cost should fall in the range of 30 percent below the estimate to 50 percent above the estimate.

ES.10.1 CIP Summary

Table ES.2 provides a summary of the short-term recommended CIP projects. Table ES.3 provides a summary of the full CIP recommended projects. As seen in the table, the total CIP estimate is anticipated to cost $768,660,000. Of the total, 11-percent of the cost is anticipated to be expended by 2026. It is anticipated that future master plan updates will further revise the cost estimates and prioritization of projects for the long-term.

ES.10.2 Additional Recommendations

Recommendations which were detailed in the 2015 WMP identified several additional recommendations not part of capital planning projects. Refer to Chapter 9 of the 2015 WMP for additional details.

Table ES.2 Short-Term CIP Summary WMPU 2018

ID	Project	Total Short-Term Cost	Short-Term by Biennium				
			2018/2019	2020/2021	2022/2023	2024/2025	2026/2027
General		**$350,000**	**$0**	**$0**	**$0**	**$350,000**	**$0**
G-1	Water Master Plan Updates*	$350,000	$0	$0	$0	$350,000	$0
Seismic Resilience Planning		**$1,320,000**	**$260,000**	**$260,000**	**$260,000**	**$260,000**	**$280,000**
S-1	Retainer Agreements*	$800,000	$160,000	$160,000	$160,000	$160,000	$160,000
S-2	Pressure Monitoring Stations	$20,000	$0	$0	$0	$0	$20,000
S-3	Stockpile Pipe & Materials	$500,000	$100,000	$100,000	$100,000	$100,000	$100,000
Storage		**$22,800,000**	**$11,720,000**	**$3,780,000**	**$5,000,000**	**$800,000**	**$1,500,000**
ST-3	Goyak Reservoir Seismic Upgrades	$750,000	$0	$0	$0	$750,000	$0
ST-4	Cooper Mountain 3 Reservoir	$5,000,000	$0	$0	$5,000,000	$0	$0
ST-5	Taylors Ferry S Reservoir Replacement	$3,660,000	$0	$3,660,000	$0	$0	$0
ST-7	North Road Reservoir Seismic Study*	$50,000	$0	$0	$0	$50,000	$0
ST-9	Grabhorn 1 Reservoir Replacement	$11,720,000	$11,720,000	$0	$0	$0	$0
ST-13	Taylors Ferry N Reservoir Seismic Upgrades	$1,500,000	$0	$0	$0	$0	$1,500,000
ST-18	Storage Facility Condition Assessments*	$120,000	$0	$120,000	$0	$0	$0
Pumping		**$8,340,000**	**$480,000**	**$2,830,000**	**$0**	**$5,030,000**	**$0**
BP-1	Cooper Mountain BPS Expansion	$2,710,000	$0	$2,710,000	$0	$0	$0
BP-2	Catlin Crest BPS Expansion & Backup Power	$190,000	$190,000	$0	$0	$0	$0
BP-3	Viewmont BPS Expansion & Backup Power	$290,000	$290,000	$0	$0	$0	$0
BP-4	Farmington Road BPS	$5,030,000	$0	$0	$0	$5,030,000	$0
BP-7	Pump Station Condition Assessments*	$120,000	$0	$120,000	$0	$0	$0
Piping		**$69,507,000**	**$4,010,000**	**$14,936,000**	**$13,481,000**	**$17,662,000**	**$19,418,000**
P-2	Fire Flow Improvements	$17,507,000	$0	$7,426,000	$2,871,000	$4,052,000	$3,158,000
P-3	Transmission Pipe Condition Assessments*	$1,300,000	$260,000	$260,000	$260,000	$260,000	$260,000
P-4	Mains Replacement Program	$50,700,000	$3,750,000	$7,250,000	$10,350,000	$13,350,000	$16,000,000
P-5	Farmington Rd BPS Discharge Main	$4,391,000	$0	$0	$4,391,000	$0	$0
Total CIP		**$102,317,000**	**$16,470,000**	**$21,806,000**	**$18,741,000**	**$24,102,000**	**$21,198,000**

*Note: Projects will be included in the operating budget and are not anticipated to be Capital Improvements.

Table ES.3 Full CIP Summary WMPU 2018

ID	Project	Total CIP Cost	Short-Term	Mid-Term	Long-Term
			2018-2027	2028-2048	2049-2068
General		**$6,620,000**	**$350,000**	**$4,060,000**	**$2,210,000**
G-1	Water Master Plan Updates*	$1,750,000	$350,000	$700,000	$700,000
G-2	PRV Installation Program	$4,870,000	$0	$3,360,000	$1,510,000
Seismic Resilience Planning		**$6,800,000**	**$1,320,000**	**$2,180,000**	**$3,300,000**
S-1	Retainer Agreements*	$4,000,000	$800,000	$1,600,000	$1,600,000
S-2	Pressure Monitoring Stations	$200,000	$20,000	$80,000	$100,000
S-3	Stockpile Pipe & Materials	$1,000,000	$500,000	$500,000	$0
S-4	Emergency Underground Storage	$1,600,000	$0	$0	$1,600,000
Storage		**$68,070,000**	**$22,800,000**	**$4,030,000**	**$41,240,000**
ST-1	Rosander 2 Reservoir	$2,690,000	$0	$2,690,000	$0
ST-2	North Bethany 1 Reservoir	$6,000,000	$0	$0	$6,000,000
ST-3	Goyak Reservoir Seismic Upgrades	$750,000	$750,000	$0	$0
ST-4	Cooper Mountain 3 Reservoir	$5,000,000	$5,000,000	$0	$0
ST-5	Taylors Ferry S Reservoir Replacement	$3,660,000	$3,660,000	$0	$0
ST-6	Grabhorn 2 Reservoir	$8,060,000	$0	$0	$8,060,000
ST-7	North Road Reservoir Seismic Study*	$50,000	$50,000	$0	$0
ST-8	Reservoir Isolation Valve Program	$1,100,000	$0	$1,100,000	$0
ST-9	Grabhorn 1 Reservoir Replacement	$11,720,000	$11,720,000	$0	$0
ST-10	Sunset Reservoir Replacement	$2,690,000	$0	$0	$2,690,000
ST-11	Somerset Reservoir Replacement	$1,340,000	$0	$0	$1,340,000
ST-12	Teufel 2 Reservoir	$2,690,000	$0	$0	$2,690,000
ST-13	Taylors Ferry N Reservoir Seismic Upgrades	$1,500,000	$1,500,000	$0	$0
ST-14	Cornell Reservoir Demolition*	$100,000	$0	$0	$100,000
ST-15	North Bethany 2 Reservoir	$4,000,000	$0	$0	$4,000,000
ST-16	Inglewood Reservoir Replacement	$13,430,000	$0	$0	$13,430,000
ST-17	Rosander Reservoir Replacement	$2,690,000	$0	$0	$2,690,000
ST-18	Storage Facility Condition Assessments*	$600,000	$120,000	$240,000	$240,000

*Note: Projects will be included in the operating budget and are not anticipated to be Capital Improvements.

ID	Project	Total CIP Cost	Short-Term	Mid-Term	Long-Term
			2018-2027	2028-2048	2049-2068
Pumping		**$11,220,000**	**$8,340,000**	**$2,640,000**	**$240,000**
BP-1	Cooper Mountain BPS Expansion	$2,710,000	$2,710,000	$0	$0
BP-2	Catlin Crest BPS Expansion & Backup Power	$190,000	$190,000	$0	$0
BP-3	Viewmont BPS Expansion & Backup Power	$290,000	$290,000	$0	$0
BP-4	Farmington Road BPS	$5,030,000	$5,030,000	$0	$0
BP-5	Bethany BPS Expansion	$0	$0	$0	$0
BP-6	Rosander BPS	$2,400,000	$0	$2,400,000	$0
BP-7	Pump Station Condition Assessments*	$600,000	$120,000	$240,000	$240,000
Piping		**$675,950,000**	**$69,510,000**	**$293,950,000**	**$312,490,000**
P-1	Transmission Improvement Program	$216,660,000	$0	$97,580,000	$119,080,000
P-2	Fire Flow Improvements	$85,990,000	$17,510,000	$35,070,000	$33,410,000
P-3	Transmission Pipe Condition Assessments*	$2,600,000	$1,300,000	$1,300,000	$0
P-4	Mains Replacement Program	$370,700,000	$50,700,000	$160,000,000	$160,000,000
P-5	Farmington Rd BPS Discharge Main	$4,391,000	$4,391,000	$0	$0
Total CIP		**$768,660,000**	**$102,320,000**	**$306,860,000**	**$359,480,000**

*Note: Projects will be included in the operating budget and are not anticipated to be Capital Improvements.

Exhibit T: Willamette Water Supply Program Water Supply Program Formulation Summary (October 31, 2018)

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Willamette Water Supply
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Willamette Water Supply Program

Program Formulation Summary

Executive Summary

October 31, 2018

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List of Abbreviations and Acronyms

Beaverton	City of Beaverton
cfs	cubic feet per second
CM/GC	Construction Manager/General Contractor
DSL	Oregon Department of State Lands
Hillsboro	City of Hillsboro
MG	million gallons
MGD	million gallons per day
ODOT	Oregon Department of Transportation
OHA	Oregon Health Authority
Partners	Tualatin Valley Water District and the cities of Hillsboro, Beaverton, Wilsonville, Sherwood, and Tigard
PFS	Program Formulation Summary
PLE	eastern extension of the Willamette Water Supply System pipelines
PLM	main stem of the Willamette Water Supply System pipelines
PLW	western extension of the Willamette Water Supply System pipelines
PLE_1.0	Beaverton Area Pipeline Project
PLM_1.0	Wilsonville Area Pipeline Project
PLM_1.1	Wilsonville Road
PLM_1.2	Garden Acres Road to 124th
PLM_1.3	Wilsonville Rd to Garden Acres
PLM_2.0	Kinsman Road Partnership Project
PLM_3.0	124th Avenue Partnership Project
PLM_4.0	Tualatin-Sherwood Area Pipeline
PLM_4.1	Highway 99 Crossing
PLM_4.2	Tualatin-Sherwood Road
PLM_4.3	Roy Rogers Road
PLM_5.0	Scholls Area Pipeline Project
PLM_5.1	North of Beef Bend to Scholls
PLM_5.2	Scholls to Grabhorn Rd
PLM_5.3	Grabhorn Rd at Tile Flat to Farmington
PLW_1.0	South Hillsboro Area Pipeline Project

PLW_1.1	Blanton to TV Hwy
PLW_1.2	TV Hwy to Frances
PLW_1.3	Farmington to Blanton
PLW_2.0	Cornelius Pass Pipeline Project
Project Participants	Tualatin Valley Water District and the City of Hillsboro
ROW	right of way
RWF_1.0	Raw Water Facilities
SW	Southwest
Tigard	City of Tigard
TVWD	Tualatin Valley Water District
UGB	urban growth boundary
USACE	U.S. Army Corps of Engineers
UV	ultraviolet
WCSL	Washington County Supply Line
WIF	Willamette Intake Facilities
Wilsonville	City of Wilsonville
WRWTP	Willamette River Water Treatment Plant
WTP	Water Treatment Plant
WWSP	Willamette Water Supply Program
WWSS	Willamette Water Supply System

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Executive Summary

Tualatin Valley Water District (TVWD) and the City of Hillsboro, collectively referred to as the Project Participants, have identified the Willamette Water Supply System (WWSS) as the best option for future delivery of drinking water to their service areas in Washington County. The Project Participants are leading the Willamette Water Supply Program (WWSP) to develop the WWSS. The mid-Willamette River at the City of Wilsonville (Wilsonville) will be the water supply source for the WWSS. Developing an additional water supply through a partnership supports the region's plans for responsible growth within the Urban Growth Boundary (UGB).

The WWSS will include more than 30 miles of water transmission pipelines ranging in diameter from 36 inches to 66 inches from the raw water facilities in Wilsonville north to Hillsboro and the Tualatin Valley Water District service areas. The WWSP also includes constructing two finished-water storage tanks (terminal storage), constructing a new water treatment plant (WTP), and expanding the raw water facilities, including replacing the fish screens and seismic improvements at the existing intake facility on the Willamette River. The WWSS will provide the Project Participants and the region with a seismically resilient water supply to meet future water demands and provide redundancy in case of a future emergency event. Other municipalities or water agencies may join the Project Participants in the future for implementing the WWSP, or for emergency interconnections. Currently, the City of Beaverton (Beaverton) is considering joining the WWSP, and the City of Tigard is planning to have an emergency intertie.

Introduction

This Program Formulation Summary (PFS) was prepared as the next step to the overall master planning efforts recently completed or under way by the Project Participants. The PFS documents the description of the WWSS, including WWSP actions and permitted facilities, and rationale that led to selection of the WWSP facilities and actions. This document was prepared to be consistent with the alternatives analysis following the Clean Water Act, Section 404(b)(1) guidelines and Oregon Health Authority (OHA) approved facility plans. The level of detail reflects the design progress for each facility, as many facilities are still in the preliminary design phase.

This PFS provides common definition and understanding of what will be constructed and implemented for the WWSS in easily understandable, straightforward language that describes the current WWSS configuration and rationale. This document does not contain technical details describing various decisions, but conveys information at a higher level than the engineering design, reports, and permit application details for the WWSS. This PFS summarizes various documents that contain more detailed technical and permitting information and summarizes the latest configurations, completed designs, and outcomes of decisions as part of the following processes and associated documents:

- Conveyance and Storage Preliminary Design and Value Engineering
- Willamette River Water Treatment Plant (WRWTP) Master Plan (2016 Update)

- Reservoir Site Selection
- WTP Site Selection
- Opportunity Project Evaluations and Detailed Designs
- Water Supply Planning and Water Rights
- Permitting Strategy and Alternatives Analysis

Planning Considerations

The Project Participants are developing the WWSS to be a resilient and reliable water source for future population and economic growth and for seismic risk, as well as other regional conditions. The Project Participants' collective service area is located in Washington County, the second most populous county in Oregon. Together, the Project Participants serve a population of approximately 300,000; TVWD alone has the second-largest drinking water customer base in the state. Washington County is also home to many commercial and industrial facilities that are key to growing and sustaining the health of Oregon's economy; a reliable and resilient water supply is foundational to maintaining the economic vitality of Washington County. It is within this regional setting the Project Participants defined the purpose of the WWSS. The purpose of the WWSS is to provide a long-term water supply option to serve the projected water supply needs of the TVWD and Hillsboro residents and businesses.

To achieve the purpose of the WWSS, the chosen water supply option must meet the following needs:

- Meet projected future water demands, supporting the region's plans for responsible growth within the UGB
- Reliably deliver water, including in times of droughts, earthquakes, or other disasters
- Supply finished quality water to TVWD and Hillsboro customers
- Be cost-effective and placed in service by July 2026
- Support ownership and control of the water supply via a partnership between TVWD and Hillsboro

A summary of the criteria identified by Hillsboro and TVWD in their independent supply source evaluations is presented in Table ES-0-1.

Table ES-0-1 Criteria Considered for Supply Source Evaluation

City of Hillsboro Criteria	Tualatin Valley Water District Criteria
Cost	Demand Uncertainty[1]
Reliability	Source Reliability
Redundancy	Source Redundacy
Implementation Risk	Implementation Risk
Operational Complexity[2]	Public Acceptance
Responsiveness to Demand Growth	Community Impacts
Source Water Quality	Metzger Fluoridation[3]
Treated Water Quality	Finished Water Quality
Environmental Impacts	Sustainability
Ownership	Governance

Notes:

[1] Ability of the supply to provide additional capacity if demands are greater than projected and accommodate demands less than forecast through phasing and/or scaling improvements.

[2] Potential level of difficulty in running a water supply and treatment system that maintains the City of Hillsboro's current high level of service quality.

[3] Ability to continue non-fluoridated supply to Metzger Service Area.

Alternatives Development and Evaluations

The Project Participants evaluated a number of potential water supply alternatives, identifying constraints and planning criteria for consideration when selecting a water supply source. While some planning constraints or criteria are more rigid than others (i.e., current applicable laws, regulations, policies, and physical conditions), others may be less restrictive, but still influential in selecting and defining WWSS alternatives. Some examples of WWSS planning constraints and criteria are:

- Alternatives should address, at a minimum, the defined purpose and needs.
- Alternatives should consider issues raised in coordination with federal, state, and local agencies.
- Alternatives should not result in a substantial adverse effect to existing and future water supplies.
- Alternatives should either avoid potential adverse effects to recreational/community resources or include features to mitigate significant impacts, when feasible.
- Alternatives should have a high certainty for achieving intended benefits and not depend on long-term actions (past the initial construction period) for success.

These planning constraints/criteria were applied to evaluate the supply source alternatives. The Project Participants ultimately identified the mid-Willamette River as the water supply option that best aligns with the WWSS purpose and needs of the region.

The Project Participants conducted numerous studies and reports investigating the various alternatives for implementing the WWSS, including: pipeline routes and alignments; reservoir siting; WTP features, processes, and siting; and intake expansion sizes and physical configurations. Screening and evaluation criteria based on planning considerations were used to shortlist preferred alternatives and approaches. Preliminary design efforts further developed WWSP critical path needs, cost estimates, and project scheduling.

The following sections summarize the alternatives evaluation process for facilities and pipelines from south to north, including the raw water facilities, pipelines, WTP, and Reservoir.

Raw Water Facilities

The current permitted withdrawal capacity at the existing Willamette Intake Facilities (WIF) is 70 million gallons per day (MGD) (108 cubic feet per second (cfs)). The intake diverts raw water from the Willamette River into the raw water pump station caisson via a 76-inch diameter pipeline that extends into the river from beneath the riverbank. Raw water flows by gravity to the caisson, which serves as a wet-well for the vertical turbine raw water pumps. Two 66-inch diameter, stainless steel cylindrical tee screens were installed approximately 80-100 feet from the river's edge on the intake pipeline to prevent debris and fish from being drawn into the caisson. The screen system was designed and approved according to the Oregon Department of Fish and Wildlife and National Marine Fisheries Service standards to meet the Endangered Species Act requirements for anadromous fish protection. Because the Willamette River is a navigable water of the U.S., in-river construction work requires a Federal Clean Water Act/Rivers and Harbors Act permit through the U.S. Army Corps of Engineers (USACE), in addition to approval by the Oregon Department of State Lands (DSL). The existing intake system was permitted in February 2000 through a joint USACE-DSL authorization and a separate USACE authorization in September 2000.

The current planned intake capacity is 150 MGD (278 cfs). Based on results of the technical evaluation, the planned intake expansion could be accomplished by replacing the existing 66-inch diameter screens with larger diameter screens. This could occur similar to maintenance activities using a barge, crane, and divers to remove the existing tee screens (unbolting the screens from the 54-inch diameter outlet flanges) and installing the new/larger screens on the same flanges. This work would be conducted during low water and low-flow conditions in the late summer or early fall and coincide with the in-water work period. The existing raw water pump station at the WIF will accommodate the increased intake capacity by replacing the existing pumps with larger pumps and adding more pumps. Seismic and structural vulnerabilities will be addressed through mitigation at the top and toe of the riverbank.

Pipelines

The WWSS pipelines include the main stem, western extension, and eastern extension (PLM, PLW, and PLE, respectively). The pipelines are divided into individual work packages (some with sub-work packages). The work packages are numbered from south to north and currently include the following (names and numbering may change as the WWSP progresses through design and construction):

- **PLM_1.0: Wilsonville Area Pipeline Project**. PLM_1.0 includes three sub-work packages: Wilsonville Road (PLM_1.1), Garden Acres Road to 124th (PLM_1.2), and Wilsonville Rd to Garden Acres (PLM_1.3)
- **PLM_2.0: Kinsman Road Partnership Project**. PLM_2.0 does not include sub-work packages.

- **PLM_3.0: 124th Avenue Partnership Project**. PLM_3.0 does not include sub-work packages.
- **PLM_4.0: Tualatin-Sherwood Area Pipeline**. PLM_4.0 includes three sub-work packages: Highway 99 Crossing (PLM_4.1), Tualatin-Sherwood Road (PLM_4.2), and Roy Rogers Road (PLM_4.3).
- **PLM_5.0: Scholls Area Pipeline Project**. PLM_5.0 includes three sub-work packages: North of Beef Bend to Scholls (PLM_5.1), Scholls to Grabhorn Rd (PLM_5.2), and Grabhorn Rd at Tile Flat to Farmington (PLM_5.3).
- **PLW_1.0: South Hillsboro Area Pipeline Project**. PLW_1.0 includes three sub-work packages: Blanton to TV Hwy (PLW_1.1), TV Hwy to Frances (PLW_1.2), and Farmington to Blanton (PLW_1.3).
- **PLW_2.0: Cornelius Pass Pipeline Project**. PLW_2.0 does not include sub-work packages.
- **PLE_1.0: Beaverton Area Pipeline Project**. PLE_1.0 does not include sub-work packages.

Prior to identifying individual pipeline project work packages, alternative routes were divided into four sections based on known fixed points of the WWSS. These points were based on connections to other existing and WWSS-related infrastructure, such as water source and treatment, existing water distribution systems, early opportunities to team with other agencies' projects, and other components such as finished water storage.

Matrices were developed to present ratings for each pipeline route based on mapping, site visits, and agency feedback meetings performed during the routing study. Following the initial evaluation process, a more detailed investigation of potential routes was conducted. The preferred pipeline alignment was determined by applying knowledge of utilities, existing obstructions (e.g., retaining walls, culverts, or bridges), future roadway projects, and other considerations.

A unique aspect of the WWSP is the option of teaming or coordinating with other agencies – primarily Washington County, the Oregon Department of Transportation (ODOT), local municipalities, and private land developers – on projects that will coincide with constructing the WWSS pipelines (called opportunity projects). Opportunity projects have several advantages, including reducing environmental and community impacts, and providing potential cost savings.

WWSP staff meet with the agencies planning these opportunity projects to assess the timing of projects and coordinate scheduling with WWSP projects. The WWSP developed a business case analysis process to critically evaluate each opportunity project on a case-by-case basis to support pursuing or foregoing each potential opportunity.

During preliminary pipeline design, WWSP staff identified 27 separate partnering opportunities. Many of these opportunity projects ultimately fell outside of the preferred route and are no longer viable. As of July 2018, the Project Participants are constructing or have completed construction on three of the previously identified opportunity projects (PLM_2.0, PLM_3.0, and PLW_1.1) and are actively coordinating on opportunities for PLM_1.1, PLM_1.2, PLM_4.1, PLM_4.2, PLM_5.1, PLM_5.2, and PLW_1.2. The Project Participants continue to work with the relevant agencies to investigate other potential opportunity projects.

Water Treatment Plant

Initial water treatment alternatives included variations on expanding facilities at the existing WRWTP in Wilsonville. As planning progressed, the Project Participants identified several constraints with expanding the WRWTP and recognized potential benefits of other optional sites in Washington County, including:

- Additional seismic stability/resiliency
- Fewer environmental and construction-related impacts to Arrowhead Creek
- Fewer construction and operational impacts to adjacent neighbors
- Easier maintenance of finished water quality due to shorter length of the finished water pipeline
- A less confined site for treatment plant components and future expansions

Considering these potential benefits, the Project Participants conducted a high-level screening of potential alternative WTP sites. The Project Participants identified the following key parameters:

- A minimum of 10 acres was used to initially identify and screen sites, as it provides the minimum area needed for WTP infrastructure. The absolute minimum space depends on site-specific configurations (e.g., parcel shape and topography) and constraints (e.g., setbacks).
- The property owner(s) expressed an interest in selling either to the public (property was listed for sale at the time of screening) or directly to the WWSP or Project Participants.
- Only sites immediately adjacent or in close proximity to the WWSS pipeline alignment were considered. Proximity to existing or anticipated roads of sufficient size to accommodate construction vehicles to and from the site was also considered.

The screening identified four alternative sites that met these parameters, including the WRWTP and three alternative sites located in Washington County. Site explorations were then conducted on the four sites to support a criteria-based evaluation and comparison among the sites to determine the preferred WTP site. Where relevant, site explorations included on-site field investigations where rights-of-entry were obtained and desktop analyses were conducted using off-site methods and existing, readily available information. The WTP criteria evaluation identified the current preferred site, located in Washington County on Southwest (SW) 124th Avenue near SW Tualatin-Sherwood Road, as the preferred water treatment plant site. The Project Participants anticipate annexing the site into Sherwood prior to construction.

The initial selection of water treatment processes for the WTP was based on providing effective and reliable treatment of Willamette River water under a wide-range of water quality conditions. This selection will provide higher quality finished water than required by state and federal drinking water regulations. The WTP will include flash mixing, high-rate ballasted flocculation/clarification, intermediate ozonation, filtration with a deep bed of granular activated carbon, disinfection with ultraviolet (UV) light and free chlorine, waste wash-water recovery, and mechanical solids dewatering facilities.

Reservoir

The key evaluations and analyses for the reservoir sites included storage volume and hydraulic grade line to meet WWSP level of service (LOS) requirements; site screening and evaluation criteria to identify candidate sites and ultimately select a preferred reservoir site; and value analysis and communications to support short-listing of the preferred sites. For the purpose of the WWSP, the components of storage addressed:

1) Operational storage to provide water to meet peak demands, thus limiting changes to the WWSS WTP production rate during the course of a day
2) Emergency storage to meet emergency scenarios related to the Willamette supply system; considered separate from in-town emergency storage already identified for the water distribution system storage identified in the previous component
3) Water distribution system storage to meet in-town storage needs for the individual Project Participants; can be used to meet fire suppression or emergency storage needs defined by individual in-town storage criteria

A total storage volume of 30 million gallons (MG) was selected, as this will meet a range of operational and water distribution system storage volume projections. The 30 MG will include two independent tanks to allow individual tanks to be taken offline for maintenance while still providing operational storage.

The reservoir site elevation range was determined based on the hydraulic grade line to meet WWSP LOS requirements. A minimum ground elevation of 470 feet (assuming a reservoir hydraulic grade line of 30 feet higher at a minimum of 500 feet) was selected. A 550 foot maximum ground surface elevation was selected to limit the amount of additional pumping needed to transport water to the reservoir site from the WTP.

Potential sites were identified using a minimum ground elevation and parcel size derived from the volume and hydraulic criteria decisions. A desktop analysis was used to identify potential sites applying a preferred ground elevation range of 470 to 550 feet and minimum parcel size of 4 acres. This ground elevation range was chosen so the Project Participants' service areas could receive water by gravity-fed pressure, which will reduce operational costs associated with pumping water from the supply reservoir. The 550 foot maximum ground surface elevation was selected to focus on sites that will not require additional pumping from the treatment plant. The 4-acre area was based on an assumed circular tank with a 30 foot high water column and buffer zones.

Candidate sites that met the minimum ground elevation and parcel size were carried forward for further evaluation in a two-step evaluation process. The first step was conducted during preliminary design and identified three potential reservoir sites on the western side of Cooper Mountain for further evaluation. This evaluation step considered potential impacts and technical viability of the sites and a review of preliminary title reports of the associated parcels. The evaluation identified three sites for further analysis: sites 2, 3, and 11.

The second step refined the evaluation criteria and incorporated additional studies, including desktop analyses, discussions with the landowner(s), and, where rights of entry could be obtained, information from field reconnaissance (e.g., geotechnical and environmental investigations). The reservoir criteria evaluation identified Site 3 as the preferred site due mainly to its ground surface elevation and subsurface conditions.

Willamette Water Supply System Description and Status

The alternatives development and evaluation described above led to the current configuration of the WWSS, as summarized below. The information provided here represents the current baseline description of the WWSS. Minor refinements to this configuration are anticipated as planning, permitting, design, and construction progress.

To facilitate completion of the WWSS and delivery of water by July 2026, the Project Participants divided the WWSS into individual project work packages, as previously described. By establishing reasonably sized work packages, each project can be assigned a project manager who is responsible for delivering the project in accordance with the established schedule and budget. In some instances, a work package is subdivided into multiple packages (phases). The work packages are then prioritized for implementation, as shown in Figure ES-0-2.

The WWSP schedule and budget are updated regularly. The anticipated timeline for each work package, as of July 2018, is shown in Table ES-0-2. As of July 2018, the Project Participants are constructing or have completed construction of three projects (PLM_2.0, PLM_3.0, and PLW_1.1) with six more in design (the Raw Water Facilities project (RWF_1.0), PLM_1.0, PLM_4.0, PLM_5.0, PLW_1.0, and PLE_1.0).

An alternatives analysis for the eastern extension (PLE_1.0) was included in the WWSP's preliminary design project, and one of the major assumptions of the need for the pipeline was to serve both TVWD and the City of Beaverton. Prior to the alternatives analysis, the 2015 TVWD Water Master Plan had recommended a connection from the WWSS to TVWD at SW Beaverton Hillsdale Highway & SW Western Avenue. In addition, the Metzger Pipeline East, a 20,750-feet long 30-inch diameter pipeline in SW Scholls Ferry Road from SW Roy Rogers Road to the intersection of SW Oleson Road and SW Hall Boulevard was included in the 2015 TVWD Water Master Plan as a TVWD capital improvement project that would be constructed in the future to serve water from the WWSS to the Metzger area. Once Beaverton dropped out of participation in the eastern extension component of the WWSS, TVWD initiated a re-evaluation of the alternatives analysis for routing the eastern extension. This additional study of the PLE_1.0 route began in November 2017.

The alternatives analysis evaluated opportunities to reduce cost, reduce risk, combine use with the Metzger Pipeline East, reduce environmental impacts, or provide operational or other advantages. The results of the alternatives analysis and TVWD's separate hydraulic analysis were presented to the TVWD Board of Commissioners (TVWD Board) in June 2018. The TVWD Board formally endorsed designing and constructing the Metzger Pipeline East to also serve Metzger by 2026. This alternative includes the following modifications:

- Increase the diameter of PLW_2.0 slightly,

- Eliminate the eastern extension, and
- Increase the diameter of TVWD's Metzger Pipeline East project slightly, construct it on the same schedule as the rest of the WWSS to be online by 2026, and extend it to both TVWD's Metzger System at SW Oleson Road & SW Hall Boulevard, and to TVWD's Wolf Creek system at SW Beaverton-Hillsdale Highway & SW Western Avenue.

With this endorsement, WWSP initiated further study of the Metzger Pipeline East route along SW Scholls Ferry Road. If early WWSP design efforts on this alternative support the findings of the alternatives analysis, the Metzger Pipeline East (MPE_1.0) route will replace the current PLE_1.0 route described in this document. This new route would require additional regulatory approvals.

The cumulative costs of implementing the WWSP, with a portion of those costs allocated to each Project Participant, are shown in Figure ES-0-1. Approximately $6.5 million of the total cumulative cost of WWSP implementation is currently allocated to other WIF Partners (in addition to the Project Participants, the WIF Partners include the cities of Beaverton, Wilsonville, Sherwood, and Tigard); the cost allocations among the other WIF Partners is not shown in Figure ES-0-1, as it is relatively small (less than one percent) compared with the current costs allocated to the Project Participants.

Table ES-0-2 Willamette Water Supply System Schedule as of July 2018

Project	Project Start[1]	Project Complete[2]
RWF_1.0 – Raw Water Facilities	Sep 2017	Dec 2024
PLM_1.0 – Wilsonville Area Pipeline Project	May 2017	Jun 2022
PLM_2.0 – Kinsman Road Partnership Project	Aug 2015	Sep 2018
PLM_3.0 – 124th Avenue Partnership Project	Jan 2014	Mar 2019
PLM_4.0 – Tualatin-Sherwood Area Pipeline Project	Jun 2016	Nov 2023
PLM_5.0 – Scholls Area Pipeline Project	Oct 2016	Sep 2024
PLW_1.0 – South Hillsboro Area Pipeline Project	May 2016	Mar 2022
PLW_2.0 – Cornelius Pass Pipeline Project	Jul 2019	Oct 2023
PLE_ 1.0 – Beaverton Area Pipeline Project	Nov 2017	Oct 2023
WTP_1.0 – Willamette Water Supply System Water Treatment Plant	Aug 2018	Mar 2026
RES_1.0 – South Beaverton Area Water Storage Tanks	Apr 2020	Dec 2024
DCS_1.0 – Distributed Control System	Oct 2018	Mar 2026

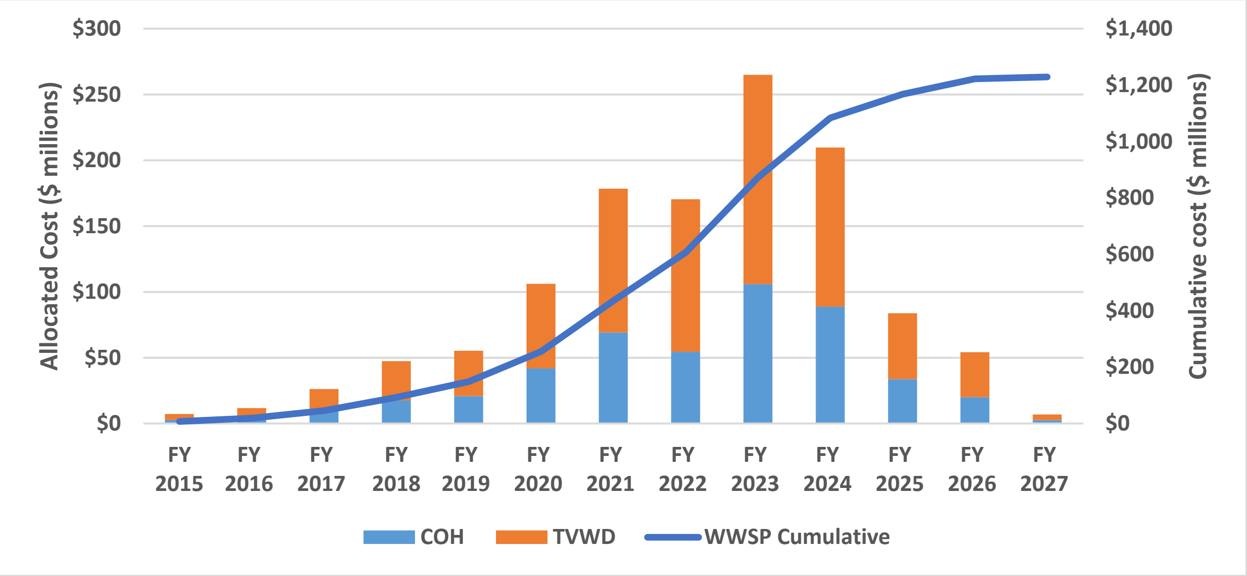
Key:
Apr = April
Aug = August
Dec = December
Feb = February
Jan = January
Jul = July
Jun = June
Mar = March
Nov = November
Oct = October
Sep = September

Notes:

[1] Start dates reflect the date the design consultant was or is anticipated to be issued Notice to Proceed. All future dates are subject to change.

[2] Complete dates reflect the anticipated date of final acceptance, not including the warranty period. All future dates are subject to change.

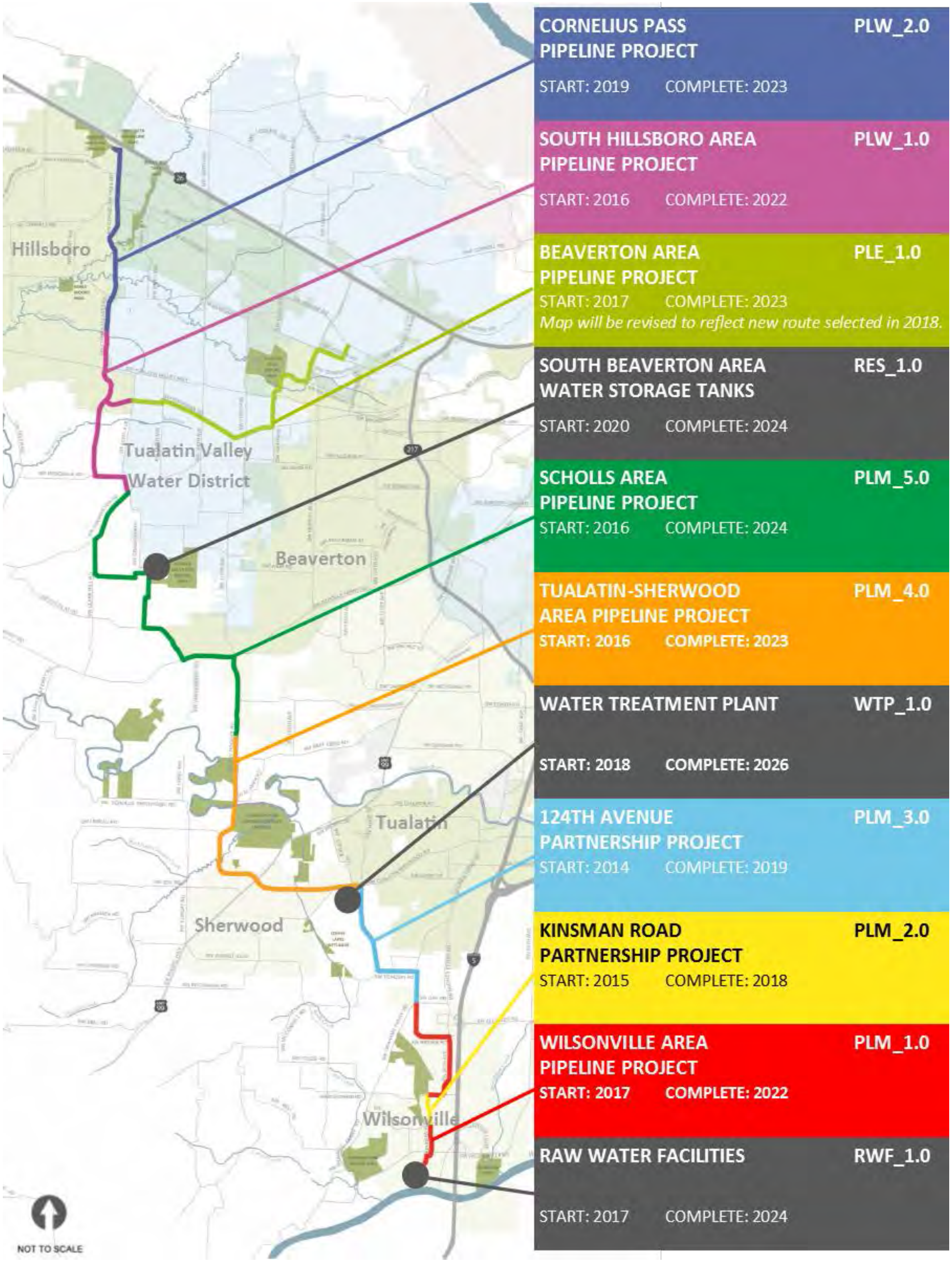
Figure ES-0-1 Willamette Water Supply Program Annual and Cumulative Costs



Key:	COH = City of Hillsboro	FY = Fiscal Year (from July 1 of the preceding year through June 30)
	TVWD = Tualatin Valley Water District	WWSP = Willamette Water Supply Program

Note: Cumulative costs include approximately $6.5 million currently allocated to other Willamette Intake Facility Partners (less than one percent of the total cumulative costs).

Figure ES-0-2 Willamette Water Supply System Work Packages



CORNELIUS PASS PIPELINE PROJECT PLW_2.0
START: 2019 COMPLETE: 2023

SOUTH HILLSBORO AREA PIPELINE PROJECT PLW_1.0
START: 2016 COMPLETE: 2022

BEAVERTON AREA PIPELINE PROJECT PLE_1.0
START: 2017 COMPLETE: 2023
Map will be revised to reflect new route selected in 2018.

SOUTH BEAVERTON AREA WATER STORAGE TANKS RES_1.0
START: 2020 COMPLETE: 2024

SCHOLLS AREA PIPELINE PROJECT PLM_5.0
START: 2016 COMPLETE: 2024

TUALATIN-SHERWOOD AREA PIPELINE PROJECT PLM_4.0
START: 2016 COMPLETE: 2023

WATER TREATMENT PLANT WTP_1.0
START: 2018 COMPLETE: 2026

124TH AVENUE PARTNERSHIP PROJECT PLM_3.0
START: 2014 COMPLETE: 2019

KINSMAN ROAD PARTNERSHIP PROJECT PLM_2.0
START: 2015 COMPLETE: 2018

WILSONVILLE AREA PIPELINE PROJECT PLM_1.0
START: 2017 COMPLETE: 2022

RAW WATER FACILITIES RWF_1.0
START: 2017 COMPLETE: 2024

Note: Start dates reflect the date the design consultant was or is anticipated to be issued Notice to Proceed. Complete dates reflect the anticipated date of final acceptance, not including the warranty period. All future dates are subject to change. The information provided here represents the current baseline description of the Willamette Water Supply System. Minor refinements to this configuration are anticipated as planning, permitting, design, and construction progress.

Exhibit U: Original Land Use Application (Casefile 00DB19) [excerpts]

Conditional Use

Design Review

and

Tree Removal Application

For

Water Treatment Facility

Intake

Passive Recreation

Access Road

In

Residential Agricultural (RA-1) Zone

APPROVED

00DB18

Blaise Edmonds 5/1/2000

RECEIVED

APR 12 2000

CITY OF WILSONVILLE
PLANNING DEPT

Applicant: City of Wilsonville

Applicant's Representative: Montgomery Watson

FILE COPY

00DB18

APPLICANT'S EXHIBIT D

Supplemental

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INTRODUCTION

The City of Wilsonville is proposing to develop a water treatment facility to provide the citizens of Wilsonville with a secure, long-term supply of municipal water. The project is needed because of the current limitations with the city's wells. The site to be developed for treatment of Willamette River water is located west of the I-5 bridge, south of Wilsonville Road (refer to vicinity map). The project will initially provide water for the citizens of Wilsonville and ultimately to other potential partner municipalities over the long term.

Development of the project requires approval of the following land use actions from the City of Wilsonville:

Design Review – Architectural, Landscape and Compatibility

Conditional Use – Public Utility within RA-1 Zone

Tree Removal – Type C Permit, Preservation and Removal Review

The application herein is for the purpose of addressing all of the applicable City of Wilsonville's Code and Comprehensive Plan provisions in order to provide information to the Development Review Board (DRB) for consideration of approval of the land use permits required to develop the water treatment plant by the Board.

APPLICATION INFORMATION

Applicant:

City of Wilsonville
Contact: Michael A. Stone, City Engineer
30000 SW Town Center Loop E
Wilsonville, OR 97070
Phone: 682-4960

Applicant's Representative:

Montgomery Watson
Contact: Joe Glicker, Garry Wohlgemuth, Becky Crockett, Kevin Hanway
111 SW Fifth Avenue, Suite 1770
Portland, OR 97204
Phone: 226-7377

Site Location: The site is located between Industrial Way road on the east and the Morey's Landing residential development on the west. This is about 1/2 mile west on Wilsonville Road from I-5 (refer to vicinity map).

Site Size: The site is approximately 31 acres in size.

Legal Description: Township 3 South, Range 1 West, Tax Lots 1800 and 1900.

Zoning: Northern Parcel – Residential Agricultural, RA-1 (7-12 units per acre)

Southern Parcel – Residential Agricultural, RA-1 (Industrial)
(refer to zoning map)

Comprehensive Plan Designations: Northern Parcel: Residential.

Northern Ravine (Arrowhead Creek), Willamette River upland to approximately 150 feet northward from the river, and western drainage ravine: Primary Open Space approximately 50 feet wide, with Secondary Open Space buffering the Primary Open Space

BPA Corridor: Secondary Open Space.

Southern Parcel
Open field: Industrial

River frontage: Primary Open Space and Willamette River Greenway
(refer to comprehensive plan map)

Subject Property is within Comprehensive Plan Area of Special Concern # 7

Adjacent Land Uses: North – filbert orchards, Wilsonville Road, Montessori School

South – Willamette River, Large lot residential across river

East – Industrial Way, Wilsonville Concrete Plant

West – Single family Residential Development (3 – 5 units per acre)
(refer to aerial photo)

Site Access: Site access will be by a public street to be developed off of Industrial Way, which intersects with Wilsonville Road.

Proposed Use: Public Utility Facility (Water Treatment Plant) and passive recreation (park).

Requested Land Use Action: Approval of Conditional Use, Site and Design Review, and Tree Removal for a water treatment facility and passive recreation amenities in the RA-1 zone.

PROJECT DESCRIPTION

Background

The City of Wilsonville needs a new source of municipal water to replace its existing groundwater system. Even though the city has been pumping less than the full amount permitted by its water rights, the aquifer serving the City's wells is being depleted. The State of Oregon will not permit any new wells to be drilled in the city. In five of the last seven years, the City has imposed severe water use restrictions during the typical peak-use summer months to avoid water shortage emergencies. In 1998, acting under ORS 197.510, the City imposed a moratorium on new development applications, citing a lack of adequate water supplies to serve new development. That moratorium was in place for two years, the maximum period permitted by state law. With the prospect of the proposed water treatment plant becoming available in April 2002, a public facilities strategy was adopted in January 2000 to determine allocations of water to new construction and new development until a new water treatment facility is operating.

After thorough investigation and evaluation of the available water sources and treatment plant sites, and after an extensive public involvement process, the City Council concluded in June 1999 that its best alternative was construction of a water treatment plant to draw and treat water from the Willamette River at the site proposed in this application. That decision was ratified by a citywide vote in September 1999 authorizing the issuance of revenue bonds to construct the plant on the Willamette River.

Working through its design-build consultant, the City has continued to solicit public involvement to guide and refine the proposed design, particularly from adjoining property owners and from the City's Parks and Recreation Advisory Board.

Proposed Site Development

Project Development Approach – The City established several primary goals to guide development of the design for the proposed treatment plant and park facilities:

- Protect neighboring property owners and residents from potential and perceived impacts of the project;
- Develop a design that is consistent with the natural character of the surrounding open spaces, and which preserves and enhances them as much as possible;
- Allow for passive recreational use of the site; and
- Allow for expansion of the treatment facilities to an ultimate capacity of 70 million gallons per day.

The design proposed in this application reflects all of these principles.

Protection from Impacts – Several elements eliminate or minimize impacts on residential neighbors. The treatment facilities will be clustered along the eastern property boundary, maximizing their distance from the residential development to the west. The placement of the facilities also adds an additional buffer for the residential neighborhood from the impacts of the concrete plant east of the site, while still retaining the berm and wall now in place on the east boundary. Adjacent residences will be screened from the treatment facilities by a continuous architectural wall extending the length of the facility. This screen will consist of the walls of the treatment structures, connected by stone or masonry walls between the structures. Varying wall heights and wall treatments will maintain visual interest and avoid presentation of a monotonous appearance.

An additional buffer of approximately 10 acres for the residential area will be created by the development of water features and a landscaped meadow west of the treatment facilities. To the west of the proposed meadow is a deep, heavily vegetated ravine separating the site from the undeveloped portions of the Morey's Landing subdivision. That buffer will be extended northward by the planting of 29 evergreen trees along the west boundary of the site.

Preserve Natural Character – The natural character of the site is preserved by the proposed design. The Willamette River Greenway area at the south end of the site will be left undisturbed. The raw water intake and pump station are set back from the top of a high embankment. On the embankment are existing mature conifer trees and other vegetation. As a result of the setback and the vegetation, the intake facilities will not be seen from the river or from adjacent properties. By clustering the treatment facilities as proposed, they will avoid the sensitive open space areas at the south and west boundaries. This site design approach also provides better protection for the adjacent residential neighborhood from activities in the park, providing a natural buffer along the west boundary and directing site visitors to the easterly and southern portions of the site, away from the adjacent residences.

Recreational Use – Both the treatment facilities and the site improvements will allow for passive recreational use of the site. The primary elements include the creation of a water feature, the landscaped meadow, and an overlook of the river. Viewing opportunities have also been incorporated into the design of some of the treatment plant structures to allow visitors to observe some of the operations and processes. These viewing opportunities will also be accompanied by graphics to aid the public in understanding the facilities on view.

Expansion Capability – The initial 15-mgd plant will serve the immediate needs of the City of Wilsonville. The Tualatin Valley Water District is also participating in the development of some components of the project to assure availability of a potential future source of water supply for its service area. The treatment facility design envisions eventual expansion of the plant to a production capacity of 70 mgd. Other communities in the area have expressed interest in the possibility of participating in the plant in the future, including Tualatin and Sherwood, and the Regional Water Supply Plan identifies the Willamette as one of several potential sources of supply for the region as a whole.

Impacts on the adjacent residential neighborhood from potential expansions will be minimized because expansions would be built between the currently proposed buildings or toward the eastern boundary, away from the residences west of the site. Only one structure in a future expansion (the clearwell at the south end of the plant) would extend further west than the initial architectural wall. (See site plan.)

Operations – The City will own the treatment plant. It anticipates that operations will be conducted by a contract operator.

Water Treatment Process and Facilities

Treatment Plant – The City proposes construction of a 15 million gallon per day (mgd) water treatment plant. Facilities to be built include an administration building and several structures to conduct treatment processes: raw water intake, a raw water pump station, clearwell, clarification basins, filtration basins, ozone generator, and a finished water pump station, along with several minor structures, parking and roads. The major elements of the facility are described briefly here:

> *Raw Water Intake*: Water will be pumped from the river through a submerged intake pipe extended into the river from beneath the bank. The intake line will extend horizontally to a wetwell excavated vertically from the top of the bank. This innovative approach to construction of the wetwell and intake allows for all construction activities to occur without disturbing the Willamette River Greenway and wildlife corridor.
>
> The capacity of the original intake structure is 70 million gallons per day. By building the intake at this time to the anticipated eventual plant capacity, the need to conduct further construction activity in the river is avoided, along with the disturbance to the riverbed that would accompany such construction activities.
>
> The intake has been designed to meet Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS) standards. It will be screened with openings not exceeding 1.75 mm, and the "approach velocity" (speed at which water passes the intake) will be less than 0.4 feet per second, to allow fish to evade the intake flow and avoid becoming entrapped on the screens. The intake will extend a maximum of approximately 11' above the riverbed at its highest point, leaving a minimum clearance of 8' from the water surface during the lowest recorded low water periods. That is more than adequate clearance to prevent any collisions or conflict between surface uses and the intake pipe. In addition, several protective pilings will be placed around the intake perimeter to divert boat traffic and debris from the intake. The pilings will extend slightly higher than the top elevation of the intake screens. Floating buoys will be

installed above the pilings to alert watercraft to the presence of the intake and pilings below water.

A separate application for the intake has been submitted to the Corps of Engineers and the Oregon Division of State Lands. That application includes a biological assessment addressing potential impacts of the intake on fish populations and other wildlife, recommending a finding by NMFS that no adverse impact is likely to occur. That assessment will be reviewed by NMFS as part of the Corps' review process.

Finally several barges currently anchored immediately downstream from the intake location will be removed. This action will enhance the appearance of the riverbank, and will eliminate them as a potential source of contamination near the intake.

Settling Basins: Water will be pumped from the intake wetwell to "Actiflo" design flocculation and clarification basins next to the administration building, where suspended particles will be settled out and removed from the water. The Actiflo process was chosen because of its effectiveness in treating water from the Willamette and because its compact size minimizes the required building footprint by 75%, thereby reducing construction costs substantially in addition to the savings in land requirements.

Ozonation: The water will then flow to ozonation basins, where ozone generated onsite from liquid oxygen will be introduced. Ozone is a powerful disinfectant and oxidant, destroying bacteria and other organisms in the water, while also reducing the level of tastes, odors, chemicals and other contaminants that may be present.

Filtration Basins: Continuing its flow downhill, the next step in the treatment process is to run the water through filters. Water will be introduced at the top of the filters, which will contain 6 feet of granular activated carbon (GAC) above 12 inches of sand. Water will flow by gravity through these filter media. These filter media are extremely effective at removing chemical contaminants from the water, as well as any remaining particulate matter.

Finished Water Pumps: In the final step, a small dose of a chlorine-ammonia compound (chloramines) will be added to the water to maintain its disinfectant capabilities while flowing through the water distribution system. The pH of the water will also be adjusted to minimize corrosion of the distribution lines. Pumps at the south end of the treatment plant will deliver the water into the city's water transmission system.

Associated Site Features

Access – The treatment plant and park facilities will generate very little traffic. To avoid traffic conflicts with the Morey's Landing neighborhood, however, a new plant access road will be built connecting the facilities to Wilsonville Road, via Industrial Way to the east. The two-lane road from Industrial Way to the development will be dedicated to the City. The road will include a bridge across Arrowhead Creek. A wetland has been delineated in the creek area, and the bridge and abutments have been located a minimum of 25 feet from the wetland to avoid impacts to that sensitive area. A combined bicycle/pedestrian path will be included parallel to the public access road.

An emergency access to the plant is provided from Brockway Drive as an alternate route for fire or other emergency vehicles. A locked gate is provided at Brockway to prevent access by other vehicles.

Recreation Amenities – A system of paths, walkways and water features are proposed to create an attractive setting for the treatment facilities and to invite passive recreation use of the area immediately adjacent to them. A pool will extend south from the administration building to near the clearwell structure. Several stone walls will be located in or near the pool to add visual interest. An ADA-accessible walkway extends from the administration building, next to and over the pool, all the way to a river viewing point on the trail at the south end of the property. An 8-foot wide pedestrian path will also extend to the top of the riverbank. The paths will provide access to viewing points along the edge of the embankment for people to appreciate the Greenway and the Willamette River. This system will allow access to the entire site while directing users away from the sensitive natural areas. The pathway will connect at Brockway Drive to the existing bicycle/pedestrian path system to the west.

Water Supply – Recognizing the limitations of the City's current water supply system to serve new development, the City will not use water from the city water system during the construction of the water treatment plant, park and other improvements. All water needed for construction purposes will be hauled in from a source other than the city's wells throughout the construction period and to get the landscaping established. After the treatment plant begins operations, water will be supplied to all the new improvements from the new treatment plant. Bringing in water from outside the city until that time will prevent the plant and park construction activities from becoming a burden on the local water supply system.

COMPLIANCE WITH CITY OF WILSONVILLE'S ZONING CODE AND COMPREHENSIVE LAND USE PLAN

This section describes how the project components directly comply with the City of Wilsonville's Comprehensive Land Use Plan and Zoning Code. Each project component is described, the applicable Code and Plan provisions are identified and then findings of fact are presented which substantiate the project's consistency with the City's Code and Comprehensive Plan.

In summary, the applicable Code provisions for each type of land use action requested are identified as follows:

<u>Conditional Use</u>

Section 4.177

Compatibility Concerns

<u>Design Review</u>

Section 4.400-4.450

<u>Tree Preservation and Protection</u>

Sections 4.600.00 – 4.610.10

Section 4.610.4

Sections 4.620.00 – 4.640.20

<u>Other General Regulations</u>

Off-street Parking	Section 4.150
Signs	Section 4.151
Sight-obscuring Fence or Plantings	Section 4.158
Protection of Natural Features	Section 4.161
Floodplain Regulations	Section 4.162
Buffering and Screening	Section 4.163
Public Safety and Crime Prevention	Section 4.165
Landscaping	Section 4.166
Street Improvement Standards	Section 4.167
Sidewalk and Pathway Standards	Section 4.168
Willamette River Greenway	Sections 4.500 – 4.514 And Ordinance No. 476

stalls are provided. It is neither feasible nor desirable to connect this parking area to areas on adjacent sites since there is no functional relationship between the two uses.

Section 4.150 (2) (h) (3) requires commercial, industrial and public utility uses which have a gross floor area of at least 5,000 sq. ft. and less than 30,000 sq. ft. to provide one truck loading or unloading berth. The gross floor area of the water treatment plant is 20,839 sq.ft., and two loading berths are provided. Two loading berths have been included, to accommodate truck deliveries at the chemical and ozone generation buildings. The Code does not require that any loading berths be provided for the park use.

Finding: The proposed development complies with the requirement of the Code for loading berths by providing two berth, which exceeds the number of berths required for developments of 5,000 to 30,000 sq. ft.

Signs (Section 4.151)

The applicant will present the design for facility signage to the DRB for review and approval prior to commencing facility operations.

Sight-obscuring Fence or Plantings (Section 4.158)

A combination of screening and landscaping will obscure treatment plant buildings and operations from view. The architectural wall along the west edge of the treatment plant complex, ranging up to 25 feet tall, will conceal the ground level storage tanks, the buildings and their operations. The landscape plan also includes a hedge to screen the parking area and a system of stone walls, hedges, and dense tree plantings west of the pool to further buffer the architectural wall and activity along the wall.

Finding: The architectural wall and landscape treatment screen the treatment plant buildings and operations from view, while maintaining an attractive appearance to visitors and adjacent properties.

Protection of Natural Features. Section 4.161 of the WC sets forth multiple requirements aimed at preservation of natural features including trees and wooded areas, rivers and stream corridors, wildlife habitat, wetlands and historic preservation. Each of these issues are addressed as follows:

General Terrain Preparation. Section 4.161 (2) (c) states:

> "all developments shall be planned, designed, constructed and maintained so as to: 1.) Limit the extent of disturbance of soils and site by grading, excavation and other land alterations. 2.) Avoid substantial probabilities of (accelerated erosion; (2) pollution, contamination, or siltation of lakes, rivers and streams; (3) damage to vegetation; (4) injury to wildlife and fish habitats. 3.) Minimize the removal of

> trees and other native vegetation that stabilize hillsides, retain moisture, reduce erosion, siltation and nutrient runoff, and preserve the natural scenic character."

A detailed grading and erosion control plan has been prepared to guide site development (attached). The plan includes preservation of the natural areas of the site including the west ravine, the north ravine and the southern edge of the property along the Willamette River. Site grading throughout the southern portion of the property will be limited to the area of the meadow that has historically been plowed annually for crop production (wheat, oats, etc.). Grading will also be required to create the access road off Industrial Way and to place the finished water pipeline. Approximately 35,000 cubic yards of earth will be excavated from the site primarily to allow the placement of the water treatment basins and the below surface facilities. The total area to be graded will be approximately 23 acres (water treatment plant facilities, park and access roadway). The total site acreage is approximately 31 acres. Best management practices for grading and erosion control will be required during site construction to minimize erosion and run-off potential. A grading and erosion control plan will be submitted prior to construction to satisfy the requirement for the mandatory public works permit.

The access road and pipeline will cross the natural ravine on the east boundary. The ravine crossing will utilize the existing BPA utility corridor to minimize impacts to trees and other native vegetation. The bridge abutments will be strategically placed at least 25 feet away from the wetland within the ravine. The pipeline will be jacked and bored under the riparian vegetation, wetland and stream that are within the north ravine.

Significant effort has been taken to design and plan construction of the intake, intake pipe and raw water pump station in order to avoid impacts to the river bank corridor. This area includes the Willamette River Greenway. It has a substantial bench of mature fir and alder trees with a well-defined shrub and herbaceous layer of plants. This area provides habitat to a number of wildlife species and aids in water quality and erosion stabilization. The proposed construction plan includes placement of the intake structure from in-river barges and upland cranes (if necessary). No road access to the river for construction will be required. The raw water pipeline (intake pipeline) will be constructed by sinking a large shaft downward from above the top of the bank and then tunneling below the surface of the steep embankment of the river to the intake structure placed in the river.

A jacking and connection pit will be excavated below the Greenway to provide a space for connection of the two ends of the intake pipe. The pit will be outside the Greenway, below the ordinary low water line. The pit location was selected at the direction of the Oregon Department of Fish and Wildlife during a site visit, to create the maximum buffer between the pit and the vegetation in the Greenway. The pit will be excavated to minimize temporary water quality impacts during construction activities. If the pit were above the low water line, it could permanently damage roots of the Greenway vegetation.

Finding: The project as proposed complies with Section 4.161 (2) in that the grading will be limited to the interior portions of the site. The natural ravines and the area along the Willamette River will not be disturbed during development. Best management practices will be used during site development and will be guided by the project grading and erosion control plan to insure that erosion and sedimentation drift and run-off are minimized. Removal of trees and native vegetation in ravines will be limited to the access route through the north ravine and the stormwater discharge structure at the southwest ravine.

Hillsides. Section 4.161 (3) states:

> "All development proposed on slopes of twelve percent (12%) or greater shall be limited -----".

No project development will occur in areas where slopes are 12 % or greater.

Trees and Wooded Areas. Section 4.161 (4) states:

> "(a) All developments shall be planned, designed, constructed and maintained so that: 1.) Existing vegetation is not disturbed, injured, or removed prior to site development and prior to an approved plan for circulation, parking and structure location. 2.) Existing wooded areas, significant clumps/groves of trees and vegetation, and all conifers and oaks with a diameter of eight inches or greater shall be incorporated into the development plan wherever feasible. 3.) Existing trees are preserved within any right-of-way when such trees are suitably located, healthy, and when approved grading allows."

This application is for the purpose of receiving approval prior to commencing any site construction that would disturb vegetation. No vegetation on site has been removed prior to this application except for some minor brush (such as blackberry vines) that was removed or cut by hand to allow access for surveying. The tree protection plan illustrates the detail of how the wooded areas will be incorporated into the project design.

Finding: The project as proposed complies with Section 4.161 (4) of the WC. Existing vegetation is not planned to be disturbed prior to DRB approval. More than 850 trees on site will be preserved through construction and incorporated into the site design.

Rivers and Stream Corridors. Section 4.161 (5) states:

> "(a) All developments shall be planned, designed, constructed and maintained so that: 1.) River and stream corridors are preserved to the maximum extent feasible and water quality is protected through adequate drainage and erosion control practices. 2.) Buffers or filter strips of natural vegetation are retained along all river and stream banks."

The project as proposed will preserve all of the river and stream corridors on the site in their natural character. Utilizing environmentally sensitive construction techniques for the placement of the intake structure and intake pipeline will minimize impacts to the southern edge of the site along the Willamette River. In particular, all excavation and pipeline installation will be conducted from a boat to avoid adverse impacts to the river bank and river bed.

The bridge and finished water pipeline through the northern ravine will be constructed to avoid impacts to the riparian and wetland values within the ravine. Stormwater runoff from the access road surface will be discharged into a detention basin that will limit the flow into the ravine to a rate equivalent to current conditions. A bioswale at the southwest stormwater discharge point is designed to protect vegetation in the ravine from the impacts of excessive runoff.

Finding: The project as proposed complies with Section 4.161 (5) of the WC. Rivers and stream corridors will be preserved on site including significant buffer areas around these natural areas. Structures in the ravines and runoff into the ravines have been designed to avoid adverse impacts on the natural areas.

Wildlife Habitats and Distinctive Resource Areas. Section 4.161 (6) of the WC states:

> "In order to minimize the adverse impacts on wildlife and sensitive areas, riparian areas and wetlands, no development shall occur in an area designated as primary open space on the Comprehensive Plan and shall further be planned, designed and constructed as follows: (a) All developments proposed in or near [within one hundred (100) feet], natural wetlands shall be designed to: 1.) Preserve functions of groundwater recharge, water storage, turbidity reduction, nutrient filtration, biologic or botanical production, and protective habitat cover. 2.) Limit uses to those compatible with the continued performance of wetland functions, such as: a.) Conservation of soil, vegetation, water, fish and wildlife. B.) Low intensity, "dispersed" outdoor recreation (hiking, nature study). C.) Utility easements, but only on peripheral areas and where alternative alignments are impractical. 3.) Maintain the runoff coefficient and erosion equilibrium for lands bordering the wetland substantially the same as if such lands were undeveloped."

Ordinance No. 482 (adopted April 1997) amended the Wilsonville Comprehensive Plan to allow public access roads and utilities (such as the finished water pipeline) to be constructed within Primary Open Space areas subject to issuance of a Public Works permit. The Public Works permit requires an Erosion Control permit. The applicant will submit the required information for review/approval of a Public Works permit upon approval of this application. The Erosion Control Plan (attached) has already been prepared.

The project does include development within 100-feet of a wetland. A wetland is located in the northern ravine, below the proposed bridge crossing. The boundaries of the wetland have been delineated by Fishman Environmental Services (delineation by C. Mirth Walker, certified by American Society of Wetland Scientists) (refer to site plan). The bridge has been designed to avoid the wetland and to maintain a buffer area of 25-feet on each side of the wetland. The preservation of the stream, wetland and riparian corridor within the northern ravine will ensure preservation of groundwater recharge, water storage, turbidity reduction, nutrient filtration, botanical production and protection of habitat cover functions.

The bridge access is being placed within an existing BPA corridor. The WC specifies that uses near wetlands be limited to utility easements. The proposed bridge access is within an area already subject to vegetation removal by BPA to insure the protection and maintenance of their utility facilities. The bridge will, in effect, protect the wetland and surrounding riparian area over current practices. The planned 25-foot setback on each side of the wetland will result in maintaining runoff and erosion consistent with that prior to the bridge crossing. (See letter from David McPherson, P.E., certifying calculations for the runoff coefficient pre- and post-construction.)

Finding: The project as proposed complies with Section 4.161 (6) of the WC. Ordinance No. 482 provides for public access and utilities (pipeline) within the Open Space designation. The bridge crossing will effectively result in increased protection of a wetland and riparian buffer area located within the northern ravine. This increased protection will preserve multiple functions associated with Arrowhead Creek, the wetland and riparian corridor within the northern ravine. A professional engineer has certified that the wetland will be protected from runoff impacts by constructing discharge facilites that maintain the runoff coefficient of pre-construction conditions.

Hazards to Safety

The site does not contain any soil or geologic hazards. Geological investigations have been completed which indicate the site is not subject to hydrologic, geologic or soil hazards.

Historic Protection. Section 4.161 (10) (a) of the WC states that the "Purpose" of Historic Preservation is:

> "to preserve structures, sites, objects, and areas within the City of Wilsonville having historic, cultural or archaeological significance."

No documented cultural resources are known to occur within the affected area of the project. The firm of Archaeological Investigations Northwest, Inc. (AINW) has completed a cultural resources survey of the project location (attached). The survey concluded that construction of the proposed project would not affect any significant cultural resources.

Finding: The project as proposed complies with Section 4.161 (10) of the WC. A cultural resources survey of the site concluded that project construction would not affect any significant cultural resources.

Exhibit V: Acoustical Analysis (January 24, 2019)

ACOUSTICAL DESIGN TECHNICAL MEMORANDUM

RWF_1.0 Design, Bidding Phase, and Services During Construction
Subtask 2.11 Acoustical Design TM

B&V PROJECT NO. 196999

Willamette Water Supply Our Reliable Water

PREPARED FOR

Willamette Water Supply Program

JANUARY 24, 2019

BLACK & VEATCH

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ACKNOWLEDGEMENTS

This report has been prepared under the direction of the following engineering professionals, licensed in the State of Oregon:

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EXPIRES: 12/31/2020

1.0 INTRODUCTION

In September 2018, WWSP issued Amendment 4 to Agreement 2018-007 that authorized Subtask 2.11, Acoustical Design TM. Under Subtask 2.11, Black & Veatch performed a desktop acoustical study for the RWF_1.0 upper and lower sites that included a site visit and sound level survey.

1.1 Background

Black and Veatch has performed an acoustical analysis for the Willamette Water Supply Program (WWSP) Raw Water Facilities (RWF_1.0) Project located at the Willamette River Water Treatment Plant (WRWTP) site.

The project is within the jurisdiction of Oregon Administrative Rules – Department of Environmental Quality (DEQ), which includes octave band sound level limits for noise emissions.

Sound sources for the Project include pumps, fans, and HVAC equipment. The purpose of this technical memorandum (TM) is to:

- Provide a summary of applicable acoustical regulations and existing acoustical conditions.
- Provide acoustical design details for new Project equipment sound sources and other pertinent architectural and mechanical design features that affect sound propagation.
- Provide the results of the acoustical analysis of the Project. The results of the acoustical analysis are evaluated with respect to applicable regulatory requirements and to impacts on existing sound levels.
- Provide details of acoustical mitigation measures required (if any) to ensure the new Project noise emissions will not exceed applicable sound level limits, and to reduce the likelihood of noise complaints from neighboring properties.

2.0 APPLICABLE REGULATIONS

This section summarizes sound level regulations that are applicable to the Project.

2.1 OAR Statistical Sound Level Limits

The Project is located in Wilsonville, Oregon and is subject to the Oregon Administrative Rules (OAR) which reference Chapter 340 – Department of Environmental Quality for allowable environmental sound level limits.

Section 340-035-0035 establishes daytime and night time sound level limits based on zoning of the receiving property. Table 1 below presents the allowable statistical noise level in any one hour per OAR. These limits are for new industrial and commercial sources, as measured 25 feet toward the noise source from the noise sensitive building, or the point on the noise-sensitive property line nearest the noise source, whichever is further.

The regulation allows for the additional application of octave band, and one-third octave band tonal limits "when the Director has reasonable cause to believe that the requirements [in Table 1] do not adequately protect the health, safety, or welfare of the public . . ." Since the future plant operations are expected to comply with the statistical noise level limits in Table 1 and are expected to be consistent with existing acoustical conditions, the analysis was conducted assuming octave band and tonal limits are not necessary. Appendix A contains additional information regarding the tonal and octave band limits as a reference.

Table 1 OAR Statistical Sound Level Limits for New Industrial and Commercial Sources

OVERALL SOUND LEVEL LIMITS (IN ANY ONE HOUR)		
METRIC	DAYTIME (6:00 AM – 10:00 PM)	NIGHTTIME (10:00 PM – 6:00 AM)
L_{50}	55	50
L_{10}	60	55
L_1	75	60

3.0 BASELINE SOUND LEVELS

This section presents the results of the ambient sound level survey. An ambient sound level survey was conducted to characterize the existing acoustical environment in the area surrounding the Project and to consider the potential sound level increases (if any) the Project may impose upon the nearest noise-sensitive receptors (homes). This section describes the results of the survey and the nature of the existing acoustical environment.

3.1 Survey Procedure and Conditions

The ambient sound level survey was conducted September 27 through October 3, 2018. The survey procedure was based on relevant portions of general industry standards including, but not limited to, ANSI S1.13, ANSI S12.9, and ANSI S12.18. Sound level measurements were conducted using Type 1 and Type 2 sound level meters that met the requirements of ANSI S1.4. The sound level meters were field-calibrated immediately before and after each measurement period. All equipment had been laboratory-calibrated within the last 12 months.

Meteorological conditions during the ambient sound level survey were suitable for environmental noise monitoring. Temperatures ranged from approximately 49 °F to 88 °F and skies were generally clear. Wind speeds were generally low; spot measurements indicated average speeds of less than 5 mph.

To effectively quantify and qualify the existing daily sound levels surrounding the Project site, the ambient survey included continuous sound level monitoring and short-term (attended) sound level measurements. Noise Monitoring Locations (NMLs) are indicated in Figure 1.

3.2 Survey Results

Results of the sound levels measurements are presented in Figures 2 and 3. Figure 2 presents monitoring results from NML1 (south area of the site), Figure 3 contains results from NML2 (north area). Figure 2 and Figure 3 compare the measured hourly statistical sound levels to the regulatory limits for day and night time. L1, L10, and L50 represent the sound level exceeded 1%, 10%, and 50% of the time, respectively. L50 is the median sound level, while L10 is generally considered the intrusive sound level (i.e., with the occasional discrete events such as traffic, aircraft, etc.).

As indicated by the red bars in the figures, ambient sound levels occasionally exceeded regulatory limits. These exceedances occurred late evening Thursday (9/27) and early morning on Friday (9/28) and Monday (10/1). Qualitative observations during the survey indicate the source of the noise to be the Wilsonville Concrete Products facility east of the Project site, combined with distant highway noise from Interstate 5. Existing Water Treatment Plant operations were not audible during the survey. Wilsonville city services were trimming trees for several hours on October 1 near NML1, which was removed from the data set (indicated in Figure 3).

Figure 1   Sound Level Survey Locations

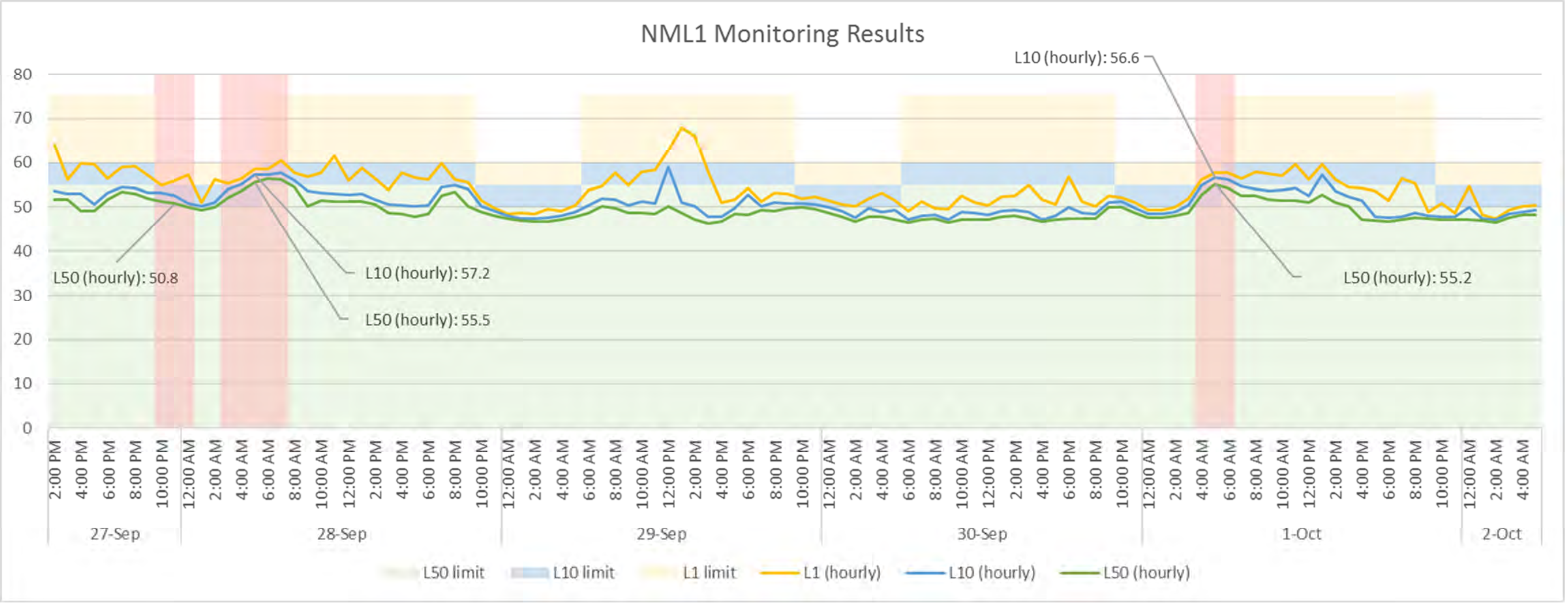


Figure 2 NML1 Sound Level Measurements

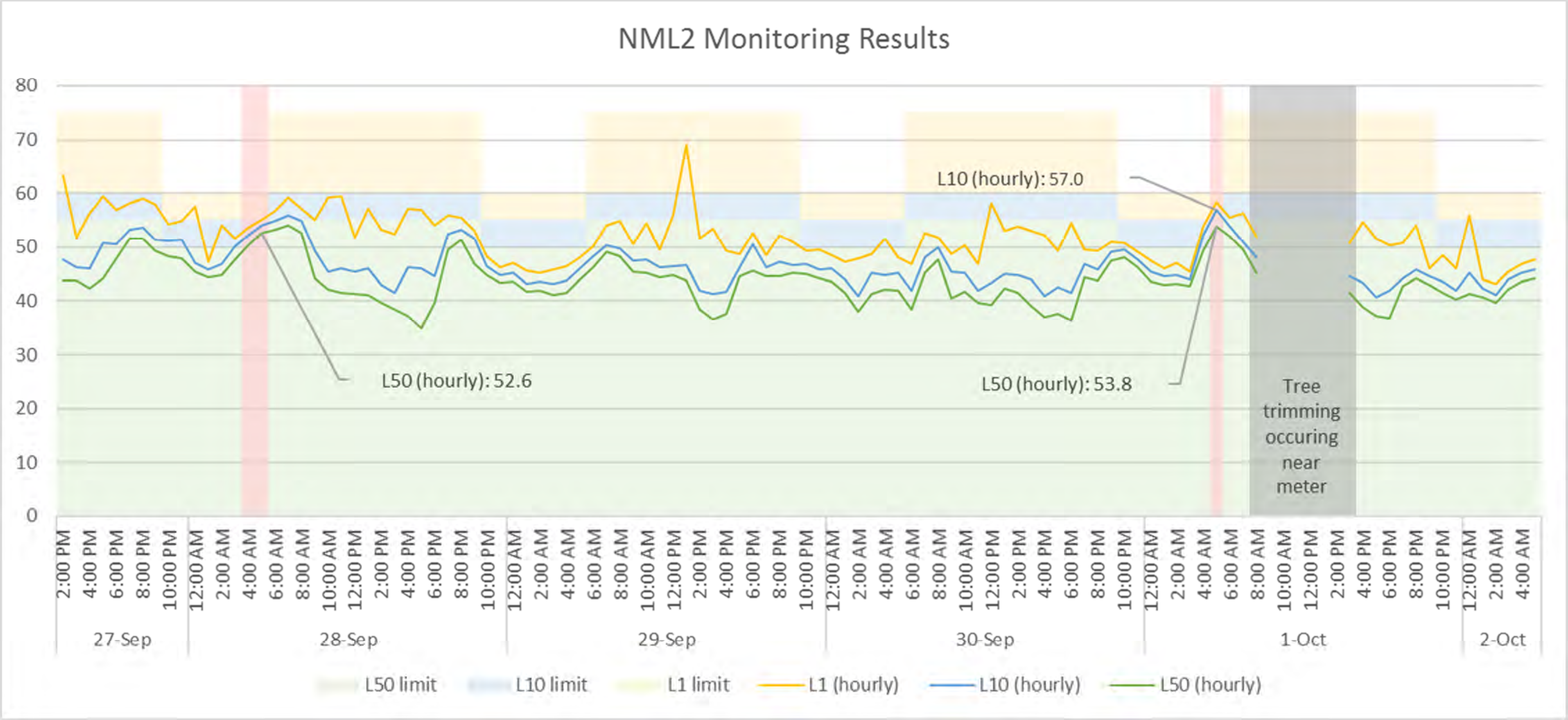


Figure 3 Night Time Sound Level Measurements

4.0 PROJECT NOISE EMISSIONS

This section describes the noise model and predicted project noise emissions.

4.1 Noise Modeling Methodology

The noise emissions associated with the proposed project have been modeled using noise prediction software (Cadna/A version 2018 MR1) which is based on methodologies specified in ISO 9613. The model simulated the outdoor propagation of sound from each noise source and accounted for sound wave divergence, atmospheric and ground sound absorption, sound directivity, and sound shielding due to interceding barriers, buildings, and terrain. A database was developed which specified the location, octave-band sound levels, and sound directivity of each noise source. A receptor grid was specified which covered the entire area of interest. The model calculated the sound pressure levels within the receptor grid based on the octave-band sound level contribution of each noise source. Finally, a noise contour plot was produced based on the overall sound pressure levels within the receptor grid, including specific receptor locations.

4.2 Project Noise Sources

The Project includes modifications to the existing Raw Water Pump Station (RWPS) area of the Project, and the addition of an Upper Site to the north. Key modifications to the existing RWPS include new vertical turbine pumps and new HVAC equipment. A new electrical and operations building is planned for the Upper Site, including a large electrical room, mechanical room, and associated outdoor electrical and HVAC equipment.

The new indoor vertical turbine pumps (VTPs) and new HVAC equipment associated with the building are anticipated to be the primary sources of noise at the RWPS. At the new Upper Site, outdoor HVAC and electrical equipment are expected to be the main noise contributors. The generators are for emergency use and will be tested 2 hours per month. Each generator will be equipped with a sound enclosure to minimize expected noise levels.

The equipment and design parameters that have been incorporated into the noise model are based on the design information and drawings included in the 50% design drawings (dated 11/01/18) and associated specifications. The VTPs are assumed to be supplied with a standard package noise guarantee of 90 dBA at 3 feet. A summary of noise sources used in the model, along with appropriate equipment details, is provided in Table 2 and Table 3. These preliminary design parameters form the basis of the predicted project noise emissions. Any changes to these design parameters should be evaluated to determine the impact to the overall project noise emissions.

Table 2 Assumed Project Equipment Sound Levels

EQUIPMENT	QTY.	SOURCE HT. (FEET)	SOUND LEVEL SPECIFICATION (PER UNIT)	DATA SOURCE
Vertical Turbine Pump/motor (VTP); 1422 hp, 1200 rpm	4	Indoor	90 dBA SPL @ 3 ft (1)	Assumed/in-house data
Upper Site – Electrical room packaged air conditioner	2	6	90 dBA PWL (2)	Trane, including vendor supplied mitigation
Upper Site – Mechanical room packaged air conditioner	1	4	85 dBA PWL (2)	Trane datasheet
Upper Site – Admin room packaged air conditioner	1	3	81 dBA PWL (2)	Trane datasheet
Upper Site - 7.5 MVA transformer	2	10	66 dBA SPL (3)	Assumed/in-house data
RWPS – Propeller fans	4	7 (above roof)	73 dBA SPL @ 5 ft (4)	VAW Systems datasheet
Generator	2	15	70 dBA SPL @ 23 ft (1)	Assumed/in-house data

NOTES

(1) SPL = Sound *Pressure* Level in dB re 20 µPa measured in accordance with ANSI/ASME PTC 36.

(2) PWL = A-weighted Sound *Power* Level re 1 pW measured in accordance with ARI 270/370.

(3) Sound *Pressure* Level per IEEE/NEMA.

(4) Sound *Pressure* Level per AMCA 301.

Table 3 Assumed Project Equipment Octave-Band Sound Levels (dB)

EQUIPMENT	OCTAVE-BAND CENTER FREQUENCY (HZ)								
	31.5	63	125	250	500	1K	2K	4K	8K
Vertical Turbine Pump/motor (VTP) 1422 hp, 1200 rpm (1)	94	95	96	98	98	101	98	94	88
Upper Site – Electrical room packaged air conditioner (2)	-	97	92	89	88	85	82	79	75
Upper Site – Mechanical room packaged air conditioner (2)	-	85	86	84	84	81	76	72	66
Upper Site – Admin room packaged air conditioner (2)	-	84	81	80	79	76	74	69	63
Upper Site - 7.5 MVA transformer (3)	63	69	71	66	66	60	55	50	43
RWPS – Propeller fans (4)	65	73	74	75	71	67	64	58	54
Generator (5)	60	75	87	78	69	62	62	60	65

NOTES

1. **Sound *Power* Levels re 1 pW per ISO 3746.**
2. **Sound *Power* Levels re 1 pW per ARI 270/370.**
3. **Sound *Pressure* Levels per IEEE/NEMA.**
4. **Sound *Pressure* Level at 5 ft per AMCA 301.**
5. **Sound *Pressure* Level at 3 ft per ISO 8528-10**

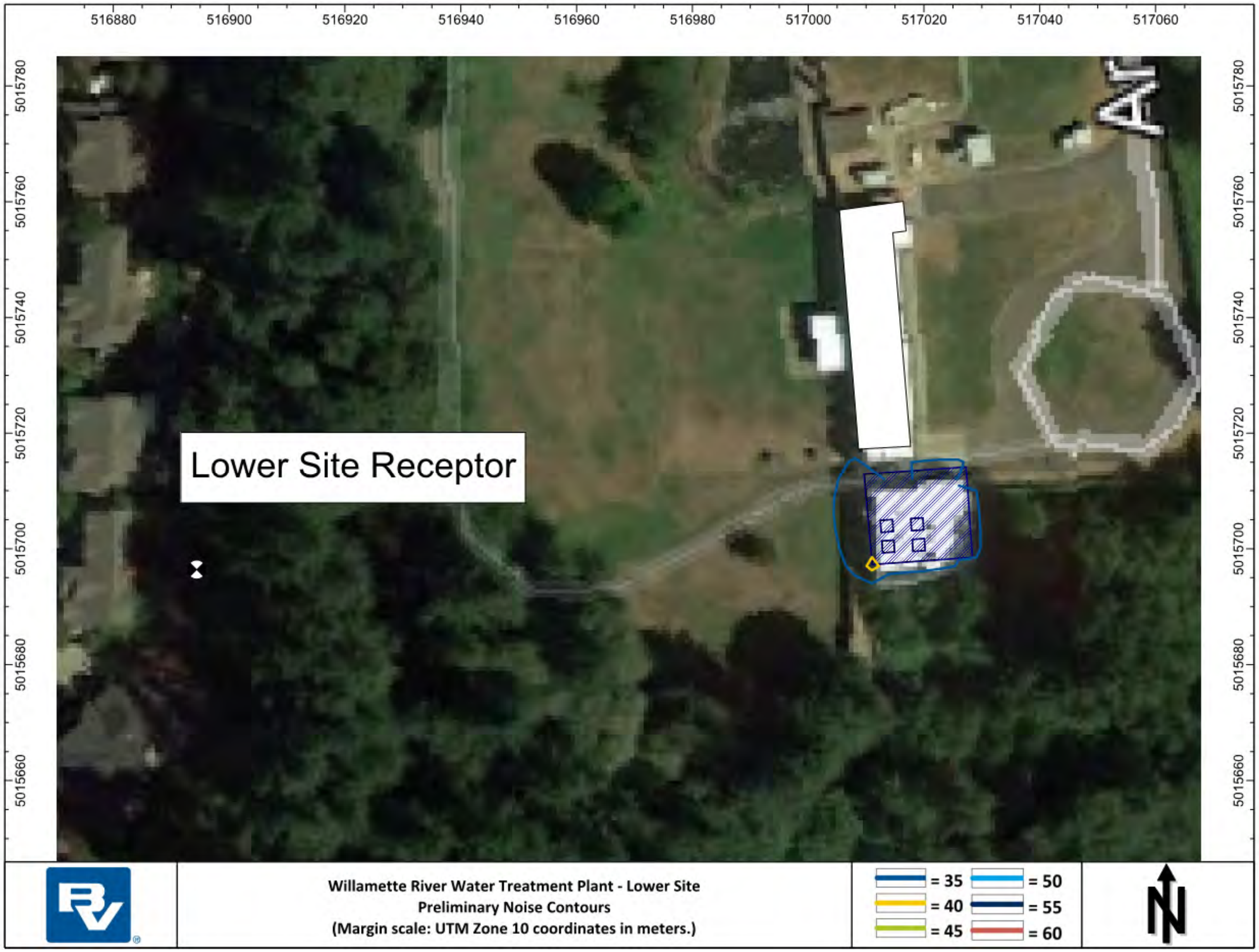
4.3 Predicted Noise Emissions

The predicted project noise emissions are detailed in Figure 4 and Figure 5 as contours of constant A-weighted sound pressure level. Figure 4 and Figure 5 include the overall sound pressure levels only due to the project at the Upper and Lower site, respectively, excluding generator testing. Figure 6 presents the expected sound levels at the Upper site during generator testing.

Based on the results of the acoustical model and the applicable zoning, two receptors were included in the model to evaluate future compliance and potential environmental noise impacts; 'Upper Site Receptor' and 'Lower Site Receptor', which are shown on Figure 4 and Figure 5. These two receptors were chosen based on the location of the residences closest to the western residential property boundary. Discussions of the future project noise emissions at each of these receptors are provided in Section 5. A-weighted sound pressure levels due to the proposed facility are presented. Since the overall A-weighted sound pressure levels are expected to comply with local regulations and are expected to be consistent with existing acoustical conditions, octave-band sound levels are not expected to be a factor in determining overall facility compliance. The expected octave-band sound pressure levels due to the project are presented in Appendix B for reference.

Aerial via Google™ Earth

Figure 4 Project (only) A-weighted Sound Level Contours at Upper Site – Excluding Generators



Aerial via Google™ Earth

Figure 5 Project (only) A-weighted Sound Level Contours at Lower Site

Figure 6 Project and Generator Testing A-weighted Sound Level Contours at Upper Site

5.0 RESULTS AND CONCLUSIONS

Based on the results of the acoustical modeling and assumptions regarding equipment sound levels, the Project is expected to meet the OAR daytime and nighttime regulatory sound level limits. As was shown in Figure 4 and Figure 5, and in Table 4 below, sound levels at the property boundary of the closest residential receptors, west of the Upper Site, are expected to reach 49 dBA. At the Lower Site, sound levels from Project operations at are expected to be approximately 38 dBA at the nearest receptor. Since the most stringent OAR limits (nighttime L_{50}) are 50 dBA, overall site compliance is expected. During monthly generator testing, sound levels at the Upper Site Receptor are expected to reach 51 dBA, which is consistent with the OAR daytime L_{50} sound level limit.

Table 4 Acoustical Modeling Results

WORST CASE RECEPTOR	EXISTING NIGHTTIME L50 SOUND LEVEL(S) (DBA)	PROJECT (ONLY) SOUND LEVEL (DBA)	OAR NIGHTTIME L50 SOUND LEVEL LIMIT (DBA)
Upper Site Receptor	38 - 54	49	50
Lower Site Receptor	47 – 55	38	50

As shown in Figure 6 and in Table 5, sound levels at the Upper Site Receptor are expected to reach 51 dBA. The most stringent OAR daytime sound level limit (daytime L_{50}) is 55 dBA. Since monthly generator testing will take place during daytime, overall site compliance is expected during generator testing.

Table 5 Acoustical Modeling Results Including Generator Testing

WORST CASE RECEPTOR	EXISTING DAYTIME L50 SOUND LEVEL(S) (DBA)	PROJECT (ONLY) SOUND LEVEL (DBA)	OAR DAYTIME L50 SOUND LEVEL LIMIT (DBA)
Upper Site Receptor	38 – 56*	51	55

*Excluding noise from tree-trimming operations on 10/1

APPENDIX A – OAR EXPANDED SOUND LEVEL LIMITS

Table A-1 presents the median octave band limits. These limits are for new industrial and commercial sources, as measured at the further of either 25 feet toward the noise source from the noise sensitive building, or the point on the noise-sensitive property line nearest the noise source. The octave band limits are only required "when the Director has reasonable cause to believe that the requirements in Table 1 do not adequately protect the health, safety, or welfare of the public..."

One-third octave band sound levels are limited by evaluating the difference in the sound pressure level of the one-third octave band containing the 'tone' and the arithmetic average of the sound pressure levels of the two adjacent one-third octave bands:

- For 500 Hz to 10,000 Hz, this difference is limited to 5 dB.
- For 160 Hz to 400 Hz, the limit is 8 dB.
- For 25 Hz to 125 Hz the limit is 15 dB.

The one-third octave band tonal limits are not applicable if the octave band containing the tone is 10 dB or more below the limits presented in Table A-1.

As discussed in Section 3, Project noise contribution at the worst-case receptors is not expected to exceed overall A-weighted limits set in the OAR, and therefore octave band sound levels are not expected to be considered in compliance evaluation.

Table A-1 Octave band sound level limits (based on OAR 340-035-0035 "Table 10")

OCTAVE BAND SOUND LEVEL LIMITS		
OCTAVE BAND CENTER FREQUENCY (HERTZ)	DAYTIME (7:00 AM – 10:00 PM)	NIGHT TIME (10:00 PM – 7:00 AM)
31.5	68	65
63	65	62
125	61	56
250	55	50
500	52	46
1000	49	43
2000	46	40
4000	43	37
8000	40	34

APPENDIX B – PREDICTED PROJECT OCTAVE-BAND SOUND LEVELS

Table B-1 Predicted Octave Band Sound Levels at Nearest Receptors

PREDICTED PROJECT OCTAVE BAND SOUND LEVELS		
OCTAVE BAND CENTER FREQUENCY (HERTZ)	UPPER SITE RECEPTOR	LOWER SITE RECEPTOR
31.5	42	38
63	59	46
125	53	42
250	48	40
500	47	35
1000	44	32
2000	40	27
4000	34	16
8000	25	5

APPENDIX C – ACOUSTICAL TERMINOLOGY

Sound Energy

Sound is generated by the propagation of energy in the form of pressure waves. Being a wave phenomenon, sound is characterized by amplitude (sound level) and frequency (pitch). Sound amplitude is measured in decibels, dB. The decibel is the logarithmic ratio of a sound pressure to a reference sound pressure. Typically, 0 dB corresponds to the threshold of human hearing. A 3 dB change in a continuous broadband noise is generally considered "just barely perceptible" to the average listener. A 5 dB change is generally considered "clearly noticeable" and a 10 dB change is generally considered a doubling (or halving) of the apparent loudness (Bies and C.H. Hansen, Engineering Noise Control, 2009). For reference, the sound pressure levels and subjective loudness associated with common noise sources are shown in Table C-1.

Frequency is measured in hertz, Hz (cycles per second). Most sound sources (except those with pure tones) contain sound energy over a wide range of frequencies. In order to analyze sound energy over the range of frequencies, the sound energy is typically divided into sections called octave bands. Octave bands are identified by their center frequencies including 31.5, 63, 125, 250, 500 1000, 2000, 4000, and 8000 Hz. For more detailed analyses, narrow bands such as ⅓-octave bands or 1/12-octave bands are employed. The sum of the sound energy in all of the octave bands for a source represents the overall sound level of the source.

The normal human ear can hear frequencies ranging from 20 Hz to 20,000 Hz. At typical sound pressure levels, the human ear is more sensitive to sounds in the middle and high frequencies (1,000 to 8,000 Hz) than sounds in the low frequencies. Various weighting networks have been developed to simulate the frequency response of the human ear. The A-weighting network was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighting network emphasizes sounds in the middle to high frequencies and de-emphasizes sounds in the low frequencies. Most sound level instruments can apply these weighting networks automatically. Any sound level to which the A-weighting network has been applied is expressed in A-weighted decibels, dBA. To characterize sound that contains relatively more low frequency energy—and to approximate the ear's response to relatively high sound levels—the C-weighting network was developed. C-weighting places more equal emphasis on low and high frequencies relative to A-weighting. Any sound level to which the C-weighting network has been applied is expressed in C-weighted decibels, dBC.

Sound Level Metrics

Noise in the environment is constantly fluctuating, such as when a car drives by, a dog barks, or a plane passes overhead. Therefore, noise metrics have been developed to quantify fluctuating environmental noise levels. These metrics include the equivalent-continuous sound level and the exceedance sound levels.

The equivalent-continuous sound level, L_{eq}, is used to represent the equivalent sound pressure level over a specified time period. The L_{eq} metric is the sound level of a steady-state sound that has the same (equivalent) total energy as the time-varying sound of interest, taken over a specified time period and covering a specified set of conditions. Thus, L_{eq} is a single-value level that expresses the time-averaged total energy of a widely varying or fluctuating sound level.

The exceedance sound level, Lx, is the sound level exceeded "x" percent of the sampling period and is referred to as a statistical sound level. The most common Lx values are L_{90}, L_{50}, and L_{10}. L_{90} is the sound level exceeded 90 percent of the sampling period. The L_{90} sound level represents the sound level without the influence of loud, transient noise sources and is therefore often referred to as the residual or background sound level (ANSI S12.9, Quantities and Procedures for Description and Measurement of Environmental Sound, 2003). The L_{50} sound level is the sound level exceeded 50 percent of the sampling period or the median sound level. The L_{10} sound level is the sound level exceeded 10 percent of the sampling period. The L_{10} sound level represents the occasional louder noises and is often referred to as the intrusive sound level. As previously discussed, the L_{90} environmental sound level typically represents the background (residual) sound level.

The variation between the L_{90}, L_{50}, and L_{10} sound levels can provide an indication of the variability of the acoustical environment. If the acoustical environment is perfectly steady, all values are identical. A large variation between the values indicates the environment experiences highly fluctuating sound levels. For instance, measurements near a roadway with frequent passing vehicles may cause a large variation in the statistical sound levels.

Typical Community Sound Levels

Typical background (residual) sound levels in various types of communities are outlined in Table C-2 for reference. However, it is important to remember that each community is unique with regard to the sources of noise that contribute to the background sound levels.

Human Response to Sound

Human response to sound is highly individualized. Annoyance is the most common issue regarding community noise. The percentage of people claiming to be annoyed by noise will generally increase as environmental sound levels increase. However, many other factors will also influence people's response to noise. These factors can include the character of the noise, the variability of the sound level, the presence of tones or impulses, and the time of day of the occurrence. Additionally, non-acoustical factors, such as the person's opinion of the noise source, the ability to adapt to the noise, the attitude towards the noise and those associated with it, and the predictability of the noise can also influence people's response. Response to noise varies widely from one person to another and with any particular noise, individual responses will range from "highly annoyed" to "not annoyed".

Table C-1 Typical Sound Pressure Levels Associated with Common Noise Sources

SOUND PRESSURE LEVEL, dBA	SUBJECTIVE EVALUATION	COMMON OUTDOOR ENVIRONMENT OR SOURCE	COMMON INDOOR ENVIRONMENT OR SOURCE
140	Deafening	Jet aircraft at 75 ft	
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 ft	
120	Threshold of feeling	Elevated Train	Hard rock band
110	Extremely loud	Jet flyover at 1000 ft	Inside propeller plane
100	Very loud	Power mower, motorcycle at 25 ft, auto horn at 10 ft	
90	Very loud	Propeller plane flyover at 1000 ft, noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately loud	Diesel truck (40 mph) at 50 ft	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner, electric typewriter
60	Moderate	Air-conditioner condenser at 15 ft, near highway traffic	General office
50	Quiet		Private office
40	Quiet	Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very quiet	Quiet residential neighborhood	Bedroom, average residence (without TV and stereo)
20	Just audible		Human breathing
10	Threshold of hearing		
0			

Source: Adapted by Black & Veatch from *Architectural Acoustics*, by David M. Egan (1988) and *Architectural Graphic Standards*, by Ramsey and Sleeper (1994).

Table C-2 Typical Daytime Background Sound Levels in Various Types of Communities

TYPE OF COMMUNITY	TYPICAL DAYTIME BACKGROUND SOUND PRESSURE LEVEL, dBA
Very Quiet Rural Areas	31 to 35
Quiet Suburban Residential	36 to 40
Normal Suburban Residential	41 to 45
Urban Residential	46 to 50
Noisy Urban Residential	51 to 55
Very Noisy Urban Residential	56 to 60
Adjacent Freeway or Major Airport	n/a

Source: Adapted by Black & Veatch from *Community Noise*, by the U.S. Environmental Protection Agency, (December 1971).

Exhibit W: Pre-Application Notes from City of Wilsonville Staff

Shayna Rehberg

From: Pauly, Daniel <pauly@ci.wilsonville.or.us>
Sent: Tuesday, January 15, 2019 1:13 PM
To: Joe Dills
Subject: WWSP Pre-Application Meeting Follow-Up
Attachments: Plan Set.docx; Reports and Other Documents.docx

As discussed, I am following up on the January 10th pre-application meeting with an email with additional information. Please forward to others with the program. Thanks.

As you look at what you need to submit for land use review the following list will aid you in what to submit and what code criteria to respond to in your project narrative. If you have further questions of what a project narrative should look like or what to submit please don't hesitate to contact a planner and ask. You can access the City's Development Code in pdf and Microsoft Word document formats at https://www.ci.wilsonville.or.us/planning/page/development-code . Please keep in mind the burden to show compliance with applicable City standards falls on the applicant (see Wilsonville Code 4.014). For planned development proposals Wilsonville Code requires a professional design team including, but not limited to, a registered architect, a registered landscape architect, a certified planner or planner with extensive experience talking projects through public review processes, and a professional engineer. We have found it typically difficult for applicants to prepare a complete and satisfactory application without this full team of professionals.

As a reminder the land use review process is separate from and occurs prior to building and other construction permitting. We do allow for some concurrent review of building and public works permits, but do not submit building or public works permits prior to your land use application being complete and a public hearing being scheduled. Building and public works permits cannot be issued until the land use decision is final after the conclusion of the local appeal period.

This email includes 4 sections

1. Land Use Review Steps
2. Anticipated/Potential Land Use Applications for Project
3. Submittal Requirements
4. Applicable Development Code Sections

1. Land Use Review Steps

Land use review has a number of steps as follows (does not included neighborhood meeting we discussed):

Step 1. Submittal (see Section 3 and attached checklist for more details on submittal requirements): Applicant submits application including:
- Signed application form
- All land use application fees
- 3 paper copies, and 1 electronic copy in flattened pdf format on CD, DVD, flash drive, or via file storage site or email of the following:
    - Project narrative (please include in MS Word document format in addition to pdf)
    - Full size, and reduced (11X17 or smaller) of plans related to land use review
    - Reports such as arborist report, stormwater drainage report, traffic report

Step 2. Initial City Review "Completeness Review": The assigned Wilsonville planner reviews the application to determine if all materials required to review the application are submitted. We call this step "completeness review." In concludes with a determination of whether the submitted application package is "complete" or "incomplete." The applicant will be notified by letter about the determination. If the determination is "incomplete" the letter includes the specific items needed to make the application "complete." If application is "complete" the next step is Step 6.
Step 3. Indication of Intention for Incomplete Applications: If the application is "incomplete" the applicant either indicates whether they intend to submit the items identified in the "incompleteness letter". This is done by signing and returning a page enclosed with the "incompleteness letter." If the applicant refuses to submit additional materials the application with proceed to step 6, noting that failure to provide sufficient information can be grounds for denying an application.

Step 4. Applicant Prepares Additional Request Materials and Resubmits Application: If the application is "incomplete" and the applicant intends to address the items identified in the "incompleteness letter" the applicant prepares the identified items. Once the applicant prepares all the items they resubmit the application as identified in Step 1. Occasionally if the additional materials are minor the previous submittal package can be supplemented or pages switches out. In most cases complete new copies of the entire submittal package will be submitted.

Step 5. City Reviews Resubmitted Package "2nd Completeness Review". The assigned Wilsonville planner reviews the revised application to determine if all materials required to review the application are submitted. A determination of "complete" or "incomplete" will again occur with the corresponding letter being sent to the applicant.

Step 6. Hearing Scheduled, City Staff Prepares Report, Public Notice and Comment Period. Once the application is "complete" the project is scheduled for a hearing before one of two Development Review Board panels. The hearing is typically scheduled 30-45 days from when the application is deemed "complete." 20 days prior to the hearing the Assigned Planner sends out a Public Hearing Notice soliciting comments from the public. The Assigned Planner also solicits comments and conditions of approval from various City Departments and Divisions as well as partner agencies and service providers such as TVF&R, NW Natural, and Republic Service (franchise waste collector). One week prior to the hearing a Staff Report is published for public review.

Step 7. Public Hearing. Development Review Board (DRB) public hearings are typically 6:30 p.m. on the 2nd and 4th Monday of the month at Wilsonville City Hall. The public hearing typically follows the following format:

- Assigned Planner presents their report to the DRB often with support from Engineering and Natural Resource staff and answers boards questions. The staff presentation typically thoroughly describes the project including layout, design, and impacts.
- The applicant is given the opportunity.to present. The applicant can say as little as they want, but the DRB typically prefers some description and explanation of the motivation behind and goals of the project adding color to staff's description of the project. The DRB can ask questions of the applicant.
- Others in attendance can testify, the DRB can ask questions of them.
- The applicant gets an opportunity to rebut any testimony
- After all testimony and questioning the DRB chair closes the Public Hearing.
- A DRB member makes a motion
- DRB discussion and deliberation
- DRB decision

Step 8. Notice of Decision and Appeal Period. Typically the next day a Notice of Decision is sent by the City. In most cases this includes a form accepting the conditions of approval the applicant must sign and return. The Notice of Decision includes notification of the 14-day appeal period from the date the decision is mailed.

Step 9. If the appeal period lapses with no appeal, applicable ordinances become effective, and the form accepting condition of approval is signed and returned construction permits consistent the DRB approval can then be processed and issued.

2. Anticipated/Potential Land Use Applications for Project

Seismic Work in Willamette River Greenway

- Willamette Greenway Conditional Use Permit
- Floodplain Permit

Upper site and other site work outside the Willamette River Greenway

- Conditional Use Permit
- Site Design Review
- SROZ Map Refinement
- Tree Removal Plan

3. Submittal Requirements (can use as a checklist)

We have tried to make this as complete as possible, and may not include everything required.

The submittal package needs to include:

1. An application form signed by the property owner
2. All applicable planning application fees
3. A project narrative Including the following sections (paper copy, pdf, and ms word):

a. Summary of Proposal (1-2 pages typically) including key numbers (i.e. acreage, square feet of buildings, number of units, etc.)
b. Background Information (1-2 pages typically)
c. Discussion of key issues or discussion items (1-2 pages), include discussion of any neighborhood outreach
d. Response Findings to Code Criteria (numerous pages), in the following basic format:

- Code Criteria Reference and Language

- Response (from applicant): The written response needs to be specific and clear. It needs to go beyond saying a criteria is met to clearly and specifically explaining how it is met. As an example, if the criteria is "Parking standards shown in Table A shall be met," the response should state, "the proposal provides 52 parking spaces, 2 more than the 50 parking spaces required. See parking layout on the site plan, Exhibit B2" not something unspecific like "the proposal provides sufficient parking".

4. Plan set including the information in the attached "Plan Set Submittal Checklist": (you can use the sheet reference field to write in a reference to where the information is).

5. Other reports and documents (traffic report, arborist report, etc.). Include in notebook or packet with narrative. A checklist of requirement documents is attached as "Reports and Other Documents Checklist"

4. Applicable Development Code Sections

These are the applicable code sections to consider in preparing your narrative and designing your site. For the most part it does not include code sections related to procedures. The code can be accessed online by following this link.

Residential Development Standards and Residential Zoning

- Residential Agriculture Holding (RA-H) Zone: Section 4.120

Overlay Zones

- Significant Resource Overlay Zone (SROZ) Sections 4.139.00 thru 4.139.11, particularly Section 4.139.05 and Subsection 4.139.06 (.01)
- Willamette River Greenway Sections 4.500 thru 4.515.

General Development Regulations and Standards

- On-Site Pedestrian Access and Circulation: Section 4.154
- Parking, Loading, and Bicycle Parking: Section 4.155
- Street Improvement Standards: Section 4.177
- Landscaping, Screening, and Buffering: Section 4.176
- Mixed Solid Waste and Recycling: Section 4.179
- Outdoor Lighting: Sections 4.199 through 4.199.60
- Underground Utilities: Sections 4.300 through 4.320
- Protection of Natural and Other Features: Section 4.171
- Public Safety and Crime Prevention: Section 4.175
- Flood Plain Regulations Section 4.172

Site Design Review (Detailed Review of Architecture, Landscaping, Signs and other Design Elements)

- Site Design Review: Sections 4.400 through 4.450

Tree Removal

- Tree Preservation and Protection: Sections 4.600 through 4.640.20

Conditional Use Permits

- Conditional Use Permits: Section 4.184

Definitions of Terms

- Definitions of Terms: Section 4.001

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WILSONVILLE
OREGON

29799 SW Town Center Loop East, Wilsonville, OR 97070

General, Including Site Plan		WC	Sheet Reference
	1. On-site and immediately adjacent features:		
	a. Streets	4.035(.04)	
	b. Private drives	4.035(.04)	
	c. Sidewalks and pathways	4.035(.04)	
	d. Off-street parking, including location and dimensions of each space	4.035(.04)	
	e. Loading areas, including location and dimensions of each berth	4.035(.04)	
	f. Direction of traffic flow into and out of off-street parking and loading areas	4.035(.04)	
	g. Turning and maneuvering areas	4.035(.04)	
	h. Garbage and recycling storage areas	4.035(.04) 4.179 (.01)	
	i. Power lines	4.035(.04)	
	j. Utility services, including sanitary sewer, water, and storm drainage	4.035(.04)	
	k. Location and dimension of all structures, primary and accessory	4.035(.04)	
	l. Utilization of structures	4.035(.04)	
	m. Tabulation of land area, in square feet, devoted to various uses such as building area (gross and net rentable), parking and paving coverage, landscaped area coverage.	4.035(.04)	
	n. Major existing landscape features including trees to be saved	4.035(.04)	
	2. Off-site features		
	a. Distance of subject property to any structures on adjacent properties	4.035(.04)	
	b. Location and uses of streets, private drives, and driveways on adjacent properties.	4.035(.04)	
	3. Grading Plan	4.035(.04)	
	a. Existing and proposed contours and other topographic information sufficient to determine direction and percentage of slopes and drainage patterns. Additional topographic information needed for environmentally sensitive areas (See WC 4.035 (.04) A. 6. f.)	4.035(.04)	
	4. Flood Plain Permit Information (as applicable)		
	a. A field survey in relation to mean sea level by a licensed surveyor or civil engineer of the actual location of the l00-year flood plain, fringe, floodway and the lowest habitable finished floor	4.172(.06)	

	elevations, including basements, of all existing structures		
	b. A Site Plan map showing all existing and proposed contours and development and supplemented by a soils and hydrologic report sufficient to determine the net effect of the proposed development on the flood plain elevations on the subject site and adjacent properties.	4.172(.06)	
	c. Clear indication of cut or fill areas	4.172(.06)	
	d. A soils stabilization plan for all cuts, fills and graded areas.	4.172(.06)	
Site Design Review			Sheet Reference
	1. Location and design of fences, walls	4.440(.01)	
	2. Landscape Plan		
	a. Location and design of landscape areas	4.440(.01)	
	b. Number and placement of trees and plant materials		
	c. The variety of trees and plant materials listed by scientific and common name	4.440 (.01) 4.176 (.09)	
	d. The size of trees and plant materials	4.440(.01)	
	e. Information, including condition, size and variety, of trees or other plant material being retained on the site	4.440(.01) 4.176 (.09)	
	f. Indication of water consumption categories (high, moderate, low, and interim or unique) See WC 4.176 (.09) A.-D.	4.440(.01) 4.176 (.09)	
	3. Tree survey showing all trees 4” or greater in caliper. Large area of trees being undisturbed only need the perimeter of the area shown.	4.440(.01)	
	4. Architectural drawings and sketches of all building and structures		
	a. Floor plans	4.440(.01)	
	b. All elevations of proposed structures and other improvements	4.440(.01)	
	c. Details of outdoor site furnishings (benches, outdoor tables, garbage cans, lighting, etc.)	4.440(.01)	
	5. Sign Plan, drawn to scale, showing the location, size, design, material, color and methods of illumination of all exterior signs	4.440(.01)	
	6. Outdoor Lighting (as applicable):		
	a. All conformance methods:		
	i. Site lighting plan		

	ii. Intended lighting by type and location		
	iii. Aiming angles for adjustable luminaires		
Tree Plan			Sheet Reference
	1. Topographical information (same as provided on other sheets)	4.610.40(.02)	
	2. Shape and dimensions of the property	4.610.40(.02)	
	3. Location of existing and proposed structures or improvements	4.610.40(.02)	
	4. Location of each tree 6” or greater d.b.h. likely to be impacted	4.610.40(.02)	
	5. Spread and canopy of each tree (may be by numerical reference to list in arborist report)	4.610.40(.02)	
	6. Common and botanical name of each tree	4.610.40(.02)	
	7. Description of health and condition of each tree	4.610.40(.02)	
	8. Approximate location and name of any other trees on property	4.610.40(.02)	
	9. Where a stand of 20 or more contiguous trees exist on a site and the applicant does not propose to remove any of those trees, the required tree survey may be simplified to accurately show only the perimeter area of that stand of trees, including its drip line.	4.610.40(.02)	
	10. Show all Oregon white oak, native yews, and any species listed by either the state or federal government as rare or endangered.	4.610.40(.02)	
	11. Location and dimension of existing and proposed easements	4.610.40(.02)	
	12. Setbacks required by existing zoning requirements	4.610.40(.02)	
	13. Grade changes proposed that may impact trees	4.610.40(.02)	
	14. Tree Protection Plan	4.610.40(.02)	

General			Reference
	Proof the property affected is in the exclusive ownership of the application or the applicant has the consent of all individuals or partners in ownership of affected property	4.035 (.04)	
	Legal description of affected property (map and taxlot, address if available)	4.035 (.04)	
	Correspondence showing coordination with franchise garbage hauler of adequate trash and recycling storage area for planned containers and access for collection.	4.179 (.07)	
Stage II Final Plan (applicable still to this project)			Reference
	Traffic Report (or approved waiver)	4.140(.09)	
	Soils and Drainage Report		
	Draft copies of legal documents including easements, dedications, CC&R's.	4.140(.09)	
Site Design Review			Reference
	Color board displaying specifications as to type, color, and texture of exterior surfaces of proposed structures.		
	Outdoor Lighting (as applicable)	4.199.50 (.01)	
	All conformance methods	4.199.50 (.01)	
	For each luminaire type all of the following:	4.199.50 (.01)	
	Drawings, cut sheets or other documents containing:	4.199.50 (.01)	
	Luminaire description	4.199.50 (.01)	
	Mounting method	4.199.50 (.01)	
	Mounting height	4.199.50 (.01)	
	Lamp type and manufacturer	4.199.50 (.01)	
	Lamp watts	4.199.50 (.01)	
	Ballast	4.199.50 (.01)	
	Optical system/distribution	4.199.50 (.01)	
	Accessories such as shields	4.199.50 (.01)	
	Calculations demonstrating compliance with Oregon Energy Efficiency Specialty Code, Exterior Lighting	4.199.50 (.01)	
Tree Plan			
	Arborist Report		

Exhibit X: Facility Site Alternatives Analysis Clarification Memorandum
(March 2, 2018)

Willamette Water Supply
Our Reliable Water

Willamette Water Supply Program

Facility On-Site Alternatives Analysis Memorandum

September 27, 2018

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List of Acronyms and Abbreviations

CSZ	Cascadia subduction zone event
CWA	Clean Water Act
CWS	Clean Water Services
ft	feet
HGM	Hydrogeomorphic Method
Hillsboro	City of Hillsboro
JPA	Joint Permit Application
MGD	million gallons per day
NAVD88	North American Vertical Datum of 1988
OHW	ordinary high water
ORWAP	Oregon Rapid Wetland Assessment Protocol
OSSPAC	Oregon Seismic Safety Policy Advisory Commission
PGE	Portland General Electric
Project Participants	Tualatin Valley Water District and City of Hillsboro
ROW	right-of-way
RWF	raw water facilities
TEACP	Tonquin Employment Area Concept Plan
TVWD	Tualatin Valley Water District
USACE	U.S. Army Corps of Engineers
WIF	Willamette Intake Facilities
WRWTP	Willamette River Water Treatment Plant
WTP	water treatment plant
WWSP	Willamette Water Supply Program
WWSS	Willamette Water Supply System

1.0 Introduction

The Alternatives Analysis discussed in the Joint Permit Application (JPA) documents the criteria used to evaluate the siting of Willamette Water Supply System (WWSS) facilities, including the water treatment plant (WTP) and raw water facilities (RWF). As described in Section 1.1 of the Alternatives Analysis, the purpose of the proposed action is to provide a long-term, resilient water supply to serve the projected water needs of Tualatin Valley Water District (TVWD) and City of Hillsboro (Hillsboro) (collectively, the Project Participants) residents and businesses.

To ensure the purpose of the proposed action is achieved, the chosen alternative must:

- Meet projected future water supply demands, supporting the region's plans for responsible growth within the urban growth boundary.
- Reliably deliver a long-term water supply, including in times of droughts, earthquakes, or other disasters.
- Supply finished water to TVWD and Hillsboro customers.
- Offer a cost-effective water supply source in service by July 2026.
- Support ownership and control of the water supply via a partnership between TVWD and Hillsboro.

Regional solutions to projected water supply demands in the Portland, Oregon metropolitan area have been studied for several decades. The various evaluations led to the current proposed alternative that is summarized in the Alternatives Analysis. After independently selecting the Willamette River at Wilsonville as the preferred water supply source alternative, the Project Participants formed the Willamette Water Supply Program (WWSP). The WWSP conducted additional alternatives evaluations for the primary components of the WWSS: a new WTP, reservoir facilities, and transmission pipelines.

In reviewing the Alternatives Analysis, the U.S. Army Corps of Engineers (USACE) requested supplemental information on the process for identifying the preferred layout for the WTP and preferred seismic mitigation for the Willamette Intake Facilities (WIF). This memorandum provides the requested information.

5.0 Willamette Intake Facilities Seismic Improvement Alternatives and Criteria

Although the JPA Alternatives Analysis does not present information on alternatives for seismic improvements at the WIF, various concepts were considered before identifying the preferred seismic improvement alternative shown in the JPA.

5.1 Raw Water Facilities Seismic Improvement Alternatives

The following three seismic improvement alternatives capture the range of concepts that were previously considered:

- **Seismic Alternative A –** This alternative includes no seismic improvements to protect the WIF.
- **Seismic Alternative B** – As presented in the JPA, this alternative includes two subsurface pile walls. The first subsurface wall of approximately 16, 4-foot (ft) diameter piles would be constructed on the bank of the Willamette River to protect the raw water intake from damage that would result if the intake were buried during a seismic event. A second subsurface wall of approximately 37, 10-ft diameter piles would be constructed near the top of the slope to protect the existing raw water pump station, structures associated with the raw water pump station, and the WWSS pipeline exiting the pump station from damage due to slope failure during a seismic event. For each pile, an auger would be used to drill shafts, a steel casing installed in the shaft to prevent soil from caving into the shaft, and concrete pumped in to backfill the shaft, creating the pile.
- **Seismic Alternative C** – This alternative includes a subsurface buttress wall located near the top of the slope to protect the existing raw water pump station, structures associated with the raw water pump station, and the WWSS pipeline exiting the pump station from damage due to slope failure during a seismic event. The buttress wall would be composed primarily of large crushed rock, and would be approximately 20 ft wide near the ground surface, extending approximately 70 ft below ground surface to a base approximately 100 ft wide. Constructing the buttress wall would require excavation of an area approximately 150 ft wide by 350 ft along the riverbank, for the full 70-ft depth. This alternative does not include protection near the riverbank to protect the intake.

5.2 Evaluation Criteria

The seismic alternatives were evaluated against nine criteria in six categories. Of these criteria, all three seismic alternatives met the thresholds for the following seven criteria:

- Potential visual and local character impacts to neighbors and nearby community
- Potential encumbrances and conditions, constraints, or restrictions on a parcel
- Opportunity for community benefits
- Potential impact to future and surrounding uses (current land use zoning)

- Available space for temporary or permanent easement for construction access and staging
- Potential effects on neighbors during construction
- Maintenance requirements

Because all three seismic alternatives met these seven criteria, the criteria did not receive substantial consideration in selecting the preferred alternative, and the performance of the seismic alternatives against these criteria is not discussed further in this memorandum.

The following two criteria and their thresholds formed the basis for selecting the preferred seismic alternative:

- **Seismic resiliency** – The seismic improvements mitigate the identified seismic vulnerability of the raw water pump station, structures associated with the raw water pump station, and the WWSS pipeline exiting the pump station such that these facilities would provide a minimum 50 percent operational capacity within 48 hours of a magnitude 9.0 Cascadia subduction zone (CSZ) earthquake.
- **Potential effects on riparian habitat and waterways –** The seismic improvements have limited or no potential effects on existing riparian habitat along the Willamette River or on areas below the ordinary high water (OHW) elevation (Clean Water Act (CWA) Section 404 and Section 10 of the Rivers and Harbors Act), and construction can be completed within the Willamette River in-water work window.

This set of criteria and their thresholds reflect the purpose, need, and criteria defined in the Alternatives Analysis; and demonstrate the basis for selecting the preferred seismic improvement alternative. Additional discussion of the criteria, and the performance of each alternative against the criteria, is presented in Section 0.

6.0 Seismic Improvement Alternatives Evaluation

Below is an explanation of how each of the alternatives would meet or not meet each criterion described in Section 5.0.

6.1 Seismic Resiliency

The threshold of the *seismic resiliency* criterion is that the seismic improvements mitigate the identified seismic vulnerability of the raw water pump station, structures associated with the raw water pump station, and the WWSS pipeline exiting the pump station such that these facilities would provide a minimum 50 percent operational capacity within 48 hours of a magnitude 9.0 CSZ earthquake.

Recent earthquakes in Japan, New Zealand, Chile, and elsewhere, coupled with an increased physical understanding of the CSZ, has increased the recognition of earthquake hazards in Oregon. In 2011, Oregon legislature passed a resolution directing the Oregon Seismic Safety Policy Advisory Commission (OSSPAC) to prepare the Oregon Resilience Plan. The purpose of the plan was to set policy direction for protecting lives and maintaining economic and commercial activity following a magnitude 9.0 CSZ earthquake (OSSPAC 2013).

To improve the overall resilience level of infrastructure for a magnitude 9.0 CSZ earthquake, the Oregon Resilience Plan suggested (1) level of operational capacity and (2) recovery period requirements for different water system components immediately following a seismic event for various lifeline systems, including water conveyance and treatment systems. For the proposed action, the Project Participants have applied the goal of meeting the Oregon Resilience Plan’s Target States of Recovery for domestic water supply in the Willamette Valley, which are shown in Table 6-1. The Project Participants have modified the goals for intake, pumping, and treatment components to achieve 50 percent capacity within 48 hours of a magnitude 9.0 CSZ earthquake (as compared to a target of 20 to 30 percent system function within 24 hours under the Oregon Resilience Plan).

Table 6-1. Oregon Resilience Plan Recommended Level of Service Goals for Water Systems in the Willamette Valley Geographic Region

	Magnitude 9.0 Cascadia Subduction Event Occurs							
System Function	0-24 hours	1-3 days	3-7 days	1-2 weeks	2-4 weeks	1-3 months	3-6 months	6-12 months
Potable water available at supply source[1]	🔺	🟡		🟩				
Main transmission facilities, pipes, pump stations, and reservoirs operational	🟩							
Water supply to critical facilities available	🟡	🟩						
Water for fire suppression at key supply points	🟩							
Water for fire suppression at fire hydrants			🔺	🟡	🟩			
Water available at community distribution centers/points		🟡	🟩					
Distribution system operational		🔺	🟡	🟩				

Notes:

🟩 Desired time to restore component to 80-90 percent operational

🟡 Desired time to restore component to 50-60 percent operational

🔺 Desired time to restore component to 20-30 percent operational

1. WWSP has adopted a modified level of service goal for intake, pumping, and treatment components, including 50 percent capacity within 48 hours of a magnitude 9.0 Cascadia subduction zone event.

Adapted from: OSSPAC 2013

6.1.1 Seismic Alternative A

Seismic Alternative A **would not** meet this criterion because it would not mitigate the identified seismic vulnerability of the raw water pump station, structures associated with the raw water pump station, and the WWSS pipeline exiting the pump station.

Seismic Alternative A includes no seismic improvements to mitigate the identified structural vulnerability of existing and proposed infrastructure. Without seismic improvements, the raw water pump station, caisson, and the WWSS pipeline exiting the pump station could be damaged or destroyed due to lateral spreading and liquefaction-induced slope instability. The intake pipe itself is located in the Troutdale Formation, a more stable geologic formation not at risk of lateral spreading or slope instability, however if debris due to a seismic event were to extend far enough into the river, the intake screens could be buried or damaged without additional protection.

6.1.2 Seismic Alternative B

Seismic Alternative B **would** meet this criterion.

Based on preliminary seismic assessments, it is anticipated that the pile walls included in Seismic Alternative B could be designed and constructed to sufficiently mitigate the identified structural vulnerability of the infrastructure located at the top of the riverbank, as well as the intake screens in the Willamette River. If Seismic Alternative B were selected as the preferred alternative, additional geotechnical data, analyses, and design development would be necessary to validate these assumptions.

6.1.3 Seismic Alternative C

Seismic Alternative C **would not** meet this criterion because it would not mitigate the identified seismic vulnerability of the intake screens.

Based on preliminary seismic assessments, it is anticipated that Seismic Alternative C would mitigate the identified structural vulnerability of the infrastructure located at the top of the riverbank, including the raw water pump station, caisson, and the WWSS pipeline exiting the pump station. If this alternative were selected as the preferred alternative, additional geotechnical data, analyses, and design development would be necessary to validate these assumptions.

Seismic Alternative C does not include seismic improvements to mitigate the risk that the intake screens could be buried or damaged by debris during a seismic event; therefore Seismic Alternative C does not meet this criterion.

6.2 Potential Effects on Riparian Habitat and Waterways

The threshold of the *potential effects on riparian habitat and waterways* criterion is that the seismic improvements have limited or no potential effects on existing riparian habitat along the Willamette River or on areas below the OHW elevation (CWA Section 404 and Section 10 of the Rivers and Harbors Act), and construction can be completed within the Willamette River in-water work window.

The Willamette River riverbank at this location consists of a steep, forested bluff leading down to the OHW elevation of the river, at elevation 74 ft North American Vertical Datum of 1988 (NAVD88) for CWA Section 404 and elevation 78.7 ft for CWA Section 10. The riverbank is protected by the City of Wilsonville’s Significant Natural Resource Overlay Zone, and by the State of Oregon’s Willamette River Greenway designation; these and other local regulations seek to protect the natural and scenic qualities of the riverbank. Seismic improvements on the riverbank would involve temporary disturbance of existing trees and other vegetation, and could involve impacts below one or both OHWs, therefore this criterion seeks to limit the extent of temporary or permanent impacts on existing riparian habitat along the Willamette River or on areas below the OHW elevation (CWA Section 404 and Section 10 of the Rivers and Harbors Act).

In addition to limiting impacts to riparian habitat and areas below OHW, this criterion also seeks to limit work below OHW to the Willamette River in-water work window of June 1 to October 31.

6.2.1 Seismic Alternative A

Seismic Alternative A **would** meet this criterion.

Seismic Alternative A does not require any construction activities, therefore there would be no effects on riparian habitat or waterways associated with construction of seismic improvements.

6.2.2 Seismic Alternative B

Seismic Alternative B **would** meet this criterion.

Seismic Alternative B includes an upper pile wall near the top of the riverbank. A portion of the upper pile wall would impact riparian habitat, but would not impact areas below OHW. The lower pile wall protecting the intake would include sixteen piles, all below the Section 10 OHW elevation. Of these sixteen piles, only one would also occur below the Section 404 OHW elevation. The pile wall will be buried approximately 1 ft below grade, and the ground level will be restored to preconstruction elevations.

Seismic Alternative B would temporarily impact approximately 1.2 acres of riparian habitat, including 0.01 acres below Section 404 OHW and 0.08 acres below Section 10 OHW. After construction, the slope would be regraded, and the hillside revegetated with appropriate riparian species and in accordance with local jurisdictional requirements. Construction of Seismic Alternative B would last approximately eight months, and construction below the OHW would be completed within the in-water work window. Because the extent of impacts would be limited and temporary, Seismic Alternative B would meet this criterion.

6.2.3 Seismic Alternative C

Seismic Alternative C **would not** meet this criterion because it would impact large areas of riparian habitat and areas below OHW, and because construction could not be completed within the in-water work window.

Seismic Alternative C would temporarily impact approximately 2 acres of riparian habitat, including 0.16 acres below Section 404 OHW and 0.05 acres below Section 10 OHW. Construction of Seismic Alternative C would last a minimum of 12 months, although further design development would be necessary to better predict the probable construction duration. It is likely that construction activities below OHW could not be limited to the in-water work window. Because the extent of construction would impact large areas of riparian habitat and areas below OHW, and because construction below OHW could not be completed within the in-water work window, Seismic Alternative C would not meet this criterion.

7.0 Preferred Seismic Alternative

Based on the criteria evaluation summarized in Table 7-1 and described in Section 0, Seismic Alternative B best meets the purpose and need of the proposed action and is therefore the preferred seismic alternative. Relative to other alternatives, **Seismic Alternative B is the only seismic alternative that meets all of the criteria**.

Seismic Alternative B would mitigate identified seismic vulnerability for the infrastructure located at the top of the riverbank, as well as the intake screens in the Willamette River. This is in contrast to Seismic Alternative C, which would mitigate risk only for top-of-riverbank facilities but leave the intake vulnerable during a seismic event. The effects on riparian habitat and waterways would be less under Seismic Alternative B than under Seismic Alternative C, due mainly to the smaller footprint and shorter construction period for Seismic Alternative B. Seismic Alternative A would not disturb riparian habitat or waterways, however it provides no seismic improvement for any facilities.

Table 7-1 Summary of Seismic Alternatives Evaluation

Criteria and Threshold by Category	Seismic Alternative Ability to Meet the Criteria		
	Seismic Alternative A	Seismic Alternative B	Seismic Alternative C
Seismic resiliency – The seismic improvements mitigate the identified seismic vulnerability of the raw water pump station, structures associated with the raw water pump station, and the WWSS pipeline exiting the pump station such that these facilities would provide a minimum 50 percent operational capacity within 48 hours of a magnitude 9.0 CSZ earthquake.	No	Yes	No
Potential effects on riparian habitat and waterways – The seismic improvements have limited or no potential effects on existing riparian habitat along the Willamette River or on areas below the ordinary high water elevation (Clean Water Act Section 404 and Section 10 of the Rivers and Harbors Act), and construction can be completed within the Willamette River in-water work window.	Yes	Yes	No

Key: CSZ = Cascadia subduction zone WWSS = Willamette Water Supply System

Note: Previous evaluations considered an additional six criteria that are not presented here for the reasons provided in Section 5.0.

8.0 References

Adamus, P., J. Morlan, and K. Verble. 2010. Manual for the Oregon Rapid Wetland Assessment Protocol (ORWAP). Version 2.0.2. Oregon Department of State Lands, Salem, OR.

City of Sherwood. 2010. Tonquin Employment Area Concept Plan: Preferred Concept Plan Report. Available online at: https://www.sherwoodoregon.gov/sites/default/files/fileattachments/Planning/page/1303/3_ordinance_2014-014_attachment_a-1_final_concept_plan_0.pdf. Final. October.

City of Wilsonville (Wilsonville). 2009. Average Daily Traffic Counts for Section 53 – Industrial Way. Available at: http://ci.wilsonville.or.us/838/Traffic-Counts. Accessed March 9, 2018.

Willamette Water Supply Program (WWSP). Willamette Water Supply Program (WWSP). 2017. Water Treatment Plant Site Selection Memorandum. January 6, 2017.

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