Bull Run TREATMENT PROJECTS | Pipelines

PORTLAND WATER BUREAU
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Pipelines Project Stormwater Report

Bull Run Filtration Pipelines Project

September 2022

Prepared by: Jacobs

In association with EMERIO ENGINEERING • SURVEYING • DESIGN and other firms

Exhibit A.77

Pipelines Stormwater Management Report

Bull Run Filtration Pipelines Project
Multnomah County, Oregon

Emerio Project Number: 0545-006

City of Portland Permit Numbers: TBD

I hereby certify that this Stormwater Management Report for this project has been prepared by me or under my supervision and meets minimum standards of the Multnomah County Design and Construction Manual (MCDCM) and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

This report was prepared in support of the City of Portland Water Bureau's Bull Run Filtration Pipelines Project land use applications in Multnomah County and reflects the current status of the project design, which is approximately 60% complete as of the date of this repor[t]. This design is subject to change and has been prepared for the specific purpose of addressing confor[mance of the project to the Multnomah County land use requirements as expressed in the Multnomah C[ounty Code.

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Submittal #	Date	Returned	Comments

EMERIO
ENGINEERING • SURVEYING • DESIGN

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1.0 Introduction

1.1 Project Overview and Description

The water supply for the City of Portland includes two sources: the Bull Run Watershed and the Columbia South Shore Wellfield (CSSWF). In addition to the City of Portland, the Water Bureau provides potable water to 19 wholesale customers. The Bull Run Watershed, located east of Portland in the Mount Hood National Forest, is the primary source of water. The 102 square mile, protected watershed is managed by the U.S. Forest Service in cooperation with the Water Bureau. There are two dam structures within the watershed that create two surface water reservoirs with a combined storage capacity of 16.5 billion gallons. This water is transported from the lower dam near the headworks site to the Portland metro area via three large-diameter pipelines.

The Bull Run supply is currently an unfiltered water supply and has consistently met the filtration avoidance criteria under the Surface Water Treatment Rule for source water quality, watershed management, and disinfection. Prior to distribution, the supply is treated with free chlorine for primary disinfection, ammonia to form chloramines as a residual disinfectant, and sodium hydroxide for corrosion control. The Water Bureau supplements the Bull Run source as needed with groundwater withdrawn from the CSSWF. The CSSWF is primarily used as an emergency backup, typically during turbidity events in the Bull Run Watershed and for summer supply augmentation.

In August 2017, the Portland City Council voted to build the Bull Run Filtration Facility to meet the U.S. Environmental Protection Agency (EPA) treatment requirements for *cryptosporidium*. As a part of the proposed plan, new raw water pipelines will intersect the existing conduits from the Bull Run Watershed and redirect the flow to the new Filtration Facility. New finished water pipelines will then convey water from the Filtration Facility and reconnect to the existing conduits. The three conduits currently in operation are referred to as Conduit 2 (C2), Conduit 3 (C3), and Conduit 4 (C4) in order from oldest to newest. Following completion of the Filtration Pipelines Project, much of the approximately 20 miles of existing conduit system from the Bull Run Watershed to the three conduits that deliver drinking water to the Portland Metropolitan Area will remain in service, with approximately 2.7 linear miles of the existing conduits being replaced with the new raw and finished water pipelines and Filtration Facility.

The Filtration Pipelines Project consists of five primary elements of work:

1. Two raw water pipelines:
    a. Lusted Raw Water Pipeline North and South (LRWP North and LRWP South)
    b. Two raw water tunnels and shaft system
2. Two finished water pipelines from the Filtration Facility to the Finished Water Intertie:
    a. Altman Finished Water Pipeline (AFWP), and
    b. Lusted Finished Water Pipeline (LFWP)
3. One intertie, flow control, and metering facility (Finished Water Intertie);

    a. and three finished water pipelines from the Finished Water Intertie to the existing conduit connections:
        i. Conduit 2 Finished Water Pipeline (C2FWP)
        ii. Conduit 3 Finished Water Pipeline (C3FWP), and
        iii. Conduit 4 Finished Water Pipeline (C4FWP).
4. The AFWP and LFWP include a trenchless crossing from the Filtration Facility south of Carpenter Lane to Dodge Park Boulevard.
5. A new small-diameter water distribution pipeline from AFWP and LFWP in SE Dodge Park Boulevard at the intersection of SE Cottrell Road, primarily installed via trenchless construction. The northerly terminus of this new Lusted Road Distribution Main connects to the existing SE Lusted Road Distribution Main located east of Lusted Hill Treatment Facility.

The purpose of this report is to evaluate the existing and proposed stormwater conditions along the length of the Filtration Pipelines Project limits. The report includes an analysis and discussion on the following:

- Existing conditions of the Project Area, including environmentally sensitive areas meeting the jurisdiction stormwater requirements (Multnomah County)
- Proposed stormwater quality treatment
- Analysis of offsite runoff conditions
- Additional regulatory triggers

A separate stormwater report addresses the individual site of the Finished Water Intertie, located on the Finished Water Pipeline alignment at SE Lusted Road east of SE Altman Road.

1.2 Project Location

See Appendix A for the Vicinity Map of the project limits. The project comprises a corridor of multiple parallel pipelines travelling a distance of 2.7 miles from end to end through right-of-way (ROW) and easement on private property within unincorporated Multnomah County. The project pipeline corridors are generally described by the following Segment Routes for the purpose of this report:

1. Project beginning on SE Lusted Road approximately one-half mile north of the intersection at SE Dodge Park Boulevard, connecting at existing pipelines in the SE Lusted Road ROW, then travelling westward through easements on private property, then;

2. Ending at the southeast corner of the new Filtration Facility (under separate contract), at which point the continued pipeline is continued under separate contract, then:

3. Beginning again at the northwest corner of the new Filtration Facility (under separate contract) and travelling northbound to SE Dodge Park Boulevard, then;

4. Travelling west within the SE Dodge Park Boulevard ROW, turning north at a point approximately 0.6 miles west of the intersection at SE Cottrell Road and continuing northward in easements on private property, then;

5. Turning at SE Lusted Road, travelling westward in the ROW of SE Lusted Road to the intersection at SE Altman Road, then;

6. Turning north at SE Altman Road, travelling north in the ROW of SE Altman Road to SE Oxbow Road.

Three connections to existing pipelines are made at the end of the project, one each at the intersections of:

- SE Lusted Road at SE Altman Road
- SE Altman Road at SE Pipeline Road
- SE Altman Road at SE Oxbow Drive

As referenced in this report, the limits of the project are the widths of corresponding ROW or the widths of easements on private property which comprise the corridor of the proposed pipelines.

1.3 Description of Existing Conditions

1.3.1 Drainage Basins

The project is located within the Beaver Creek-Sandy River Watershed. The pipeline corridors cross multiple drainage basins which discharge to separate reaches along Beaver Creek or lowland areas. The pipelines are primarily proposed within the roadway section, which is a crowned section. Drainage basins were delineated as the ultimate drainage basin to each waterbody, as opposed to only the proposed linear segment of pipeline.

A drainage basin map is shown in Appendix A Figure 2, with Table 1-1 showing the size of each drainage basin and its discharge location.

Table 1-1. Drainage Basin Area Summary		
Drainage Basin	**Area (Acres)**	**Discharge Location**
A	35.62	Middle Fork Beaver Creek (West of Altman Road)
B	17.83	Glendale Pond
C	67.16	Middle Fork Beaver Creek (West of Altman Road)
D	39.88	Sester Reservoir #1
E	32.53	Middle Fork Beaver Creek (West of Altman Road)
F	110.94	Surveyed Wetlands
G	65.80	North Fork Beaver Creek
H	57.13	North Fork Beaver Creek
I	68.40	North Fork Beaver Creek
J	11.68	Lusted Creek
K	10.66	Johnson Creek Tributary
L	90.26	Surveyed Wetlands
Total	**572.27**	**Beaver Creek-Sandy River Basin**

1.3.2 Existing Soil Characteristics

The project limits span multiple soil types identified by the National Resource Conservation Service (NRCS) Web Soil Maps:

- SE Altman Road:
  - Cornelius Silt Loam, 8 to 15 percent slopes.
  - Powell silt loam, 0 to 3 percent slopes, 3 to 8 percent slopes, 15 to 30 percent slopes.
  - Wollent silt loam.
- SE Lusted Road (Finished Water Pipelines scope)
  - Cornelius Silt Loam, 8 to 15 percent slopes.
  - Powell silt loam, 0 to 3 percent slopes, 3 to 8 percent slopes.
  - Wollent silt loam.
- Easement through Private Property (Finished Water Pipelines scope, between Dodge Park Blvd. and Lusted Rd.)
  - Cornelius Silt Loam, 8 to 15 percent slopes.
  - Mershon Silt Loam, 0 to 8 percent slopes, 8 to 15 percent slopes, 15 to 30 percent slopes.
  - Wollent silt loam.
- SE Dodge Park Blvd:
  - Cazadero Silty Clay Loam, 0 to 8 percent slopes, 8 to 15 percent slopes.

    - Mershon Silt Loam, 0 to 8 percent slopes, 8 to 15 percent slopes, 15 to 30 percent slopes.
    - Wollent silt loam, 0 to 8 percent slopes.
- Easement through Private Property (Raw Water Pipelines scope, west of SE Lusted Rd.)
    - Cazadero Silty Clay Loam, 0 to 8 percent slopes.
- SE Lusted Rd. (Raw Water Pipelines scope)
    - Cazadero Silty Clay Loam, 0 to 8 percent slopes.

The origin of all these soil types is from a mixed alluvium that has glacial silt and clay with small particle size. These soils have the following K_{sat} values (referring to the soils permeability to transmit water when saturated) and Hydrologic Soil Group (Rated A, B, C, D with A as highest permeability to D as lowest):

- Cornelius Silt Loam, K_{sat} of 0.64 inches per hour, Hydrologic Soil Group C.
- Powell silt loam, K_{sat} of 1.6 inched per hour, Hydrologic Soil Group D.
- Wollent silt loam, K_{sat} of 0.42 inches per hour, Hydrologic Soil Group C/D.
- Mershon Silt Loam, K_{sat} of 0.48 inches per hour, Hydrologic Soil Group C.
- Cazadero Silty Clay Loam, K_{sat} of 0.50 inches per hour, Hydrologic Soil Group C.

See Appendix C for NRCS Web Soil Survey Maps and more information.

Based on the Geotechnical Engineering Report, "Filtration Pipelines Project – Finished Water Pipeline" dated February 2022 by Jacobs Engineering Group, the soil investigations at soil boring logs along the pipeline alignments are consistent with the silty clay loam characteristics as noted in the NRCS Web Soil Maps. Infiltration testing was not performed at any locations along the pipeline alignment outside of the Filtration Facility site during investigations.

1.3.3 Environmentally Sensitive Areas

Wetlands

There are no County-mapped wetlands along the pipeline corridor. Potential wetland areas were identified by Winterbrook Planning during site observations, and overlay zones were applied to those areas along the pipeline corridors to minimize any impact. All County designated Significant Environmental Concern (SEC) areas and potential wetland areas are shown in Appendix B in the Stormwater Drawings, and will not be impacted by the pipeline project.

Waterbodies

Portions of the project limits drain to segments of North Fork Beaver Creek and Middle Fork Beaver Creek, specifically near the Bissel and Oxbow/Altman segments. Based on Oregon's Department of Fish and Wildlife (ODFW) Web Map, these segments are not considered fish

bearing streams or tributaries based on ODFW identified segments, however, extra precaution such as stormwater treatment Best Management Practices (BMPs) will be used upstream of these areas. See Appendix C for Fish Habitat Distribution and Barriers near the Project.

Floodplains

The project does not intersect any areas mapped within the Federal Emergency Management Areas (FEMA) mapped floodways for the 100-year flood, according to FEMA FIRMette Panel 41051C0427J, effective 2/1/2019.

1.4 Offsite Drainage Analysis

Offsite mixed agricultural and rural residential land drains into the ROW for most of the project limits. The ROW impacted by the proposed pipeline construction are primarily two-lane roadways with crowned prism sections where offsite drainage is currently collected or conveyed by the roadway ditch to culverts which cross the roadways.

There are existing culverts (hydraulic crossings) that connect these offsite drainage basins in the project area and have been reviewed for capacity of the 25-year storm in Section 3.1. Table 1-2 shows the existing hydraulic crossing drainage areas sizes, and Appendix A Figure 3 shows the drainage basin locations associated with the respective hydraulic crossings. Additional survey is being performed to identify existing crossings with unknown design parameters at this phase of the project design.

Table 1-2: Hydraulic Crossing Drainage Areas Summary

Hydraulic Crossing ID	Culvert Size and Type	Drainage Area (acres)
DA 1	12-inch Reinforced Concrete Pipe	28.29`
DA 2	18-inch Corrugated Plastic Pipe	33.11
DA 3	24-inch Corrugated Plastic Pipe	90.27
DA 4	72-inch concrete box culvert	12.82
DA 5	Unknown	24.37

1.5 Proposed Improvements

The project proposes the installation of over 30,000 linear feet of new large-diameter welded steel pipeline which conveys both unfiltered (raw) and filtered (finished) water to and from the proposed drinking water Filtration Facility. Construction of these large-diameter pipelines requires significant trench width in public ROW and, subsequently, reconstruction of existing roadways over the pipeline corridor. Existing culverts (hydraulics crossings) which convey stormwater across the ROW impacted by this project will be replaced to existing line and grade. Verification of hydraulic capacity of those existing crossings is included in Section 3 and Appendices.

1.6 Agency Stormwater Criteria and Permitting

Multnomah County is the governing agency for stormwater requirements within the pipeline project limits. With two exceptions, the project limits for pipeline construction are to be restored to pre-construction conditions. The first exception is the Finished Water Intertie site, addressed under a separate report cover, which will be improved with permanent stormwater facilities, pavement, a new electrical building, and a large, buried vault. The second exception is the improvement of existing dirt/gravel farm roads with new gravel roads with unchanged surface characteristics, which is not expected to change the runoff coefficient from the existing condition. The existing dirt/gravel farm roads are compacted, and will be improved with gravel with the same drainage direction. Otherwise, easements on private property are to be restored with in-situ topsoil and seeding, unpaved areas within ROW are to be restored to original line and grade and seeded with native grasses, and roadway pavement in ROW is to be repaved matching original line and grade. Though all new paved roadway is replacement of existing roadway, the project replaces over 500 square feet of impervious surface, and therefore stormwater flow control and stormwater quality treatment are required per Multnomah County Code (MCC) Section 39.6235, which states,

> *"(A) Persons creating new or replacing existing impervious surfaces exceeding 500 square feet shall install a stormwater drainage system as provided in this section…*
>
> *(C)The provisions of this section are in addition to and not in lieu of stormwater and drainage requirements in the Multnomah County Road Rules and Design and Construction Manual, including those requirements relating to impervious surfaces and proposals to discharge stormwater onto a county ROW.*
>
> *(D) The stormwater drainage system required in subsection (A) shall be designed to ensure that the rate of runoff for the 10-year 24- hour storm event is no greater than that which existed prior to development at the property line or point of discharge into a water body."*

The stormwater facilities shall be designed in accordance with Section 5 Drainage of the Multnomah County Design and Construction Manual (MCDCM). In the MCDCM Section 5.1.2, there is a contradictory statement to the MCC regarding flow control.

"Flow control and volume storage shall be analyzed for the 2, 5, 10, and 25 year storm events for the pre-development discharges, and the post development discharges. The post-developed discharge flow rate shall be controlled to the pre-development levels. In addition, initial discharge flow rate shall be controlled to one half the 2 year flow rate before any development."

The contradiction between the 10-year and 25-year storm in Multnomah's Code and the MCDCM is related to MCDCM's reference of the City of Portland's Stormwater Management Manual (SWMM), where the City of Portland uses urbanized stormwater practices, which have more stringent requirements and maintenance. Since this project is in rural Multnomah County and has similar project characteristics to a linear transportation project, the Oregon Department of Transportation (ODOT) Hydraulics Manual is proposed for drainage design guidance, which prioritizes dispersion as a stormwater BMP sized for water quality and the 10-year storm event.

In addition to stormwater requirements, the following regulatory district areas were considered that have stormwater impact requirements and may require additional permitting for this project:

- Oregon Department of Environmental Quality (DEQ)
    - 1200-C Construction Stormwater Permit
        - Per Oregon Department of Environmental Quality (DEQ), construction of the proposed pipelines will cumulatively disturb greater than one acre and will require a 1200-C Construction Stormwater Permit.
- Oregon Department of State Lands (DSL)
    - Joint Permit Application
        - Provide 50-foot buffers around all wetlands.

2.0 Methodology

To meet the Multnomah County Stormwater requirements, this project report follows the guidance of the ODOT stormwater requirements, which requires analysis and discussion of the infiltration and discharge hierarchy, along with the selection of Best Management Practices (BMP) for stormwater management.

2.1 BMP Selection

ODOT has an established hierarchy of stormwater treatment approaches and techniques that supports water quality goals and flow control. Per Section 14.9.1 in BMP Selection Prioritization of the Hydraulic Manual, the preference for stormwater treatment is to disperse treatment along the length of the project, using characteristics of the ROW to provide treatment. A

requirement to manage runoff for water quality does not mean that a treatment facility needs to be constructed—often the properties of the ROW provide excellent stormwater treatment without minimal enhancement.

ODOT's BMP Hierarchy has the following preference levels:

1. Use of the adjacent unaltered ROW as a treatment filter strip
2. Modification of the ROW (slopes, soils and/or vegetation) to provide treatment
3. Use of small, distributed treatment facilities along the length of the project
4. Use of large, consolidated treatment facilities.

This project will use preference levels 1 and 2 with the use of unaltered ROW as a treatment filter strip and modifications to the ROW to provide treatment as the appropriate BMPs for the linear characteristics of this project. Preference levels 3 and 4 are not considered as the underlying soils are not suitable for infiltration facilities, with a K_{sat} of less than 2 inches per hour.

2.1.1 Stormwater Quality Treatment

To meet the stormwater requirements for both stormwater quality treatment and flow control, the project proposes to use dispersion through native vegetation and enhancing the existing roadside shoulders with seeded vegetation and amended soils, referred to as Filter Strips in this report. The project discharges to environmentally sensitive areas, and per MCDCM Section 5.1.3 for water quality design standards,

> *"The quality of stormwater entering or leaving the ROW after a project shall be equal to or better than the quality of stormwater entering or leaving the ROW before the project."*

Stormwater runoff shall be treated to remove 70% of TSS for the water quality design storm per Multnomah County, which is based on a depth of 1.81 inches using the ODOT water quality region design factor 67% of the 2-year 24-hour design storm with, based on ODOT TransGIS isopluvial maps.

The proposed improvements requiring stormwater quality treatment are the replaced roadways, and the project proposes to use Filter Strips adjacent to the roadways. The ODOT dispersion requirements for stormwater quality treatment closely align with the BMP practices for rural Multnomah County, especially for linear projects. Dispersion is the preferred practice for treatment per Chapter 14 of the ODOT Hydraulics Manual,

> *"The preference for stormwater treatment approaches is to disperse treatment along the length of the project, using the characteristics of the right of way to provide treatment, using consolidated facilities only when that is not possible."*

Filter strips are a common and preferred BMP for ODOT for stormwater quality treatment and provide treatment through filtration and hydrologic attenuation through vegetated flow paths

through sheet flow. Filter strips are also easily maintained, affordable and accessible when compared to other BMPs. An operation and maintenance checklist has been established for the dispersion practices utilizing the ODOT Hydraulics Manual Sections 14.10.15, 14.11, as well as Chapter 4.

In addition to the water quality rates and TSS removal requirements, discharge from the project area eventually enters the waters of Beaver Creek-Sandy River Watershed. Per the Oregon 2018/2020 Integrated Report and the 2018/2020 Water Quality Report and List of Water Quality Limited Waters, dated April 2020 Beaver Creek has a TMDL and 303(d) listed.

Impairments:

- Bacteria
- Dissolved Oxygen
- Temperature
- DDT 4, 4'; DDD4, 4'; DDE 4,4'
- Dieldrin
- Heptachlor Epoxide

Amended soil and dispersion BMPs facilitate removal of the listed impairments through biofiltration of the amended soil and vegetation.

2.1.2 Stormwater Flow Control

As discussed in Section 1.6, this project shall provide flow control up to the 10-year storm per MCC Section 39.6235. Appropriately sized dispersion is considered to serve as a management technique for both water quality and flow control and is a recommended post-construction stormwater BMP. Filter strips will be designed per the ODOT Hydraulics Manual in order to meet flow control and water quality standards for Multnomah County. Since dispersion through filter strips can be used for both flow control and water quality, hydrologic modeling for flow control was not performed for each drainage basin as the existing and proposed condition does not change.

3.0 Analysis

3.1 Proposed Stormwater Flow Control and Water Quality

This project utilizes dispersion BMPs such as vegetated filter strips, native vegetation and seeding with soil amendment to manage the stormwater runoff from roadways by allowing stormwater to sheet flow across the shoulders and disperse into the vegetated areas located within the ROW.

Based on guidance from Chapter 14 Appendix B, Section 3.1in the ODOT Hydraulics Manual, filter strips for this project shall have the following criteria:

- The flow width of the filter strip must be equal to or greater than 5 feet

- The length of filter strips placed parallel to the road must be equal to the length of the contributing impervious or pavement area
- The lateral or cross-section of the filter strip must be equal to or greater than 1 percent and to not exceed 15 percent. The native existing slope is adequate if flow length exceeds
- The contributing impervious drainage area to filter strip shall have the following corresponding widths:
    - 2% sloped filter strip to treat 4 feet of pavement for every 1 foot of filter strip
    - 5% sloped filter strip to treat 3 feet of pavement for every 1 foot of filter strip
    - 10% sloped filter strip to treat 2 feet of pavement for every 1 foot of filter strip
    - 15% sloped filter strip to treat 1.5 feet of pavement for every 1 foot of filter strip

In addition to the filter strip geometry, all Filter Strips and impacted vegetation by the project shall be improved with amended soil. The native soil shall be amended with at least 3 inches of yard-debris compost and mixed to a depth of 12 inches before planting. The proposed dispersion areas and filter strip widths are shown in the Stormwater Drawings in Appendix B with the entire ROW proposed for soil amendment and seeding.

A key difference in the filter strips proposed for this project and the standard ODOT filter strip design criteria is that there is no 8-foot aggregate shoulder prior to discharging to the vegetated filter strip. The ODOT filter strip is intended for wider roadways and highways and needs larger shoulders for traffic-related design. The filter strip for this project starts at the existing aggregate roadway edge based on the standard local roadway cross-section in Multnomah County.

4.0 Engineering Conclusions

4.1 Dispersion Analysis

There are segments in which the ROW does not allow for the minimum dispersion widths to be met under the performance approach and general ODOT sizing guidance, for the following various reasons: limited ROW width; grade changes with an existing ditch; slopes steeper than 15% ; impacts to wetland buffers. However, along the entirety of the project, existing soil within the ROW will be amended and seeded with the appropriate seedings per soil and land use type along the ROW, as shown on the drawings in Appendix B. Some areas are shown as undisturbed as those areas are already heavily vegetated with native plantings or within a SEC buffer. Parts of Segment Route 6 as described in Section 1.2 in this report does not meet the ODOT Filter Strip criteria, but does provide some water quality and flow control benefit post-construction based on Multnomah County criteria:

- **SE Altman Road (West Side):** The roadside is steeper than 15% and ROW width only allows for 8 feet past road edge. Beyond the ROW line is agricultural crop land with native vegetation buffer between road and cropland. The contributing impervious

drainage of 12 feet of width does not increase flows from the existing condition, and the 8 feet of vegetation within the ROW will be improved with amended soil and seeding—which improves the existing compacted earthen shoulder. This is an improvement from the existing condition and meets the water quality enhancement criteria per Multnomah County.

- **SE Altman Road to SE Oxbow Drive Connection and Intersection:** This segment is an existing steep road grade (greater than 10%), with heavily vegetated ditches and trees on either side of the road. The proposed BMP here is to protect the native vegetation in place (in the SEC zone), as it is already providing a water quality benefit for the roadway prior to discharging to Beaver Creek.

4.2 Hydraulic Crossings

Multnomah County Design and Construction Manual Section 5 requires that all culverts and pipes,

> *"pipes shall be designed to the 25-year storm, full build out of the ROW, and all natural runoff that drains into the ROW. If area of concern has been studied for stormwater planning, the pipe shall be designed so as to accommodate the stormwater plan flows. "*

Culverts identified as impacted by this project need to meet the 25-year conveyance capacity. For this project, the 25-year 24-hour storm event depth is 3.8 inches, based on a Portland-modified NRCS 24-hour Type 1A rainfall distribution. The 25-year peak discharge for each hydraulic crossing was calculated using Santa Barbara Unit Hydrology (SBUH) method. The HY-8 Culvert Analysis Program was used to determine the minimum culvert size for each crossing to convey the 25-year peak discharge. Table 4-1 shows the proposed minimum size required to carry the 25-year storm or if the existing size is adequate. Based on the calculations, the project proposes to replace at least one culvert (DA-1) for a larger hydraulic opening. See Hydraulic Crossing Drainage Areas in Appendix D for calculations.

Table 4-1. Hydraulic Crossing Minimum Pipe Size

Hydraulic Crossing ID	25-year peak discharge(cfs)	Existing Culvert Size and Type	Proposed Minimum Culvert Size
DA 1	7.67	12-inch Reinforced Concrete Pipe	18-inch Corrugated Plastic Pipe
DA 2	11.13	18-inch Corrugated Plastic Pipe	Maintain hydraulic opening of the 18-inch Corrugated Plastic Pipe
DA 3	20.86	24-inch Corrugated Plastic Pipe	Maintain hydraulic opening of 24-inch Corrugated Plastic Pipe
DA 4	4.64	72-inch concrete box culvert	Maintain Existing 72-inch concrete box culvert

DA 5	7.86	Unknown	18-inch Corrugated Plastic Pipe

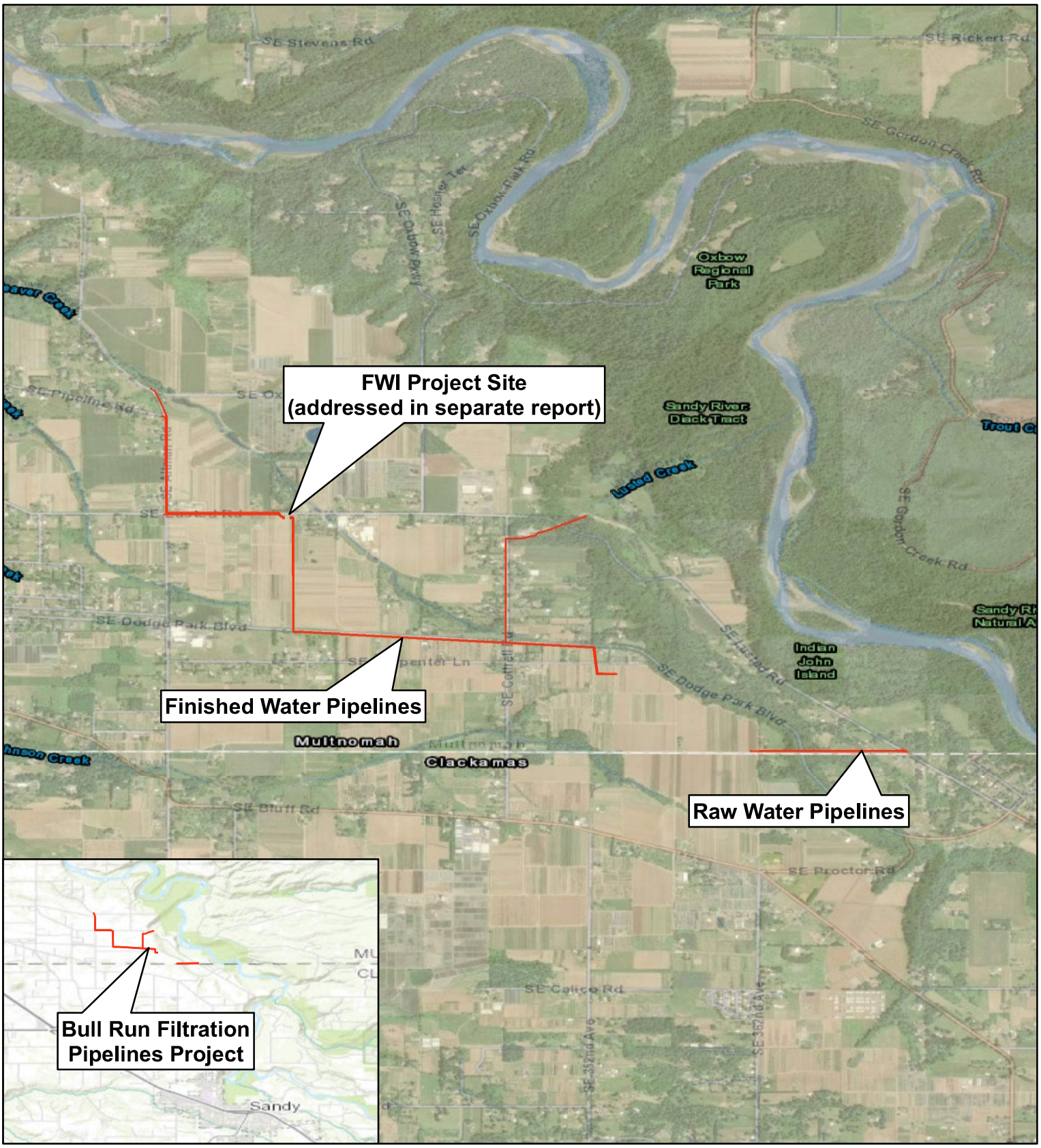
4.3 Conclusion

The proposed stormwater approach to the project meets the Multnomah County requirements for flow control and stormwater water quality treatment for the replaced impervious surfaces within the ROW. For each drainage basin, the dispersion provided by restored ROW unpaved area acting as vegetated filter strips matches or reduces the flow rates from existing conditions and provides water quality treatment prior to the runoff entering the downstream water body.

5.0 Operations & Maintenance

Multnomah County shall maintain all facilities within the ROW. Portland Water Bureau shall maintain all facilities on private property or easements. A copy of the City of Portland maintenance procedures listed in the SWMM will be used for the vegetated filter strips for this project, see Appendix E for City of Portland Operations & Maintenance procedures with Maintenance Log for the vegetated filter strips and maintenance components.

Appendix A: Figures



Legend

Pipeline Project Area Extents

Note:
1. Aerial imagery source: ESRI, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, AeroGRID, IGN, and the GIS User Community

0 0.25 0.5 1 Miles

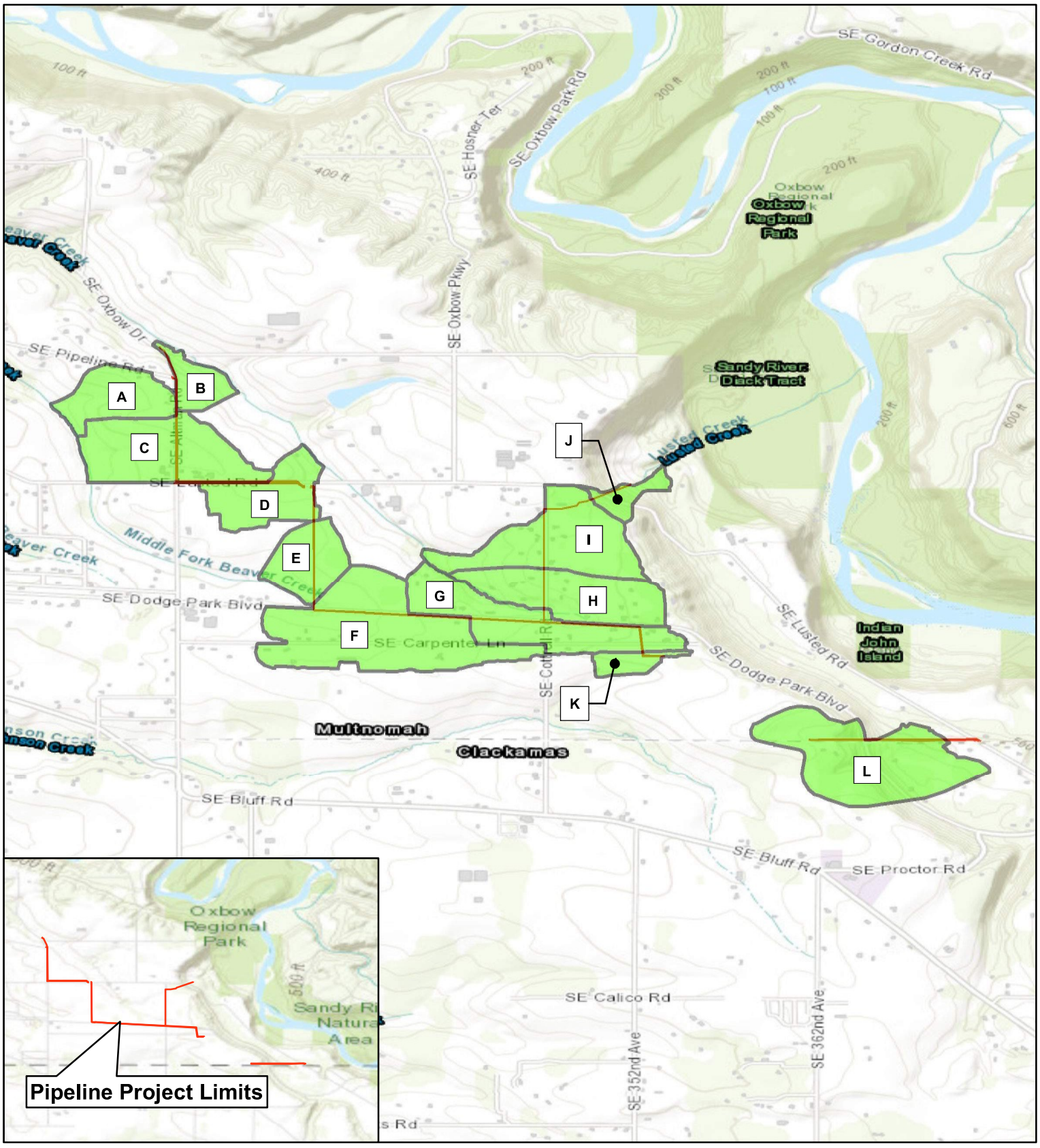
N

Appendix A - Figure 1
Vicinity Map

Bull Run Pipeline Project

Multnomah County

Jacobs



Legend

Pipeline Project Area Extents

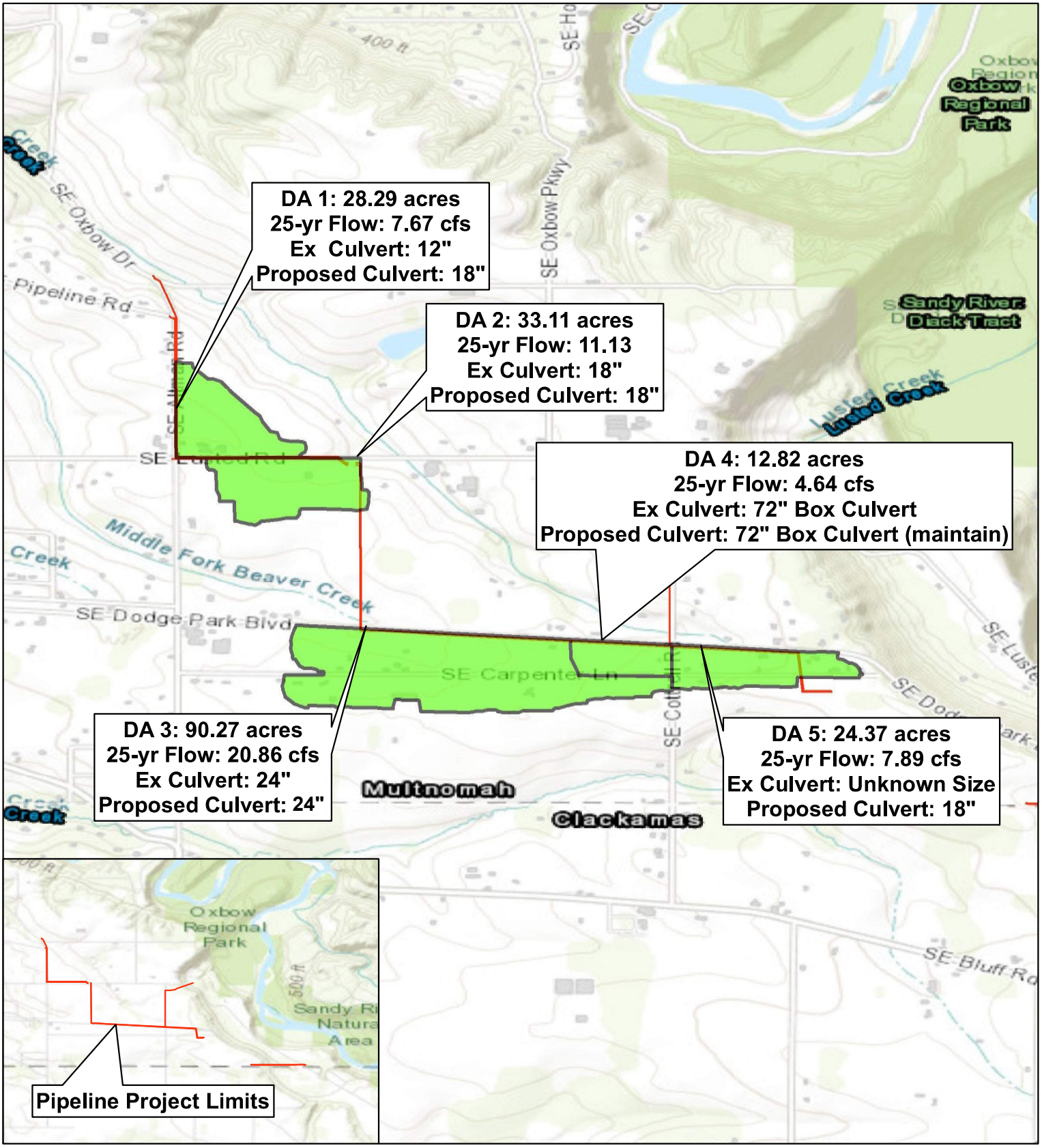
Note:
1. Aerial imagery source: ESRI, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, AeroGRID, IGN, and the GIS User Community

N

0 0.25 0.5 1 Miles

Appendix A - Figure 2
Drainage Basins
Bull Run Pipeline Project
Multnomah County

Jacobs



Legend

- Pipeline Project Area Extents
- Drainage Areas

Note:
1. Aerial imagery source: ESRI, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, AeroGRID, IGN, and the GIS User Community

N

0 0.25 0.5 1 Miles

Appendix A - Figure 3
Hydraulic Crossings
Bull Run Pipeline Project
Multnomah County

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Appendix B: Stormwater Drawings

Bull Run Filtration Project Pipelines Stormwater Plans

Portland Water Bureau

Bull Run Filtration Pipelines Project

Stormwater Exhibits

STORMWATER EXHIBITS SUBMITTAL PACKAGE		
SHEET NUMBER	**SHEET NAME**	**PIPELINES DRAWINGS**
PIPELINES DRAWINGS		
1	SW-001	COVER SHEET
2	SW-002	KEY PLAN
3	SW-101	RAW WATER PIPELINE GRID 1, GRID 2, GRID 3
4	SW-102	FINSIHED WATER PIPELINE GRID 4, GRID 5
5	SW-103	FINISHED WATER PIPELINE GRID 6, GRID 7
6	SW-104	FINISHED WATER PIPELINE GRID 8, GRID 9
7	SW-105	FINISHED WATER PIPELINE GRID 10, GRID 11
8	SW-106	FINISHED WATER PIPELINE GRID 12, GRID 13
9	SW-107	FINISHED WATER PIPELINE GRID 14, GRID 15
10	SW-108	FINISHED WATER PIPELINE GRID 16
11	SW-201	STORMWATER EXHIBITS DETAIL

W02563_ANSI_D.dgn

19-SEP-2022 22:56

No	Date	Description	Appd
Revision			
Survey			

PRELIMINARY NOT FOR CONSTRUCTION

Designed By		Program Mgr	WH	XXX
Drawn By		Const Mgr	AP	XXX
Checked By		Const Supvr	SSA	XXX
Project Mgr		Date	XXX	6/30/22

WARNING

0 1"

If this bar does not measure 1" then the drawing is not to scale

FROM FOREST TO FAUCET

XXX XXX Date

XXX XXX Date

Bull Run Filtration Pipelines

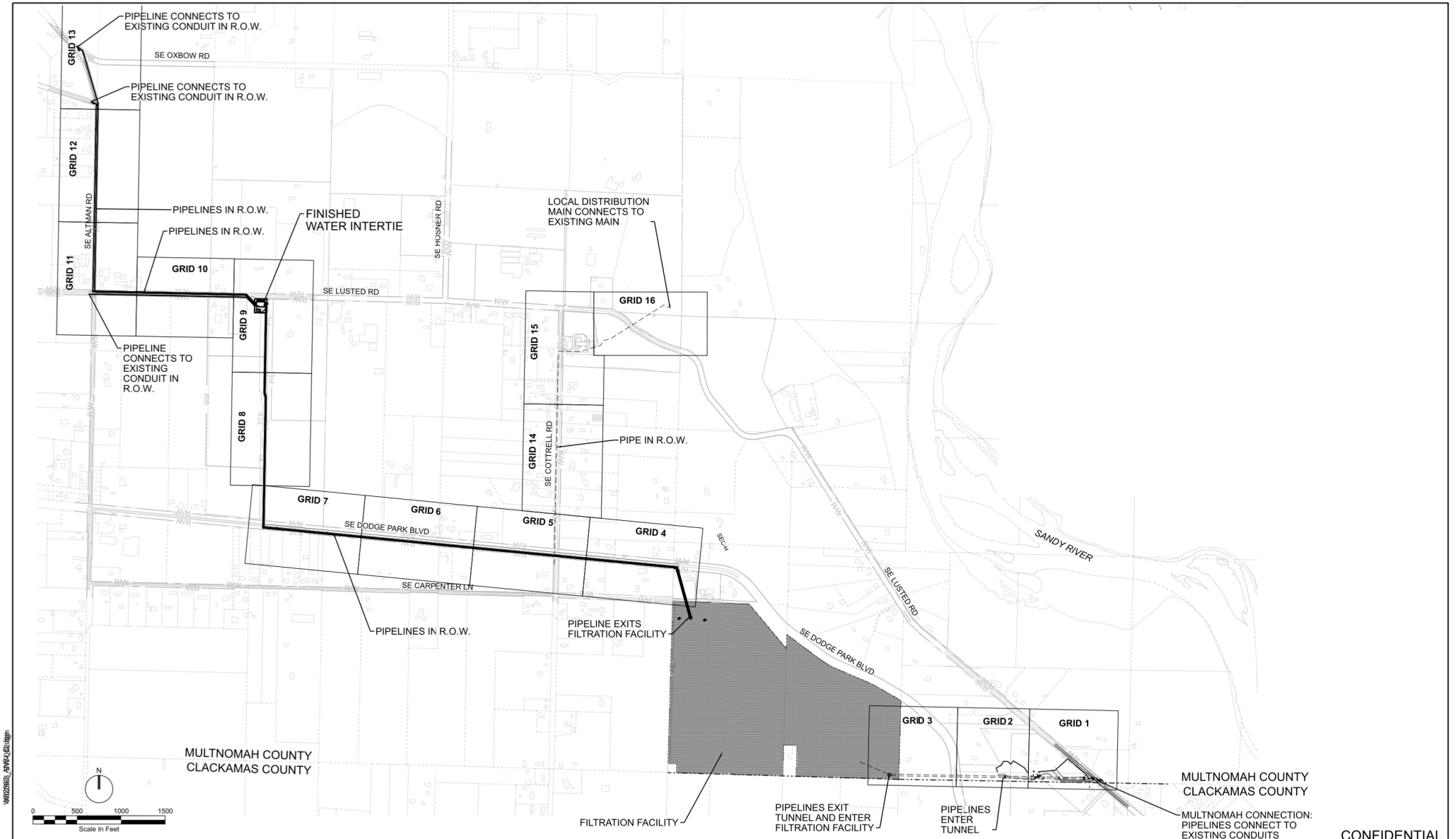
STORMWATER EXHIBITS

COVER SHEET

SAP Project No: W02563

1/4 Section

Sheet No: SW-001



CONFIDENTIAL

No	Date	Description	Appd
		Revision	
Survey			

PRELIMINARY NOT FOR CONSTRUCTION

Designed By	DG	Program Mgr	XXX
Drawn By	BS	Const Mgr	XXX
Checked By	BN	Const Supvr	XXX
Project Mgr	XXX	Date	6/30/22

WARNING

0 1"

If this bar does not measure 1" then the drawing is not to scale

PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

XXX XXX Date

XXX XXX Date

CITY OF PORTLAND OREGON 1851

Bull Run Filtration Pipelines

KEY PLAN

SAP Project No W02563

1/4 Section

Sheet No SW-002

W02563_SW-002.dgn 23:07 19-SEP-2022